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Presenting and Evaluating Factors Effective in Sustainable Supply Chain in National Iranian South Oil Company

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Highlights

- Thirteen main components included organizational factors, production products, sustainable supply chain, industry supply chain, macro policies, technology, customer, economic factors, deficits of supply chain, social factors, political factors, organizational performance, and organizational productivity.
- Nine categories were identified: strategies, blockchain technology, improving the economic environment, improving the social and environmental policies and laws, internal organizational solutions, external organizational solutions, environmental management, market, and capital factors.
- The presented model helps industry managers and decision makers to significantly improve the performance of the supply chain by re-designing the supply chain and taking appropriate measures.

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Abstract

This work aims to identify the factors effective in sustainable supply chain in the National Iranian South Oil Company (NISOC). The method of data collection was mixed methods. In the qualitative section, the data were collected through reviewing 32 previous studies as well as in-depth interviews with 10 faculty members and experts in the field of sustainable supply chain of crude oil and oil products of the NISOC using a non-probability judgmental sampling. In this regard, the interviews' texts were first analyzed in three stages of open, axial, and selective coding in the grounded theory. The main dimensions of the research were identified from interviews, and the dimensions were grouped in 13 main categories and 78 sub-categories. Thirteen main components included organizational factors, production products, sustainable supply chain, industry supply chain, macro policies, technology, customer, economic factors, deficits of supply chain, social factors, political factors, organizational performance, and organizational productivity. Second, through reviewing the literature and previous studies, 72 open codes in 9 categories, including strategies, blockchain technology, improving the economic environment, improving the social and environmental policies and laws, internal organizational solutions, external organizational solutions, environmental management, market, and capital factors, were identified. In the quantitative part, the researcher-made questionnaire was applied in a preliminary study on 10 experts in the field of management, and its relative content validity was examined. Then, the final and modified version was provided to 384 employees of the NISOC. Structural equation modeling (SEM) with SmartPLS software were employed for the quantitative evaluation of the model. Finally, all T-value were greater than 1.96, and the standard coefficient was larger than 0.4; thus, the model was accepted. The presented model helps

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industry managers and decision makers to significantly improve the performance of the supply chain by re-designing the supply chain and taking appropriate measures.

Keywords: Sustainable Supply Chain, Oil Company, Organizational Productivity, SmartPLS

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1. Introduction

The term supply chain management was introduced in the late 80s and widely applied in the 90s (Lummus and Vokurka, 1999). A supply chain consists of a network of equipment and distribution facilities which is responsible for the supply of materials, conversion of materials for semi-finished and finished products, and the distribution of finished products among customers (AliAkbari and Shateri, 2013). With the globalization of markets, the only way for survival of organizations and companies depends on maintaining and gaining a sustainable competitive advantage. Generally, prioritizing customer services lead in higher supply chain competitiveness (Alirezanjad and Sobhani, 2021). Currently, competition is mostly between supply chains and not just between individual companies. Supply chains link suppliers to a manufacturing company and then the company to the customers. Good supply chain management occurs when we guarantee low costs, excellent customer service, and short cycle times (Mollahosseini et al., 2017). Nowadays, the powerful solution to achieve cost advantage is not necessarily the economic scale and the volume of products, but rather the management of the supply chain (Azevedo et al., 2014). Supply chain management is among the essential tools that companies should apply for controlling costs and increasing economic performance in a competitive market (Hong et al., 2018). Research in the field of supply chains has shown that natural risk and disruptions in the supply chain are inevitable. Reports about examining the flexibility of supply chains in 71 countries showed that each supply chain experiences at least one major and serious disruptions (Glendon and Bird, 2013). Meanwhile, 15% of reports suggested a loss of more than one million pounds in supply chains (Pournader et al., 2016).

In recent years, sustainability has thoroughly been discussed in major global forums. These forums highlight the requirements for organizations to understand the necessity of reaching sustainability in the business activities. Companies should know whether their sustainable practices are working or not, making it vital to measure the influence of sustainability practices from the perspective of company's performance (Darbari et al., 2019). The performance of a company is generally evaluated through its profitability, efficiency, or operating and financial ratios. Hart and Milstein (2013) stated that most studies did not consider the influence of social and environmental actions on corporate performance. However, the existing literature has begun to explore the role of social and environmentally friendly practices to enhance corporate performance (Govindana et al., 2020).

The proper functioning of the sustainable supply chain plays an important role in the continuous success and achievement of the goals and objectives of an organization (Golinska-Dawson et al., 2020). The main and significant issue is that basically, sustainability has become an important issue for companies that consider social and environmental issues in their strategies (Salim and Sulphey, 2021). Today, companies understand the importance of responsibility. In their development, they are aware, and the environmental sustainability of any organization is impossible without using sustainable supply chain management procedures (Ahmadpour et al., 2023).

The southern oil-rich regions in Iran are considered the most important source of exporting crude oil. In this regard, the annual production value of the National Iranian South Oil Company (NISOC) is estimated to be more than $40 billion, based on an average of $45 per barrel. Moreover, the contract department of this company annually concludes about 100 capital and the current contracts in the form of foreign currency and Iranian Rials. This company spends a huge amount of money (22,000 billion IRR) to supply its goods and parts (200,000 items of standard goods). Therefore, its supply chain is facing many problems. NISOC, with more than 45 hydrocarbon fields, both large and small, covering more than 400,000 square kilometers in Bushehr province, is one of the largest companies in Iran and the world. The company produces about 80% of the country's crude oil and 16% of its gas. In this vast oil territory, there are large fields such as Ahvaz, Gachsaran, Maron, Aghajari, Karanj, Parsi, and Bibi Hakimeh (Rashidnia, 2018).

Supply chain management is complex, and all of its activities face a variety of risk factors (Ghorani et al., 2016). Supply chain risks are considered unforeseen events. Aloini et al. (2012) identified some of the supply chain risks, including policy failure, corporate risks, key customer failure, market risks, and technology risks. Through considering 519 articles between 1995 and 2010, Min and Kim (2012) showed that reducing supply chain across all business activities (due to sourcing, production, and product delivery) is linked with supply chain management. The systems theory can be applied to several disciplines. Although an organization may seem exclusive and independent, it is part of a larger whole, i.e., society, and the interaction between its elements. If not understood carefully, it may contribute to the destruction of the organization (Mele et al., 2010). It addresses the complex relationship between the organization and the occurrence of events beyond management's control in the external environment: how these events affect suppliers/customers and disrupt the productivity of the company and its customers. An understanding of the systems theory will help identify events with potential impacts and managing their impacts (Odfo et al., 2021). Concerns about organizational productivity stem from the earliest scientific methods of management. Productivity measurement and improvement have always been central to management and without them organizations face losses (Shahiduzzaman et al., 2017). This is very important since productivity makes any company more competitive (Drasch et al., 2018). Productivity is a rich combination of efficiency and effectiveness (Khan, 2003) without it a manufacturing company's organizational goals cannot be met (Ali et al., 2011). Performance is a term commonly used by management and industry professionals (Bayo-Moriones et al., 2013).

According to the diagnostic study of ISO Institution, NISOC company struggles with some main problems, including the non-availability of the required goods, the low efficiency of communication between organizational units, low coordination and integration in the supply chain, problems related to the organizational culture, the non-optimal organizational structure, the lack of effective exchange of information among organizational units, financing problems, and unclear strategies and goals of the current supply chain. Therefore, managers of oil companies have a great desire to improve organizational functions, increase productivity, reduce costs from the exploration to production of crude oil, and increase profitability and productivity. They are also seeking to remove limitations to promote stability and confidence for long-term decisions in this industry, leading to an increase in organizational performance and productivity.

Considering the lack of a sustainable supply chain in the NISOC, as well as the necessity for doing this research, this study tries to develop a model to be compatible with the current status of the company. The NISOC is facing many problems in the field of sustainable supply chain. Therefore, this work seeks to fill the research gap in this field and provide a suitable local model for the NISOC.

2. Theoretical foundations and research backgrounds

Supply chain management is among the principal tools employed by companies to control costs and increase the economic performance in a competitive market (Hong et al., 2018). Research in the field of supply chains has shown that they are substantially risky. Moreover, disruptions in these very important chains are inevitable. A survey on the flexibility of supply chains in 71 countries suggested that each supply chain should be of at least one major and serious disruption (Glendon and Bird, 2013), while 15% of the reports have shown more than one million pounds' losses. Supply chain management is complex, and various risk factors are involved in different activities. From a managerial point of view, supply chain disruption is a threat to carry out normal activities, resulting in some unfortunate and unforeseen events.

Romine et al. (2012) identified some of the supply chain risks commonly seen in policy failure, corporate risks, key customer failure, market risks, and technology risks. Through considering 519 articles between 1995 and 2010, Min and Kim (2012) showed that reducing supply chain across all business activities (due to sourcing, production, and product delivery) was linked with supply chain management. Various researches have been performed in the realm of sustainable supply chain, most of which are limited to the general nature of this concept. Mehri Babadi et al. (2022) presented a model to evaluate the performance of large supply chain in oil and gas industries. The results show the convergence of the methods of risk management culture, advanced resource planning, ISO 14001 certification, and the long-term market perspective in the large supply chain of oil and gas. Keygobadi (2021) explained a model for evaluating the sustainability of the supply chain in the oil and gas industry based on structural equations. They stated that the variables of external factors, commitment to sustainability, and management readiness have an effect on the sustainable supply chain management in the oil and gas industry.

In a work entitled "Presenting an Ideal Planning Model for the Sustainable Supply Chain of Downstream Oil with Multiple Modes of Transportation", Fathipour and Qadri (2018) showed that if all aspects of sustainability are taken into account simultaneously, decreasing the emission of pollution and increasing development require more money. In the article entitled "Studying and Investigating the Role of Supply Chain Management on Improving the Sustainability of the Company", Karimi Gavarashki et al. (2018) reported that an important relation exists between sustainable supply chain management and promotion of company sustainability. In the paper titled "Presenting the Structural Model of Sustainable Supply Chain Management in Companies with Multiple Businesses (Case Study: Shahid Qandi Manufacturing Factories Company)", Qadri et al. (2018) stated that managing relations between subsidiaries as well as the long-term orientation and policies of the parent company is of special place in realizing sustainable supply chain management of the company. Mirfakhreddini et al. (2018) in the research entitled "Presenting the Sustainable Performance Evaluation Model of the Supply Chain Using Interpretive Structural Modeling", classified 11 factors under 5 levels. The results can guide the managers of organizations to consider sustainable performance evaluation a road map.

Rehman Khan et al. (2021) performed a meta-analysis in sustainable supply chain management. The findings show that this area is dominated by multi-criteria decision making (MCDM) research methods and company level studies. In addition, for discovering new connections, researchers require using advanced economic modeling and effective algorithms and should conduct studies at the macro level (regional and country level). Jermsittiparsert et al. (2019) examined a game theory model for two competitive sustainable supply chains in terms of product sustainability. In this research, the structure of vertical integration channels is not in a balanced position, except when two sustainable supply chains are independent of each other. Floresco et al. (2019) studied the impact of the sustainable supply chain management strategy on supply chain management functions in the oil and gas distribution industry.

Companies in oil and gas distribution can use these findings in two aspects. First, they are useful in designing strategies effective in sustainable supply chain management to deal with requirements of social and environmental activities in supply chains. Second, these findings can optimize supply chain management to meet the requirements of sustainable supply chain management. Saeed and Kersten (2019), in the work titled "Drivers of Sustainable Supply Chain Management: Identification and Classification of Sustainability" acknowledged that regulatory and market pressures are the most dominant drivers of sustainable supply chain management (SSCM) for implementing sustainable practices. Classifying SSCM drivers into primary and secondary driver categories may help decision-makers and researchers prioritize sustainable initiatives and adopt sustainable practices throughout the supply chain network.

Rentizelas et al. (2020) in the article entitled "Social Sustainability in the Oil and Gas Industry: Institutional Pressure and the Management of Sustainable Supply Shains" found that (a) if organizations do not show initiative actions, compulsory government pressure is not enough for the development of socially sustainable practices in organizations because this leads to adaptive rather than creative performance; (b) policymakers should consider that coercive pressure is not capable of leading improvement in social sustainable performance because organizations can meet the minimum amount of government requirements.

Atstaja and Mukem (2023) in the article titled "Sustainable Supply Chain Management in Oil and Gas Industry in Developing Countries", with a systematic review method, that oil and gas is one of the most profitable and polluting industries in developing countries, and few studies have been performed in this field; therefore, it is recommended that oil and gas companies should improve their performance by using management methods: Using sustainable supply chain management instead of green supply chain management (GSCM). Sultan Mohammadi et al. (2023) in a work entitled "Providing a Model for Managing Resources in a Sustainable Supply Chain in Selected Industries with the Comparative Approach of K-means Methods, Principal Component Analysis, and Random Forests" found that environmental management indicators and inter-departmental cooperation in the automotive industry are the most important. In the tile and ceramic industry, indicators of social issues and indicators of human resource management are of great significance. Furthermore, in the steel industry, indicators of social issues and environmental management are identified as the most important ones. In the food industry, indicators of quality management, interdepartmental cooperation, and human resources management are of great importance. In addition, in the textile industry, the quality management index is recognized as the most important one. Eggert and Hartmann (2023) in the article entitled "Sustainable Supply Chain Management: a Key to Resilience in the Global Pandemic", after studying 231 public companies in the European Union, found that companies that use supply chain management are flexible against crises and can therefore prevent future incidents and disruptions.

Gardas et al. (2019) conducted research on the "Determinants of Sustainable Supply Chain Management: A Case Study from the Oil and Gas Supply Chain". First, the interpretive structural modeling (ISM) method was used to establish the mutual relationship between the determinants. Moreover, the dependency of operational and commercial performance on determinants was obvious. Then, primary data on the determinants of the sustainable supply chain management system and their influence on operational and business performance were collected. Next, structural equation modeling (SEM) was used to analyze the data. The ISM approach contributed to the conclusion that the determinant "regulatory pressure" has the upmost driving force. The results of the SEM method indicated that one of the determinants, "collaborative logistics" (CGLC), had a significant effect on operational and business performance.

Raut et al. (2017), in a study entitled "To Identify the Critical Success Factors of Sustainable Supply Chain Management Practices in the Context of Oil and Gas Industries: ISM Approach" indicated that the concept of sustainable supply chain management is a significant organizational philosophy. It can reach profitability through mitigating the risk and environmental effects while promoting the social and economic efficiency factors. The pressure of global climate and the ecological scarcity of resources are the most effective criteria that may force industries to implement sustainable measures. Hooshangi et al. (2017) tried to find out the mediating role of supply chain integration in the relation between organizational performance and the commitment of employees. Their experimental results showed that the employee commitment directly affects the integrity of suppliers, customers, internal integrity, and organization performance. On the other hand, internal integration positively affects supplier and customer integration, as well as organizational performance. The results show the positive effects of customer integration on organizational performance, but there is no clear evidence concerning relation between supplier integration and organizational performance. In a study entitled "Sustainable Supply Chain Management in the Oil and Gas Industry: a Review of Corporate Sustainability Reporting Practices", Wan Nurul Karimah et al. (2016) stated that the number of companies has been increased in terms of publishing sustainability reports.

Nurul et al. (2016), in a work titled "Sustainable Supply Chain Management in the Oil and Gas Industry", proposed a framework for understanding the underlying factors of sustainable supply chain management practices in the oil and gas industry. The review implied that there is a shortage of industry-specific SSCM research. The focus of current studies is on the separated stages of supply chain management, and they do not consider all dimensions of sustainable development: social, environmental, and economic factors. Furthermore, current frameworks lack the important contextual aspects of the industry's business and organizational environment. To fill these gaps, our study develops a comprehensive framework to operationalize the internal and external contextual factors of the fresh food industry environment, influencing the outcome of SSCM practices. Table 1 presents the components and concepts collected from the theoretical foundations and backgrounds.

Table 1

Components and categories extracted from previous studies

Dimensions	Concepts	Components	Source
Causal conditions	Environmental management	Environmental effects and pollution	Zhou et al. (2013)
		GSCM practices as well as environmental performance of companies	Sitek, P. and Wikarek (2015)
		Emission of greenhouse gases	Zhou et al. (2013); Bonney and Jaber (2013)
		Health and environmental risks of products	Mohan and Deshmukh (2013); Schneider et al (2013)
		Environmental knowledge	Bowen et al (2001)
		Global warming BOD and COD	Ahmed Saeed and Kersten (2019); Kusrini and Primadasa (2018)
		The percentage of used waste	Ahmed Saeed and Kersten (2019); Kusrini and Primadasa (2018)
		Substance use	Kusrini and Primadasa (2018)
	Market and capital factors	Level of investment and costs	Stranieri et al. (2019); Mathiyazhagan et al. (2021); Narimissa et al. (2020)

Dimensions	Concepts	Components	Source
		Information sharing	Gardas et al (2019); Narimissa et al. (2019); Ahmed Saeed and Kersten (2019)
		Organizational credibility	Taghipour and Beneteau-Piet (2020); Ahmed Saeed and Kersten (2019)
		Customer demand	Ahmed Saeed and Kersten (2019); Raut et al. (2017)
		Public pressure (social groups)	Ahmed Saeed and Kersten (2019)
		Pressure from suppliers and pressure from non-governmental organizations (NGO pressure)	Gardas et al. (2019); Ahmed Saeed and Kersten (2019)
		Organizational culture	Ahmed Saeed and Kersten (2019); Nurul et al (2016)
		Strategic alignment	Hussain (2019); Walker and Jones (2012)
		The commitment of senior managers	Gardas et al. (2019); Saberi et al. (2019)
	Strategies	Suppliers' competence	Wan Nurul et al. (2016)
		Organizational capabilities	Wright and Ulrich (2017)
		Infrastructure	Walker and Jones (2012)
		Senior management support	Govindan et al. (2014),
		Effective guidance	Lyons-White and Knight (2018)
Contextual conditions		Necessary tools to implement the blockchain technology	Saberi et al. (2019)
		Awareness and customer orientation about sustainability and blockchain technology	Saberi et al. (2019)
		Implementation of blockchain technology measures	Saberi et al. (2019)
	Blockchain technology	Adopting blockchain technology	Saberi et al. (2019)
		Immutability of blockchain technology	Saberi et al. (2019)
		Smart contracts	Saberi et al. (2019)
		Certificates	Saberi et al. (2019)
		Product information for customers	Saberi et al. (2019)
		Standards	Saberi et al. (2019)
		Licenses of suppliers	Halldórsson, Kotzab, and Skjøtt-Larsen (2009); Colicchia et al. (2011)
		Environmental and legal regulations	Gardas et al. (2019); Wright and Ulrich (2017); Wan Ahmad et al. (2016)
Intervening conditions	Policies and regulations	Global marketing	Quintana-García et al. (2021); Costantini et al. (2017); Wright and Ulrich (2017)
		Unavailability of bank loans	Mathiyazhagan et al. (2021); Lyons-White and Knight (2018); Wright et al. (2017)
		Government regulation and government support	Mudgal et al. (2009); Paulraj (2011); Bai et al. (2010)

Dimensions	Concepts	Components	Source
Strategies	Intra-organizational approaches	Environmental standards (ISO 14000 and 14001)	Narimissa et al. (2020); Amemba et al. (2013); Wright et al. (2017); Colicchia et al. (2011); Hussain (2011)
		Globalization	Ahmed Saeed and Kersten (2019)
		Performance evaluation	Azadi et al. (2015)
		Risk management	Nurul Karimah et al. (2016); Narimissa et al. (2020)
		Logistics management	Colicchia et al. (2011); Nurul Karimah et al. (2016)
		Product monitoring	Nurul Karimah et al. (2016); Florescu et al. (2019)
		Production management	Nurul Karimah et al. (2016); Gardas et al. (2018)
		Supplier management	Nurul Karimah et al. (2016)
		Waste management	Gardas et al. (2018); Taghipour and Beneteau-Piet (2020)
		Staff training	Nurul Karimah et al. (2016); Narimissa et al. (2020)
		Reverse logistics and recycling	Mavi, Goh, Zarbakhshnia (2017); Narimissa et al. (2020)
		Innovation in production	Ahmed Saeed and Kersten (2019); Costantini et al. (2017)
		Standardization and intelligent traceability	Ching and Moreira (2014); Lyons-White and Knight (2018)
		Compilation of the code of ethics	Matos and Hall (2007); Keating et al. (2008)
		Environmental management system	Lyons-White and Knight (2018)
		Environmentally friendly technologies	Ahmed Saeed and Kersten (2019); Glover et al. (2014)
		Coordination	Pagell and Shevchenko (2014)
		Participation	Gardas et al. (2019); Saberi et al. (2019)
		Competitive advantage	Ahmed Saeed and Kersten (2019); Krause et al. (2009)
	Extra-organizational approaches	Health and safety requirements	Narimissa et al. (2020); Schneider et al. (2013); Nurul Karimah et al. (2016)
		Optimizing economic and environmental criteria through balancing trade-offs or proposing optimal solutions	Balaman et al. (2018); Sitek and Wikark (2015)
		Incentives	Dam and Petkova (2014); Glover et al. (2014); Ahmed Saeed and Kersten (2019)
		Supplier audit	Dobi et al. (2015); Gunasekaran et al. (2015); Nurul Karimah et al. (2016)
Consequences	Improving the economic space	Organizational transparency	Nurul Karimah et al. (2016); Brindley and Oxborrow (2014)
		Economic growth	Nurul Karimah et al. (2016)
		Political and economic stability	Nurul Karimah et al. (2016)
		Reduction in costs	Ahmad Saeed and Kersten (2019); Wright et al. (2017)

Dimensions	Concepts	Components	Source
		Welfare and improvement of working conditions of employees	Mani et al. (2015)
		Customer satisfaction	Narimissa et al. (2020); Wright et al. (2017)
		Reliability	Li (2013); Narimissa et al. (2020)
		Reducing energy and material consumption	Colicchia et al. (2011); Van Wan Ahmad et al. (2016)
		Material recovery	Colicchia et al. (2011); Van Wan Ahmad et al. (2016)
	Improving social and environmental space	Corporate social responsibility	Wan Ahmad et al. (2016); Wright et al. (2017)
		Health and safety	Ahmed Saeed and Kersten (2019)
		Spreading social and moral values	Lyons-White and Knight (2018)
		Community development and social welfare	Ortas et al. (2014); Lyons-White and Knight (2018)

3. Research methodology

This research is meta-positivism in terms of philosophy. Its orientation in the model design is fundamental and applied in the test stage. The research approach, comparative induction, and its strategy were a combination of qualitative and quantitative strategies, conducted with the design of combined exploratory and explanatory methods. First, the grounded-theory strategy (Strauss and Corbin, 1998) with a systematic approach was used to extract components and design a conceptual model. Then, descriptive survey and structural equation modeling were used to collect and analyze the data in order to evaluate the accuracy of the identified criteria and their relation and to determine the validity of the research model. The grounded theory is proposed as a theorizing method that uses the inductive approach and is based on the three elements of concepts, categories, and theorems. The synthesis of previous studies showed that the sustainable supply chain model can be designed in the form of a process theory that has different dimensions and may be consistent with the paradigm model in the grounded theory; therefore, in the first stage, the collected data were coded, and the relationships between them were determined to some extent by applying the four principles of the grounded theory, including theoretical sampling, repeated data collection, continuous comparison, and transparent coding. Open coding was performed for the implemented interviews. Then, axial coding was conducted based on the paradigm model. In the selective coding stage, the relationship between the dimensions of the sustainable supply chain was determined in the form of narrative analysis of the research. Therefore, a theoretical theorem expressing the conceptual and generalized relationships of the components and sub-components of the model was presented.

By reviewing 32 previous studies, we first identified 72 open codes in 9 categories: strategies, blockchain technology, improving the economic environment, improving the social and environmental environment, policies and laws, internal organizational solutions, external organizational solutions, environmental management, and market and capital factors. Second, 10 faculty members (2 women and 8 men) and experts of the sustainable supply chain of crude oil and petroleum products of the NISOC participated in an interview. Further, three were members of the board of directors, and seven were the managers of the oil company who had at least five years of work experience. Based on in-depth semi-structured interviews conducted with managers and experts, we identified 78 coders.

In the quantitative part, while formulating the relationships between the variables of the research model and how they are affected, we used the modeling method with SmartPLS software according to the

number of questionnaires collected (150 items) from the structural equation in order to test and determine the validity of the conceptual model. The following are the most important reasons for using this approach:

- No need for presuppositions related to the distribution of the indicator and the measurement scale;
- The goals of prediction and theorizing;
- The suitability of PLS with the sample size;
- The absence of difficult solutions and the uncertainty of the factors in the qualitative part, including two methods:
    - Extraction of documents related to the sustainable supply chain in the oil company: it was tried to electronically store the extracted items to be used in the theoretical coding stage.
    - In-depth interviews with experts: First, semi-structured interviews were conducted with some managers of the headquarters of the NISOC.

Moreover, in order to refine and develop concepts and categories resulting from specialized interviews with company managers and develop concepts and primary categories resulting from the study of research literature, we conducted semi-structured interviews with university professors and used data collection tools in the quantitative part. It was an electronic questionnaire consisting of two parts.

4. Data analysis and findings

In the interviews section, 305 codes from interviews and 106 codes from previous studies were identified, resulted in 78 categories from interviews and 72 categories from previous studies. The process of relating categories to their sub-categories was axial coding, performed based on a comprehensive and general model, i.e., paradigm model. In this step, along with selecting one category as the axial category, all the related components of axial coding, including contextual factors, intervening variables, causal conditions, axial phenomenon, strategies, and consequences were identified using the collected data. Tables 2 and 3 present the initial and organized codes from the interviews.

Table 2

The compilation and description of categories

Selective coding	Axial coding	Open coding	Repetition	Interviewee
Consequences	Organizational productivity	Improve effectiveness	2	6-5
		Increase efficiency	2	1-8
		Reduce costs	5	3-5-6-10
The axial category	Supply chain	Organizational strategies	4	1-10
		Chain usage	6	1-10
Strategies	Industry supply chain	Returned management	1	6
		Technical services	2	10-4
		Foreign procurement	3	3-6-10
		Timely supply	3	9-7
		Procurement strategy	4	3-6
		Internal procurement	6	3-7-6-10
		Management of contracts	6	9-8

Selective coding	Axial coding	Open coding	Repetition	Interviewee
Strategies	Macro policies	Adoption of international standards	3	7-9
		Macro management styles	4	6-10
		Identifying macro needs	4	9-7-1-3
		National macro strategies	6	3-9-10
		The laws of the country	10	7-8-9-5-6-10
Consequences	Organizational performance	Improve social functioning	2	10
		Increase profitability	2	6
		Improve environmental performance	3	4-10
		Increasing international activity	3	4-6-5-3-9
		Improving economic activity	4	2-4-10-8
		Increasing the welfare of society	5	2-3-6
		Improve performance	6	7-9-6
		Increase market share	6	3-4-8-9
Intervening conditions	Social factors	Environmental culture	1	10
		Responsibility at the community level	1	6
		Lack of knowledge	5	8-9-6
Contextual conditions	Economic factors	Economic fluctuations	1	8
		Insurance companies	1	5
		International financial transactions	3	5
		Bank and domestic investor	4	8-5-6
		Foreign investment	4	8-9-6
		Strategic alliance	4	4-6-9-8
Causal conditions	Organizational factors	Being a single product	5	3-8-9
		Ability and equipment of participants	9	7-8-9
		Access to appropriate financial resources	14	8-7-9-5-6
		Providing financial resources within the organization	1	6
		Organizational culture	1	6
		Marketing	1	6
		Education	1	6
		Qualification required	1	6
		Resource management	2	6-10
		Risk management	3	8-9-6
		Commitment of managers	3	9-6
		Organizational structure	3	8-5-6
		Performance evaluation	4	7-9-6

Selective coding	Axial coding	Open coding	Repetition	Interviewee
Intervening conditions	Political factors	Organizational information	4	8-6
		Performance indicators	6	7-9-5-6
		Inter-organizational coordination	9	4-8-9-5-6
		Efficient manpower	9	7-8-9-5-6
		Bargaining power	2	8-6
		Political strategies of the country	5	2-3-4-5
		Political interventions	7	4-7-9-5-8
		Political sanctions	10	2-3-7-8-5-6-10
Strategies	Technology	Using new technology	3	6-10
		Employing knowledge-based companies	4	6-10
		Supply technology	7	5-7-9
Causal conditions	Manufactured products	Longevity of the product	2	7-8-9-10-6
		Quality of products	4	4-10
		Consumption and supply of raw materials	6	3-4-8-9-5-6
		Production equipment	10	4-7-8-9-5-6
Strategies	Customer	Customer orientation	1	6
		Demand management	2	6
		Responsiveness	3	6
		Customer satisfaction	4	8-6
		Management of customer orders	4	6
Contextual conditions	Supply chain failures	Storage problems	1	6
		Lack of resources	2	4-6
		Long delivery time	2	6-1
		Lack of supply chain	2	3-6
		Supply problem	2	3-6
		Lack of support for domestic production	2	9-7
		Lack of necessary competence	2	4-8
		Lack of evaluation indicators	3	1-6
		Equip resources	3	2-8-6
		Lack of quality resources	4	8-3-4
		Changes to the laws	6	1-2-3-7-8
			305	

Table 3

Frequency of coding of sustainable supply chain categories

	Interview 1	Interview 2	Interview 3	Interview 4	Interview 5	Interview 6	Interview 7	Interview 8	Interview 9	Interview 10	Total
Organizational productivity	1	0	1	0	2	3	0	1	0	1	9
Sustainable supply chain	8	0	0	0	0	0	0	0	0	2	10
Industry supply chain	0	0	5	1	0	5	5	1	5	3	25
Macro policies	1	0	5	0	1	3	4	1	9	3	27
Organizational Performance	0	3	8	4	2	4	0	3	2	5	31
Social factors	0	0	0	0	0	4	0	1	1	1	7
Economic factors	0	0	2	1	10	8	4	9	11	0	45
Organizational factors	0	0	0	32	6	20	4	7	8	1	48
Political factors	0	2	3	0	3	2	3	4	2	2	24
Technology	0	0	0	4	1	4	3	1	3	2	14
Manufactured products	0	0	1		4	4	2	2	3	2	22
Customer	0	0	0	0	0	13	0	1	0	0	14
Supply chain failures	3	3	5	3	0	8	2	4	1	0	29
Total	13	8	30	18	29	78	27	35	45	22	305

After identifying the categories by axial coding, their importance can be determined using the frequency of the codes given to the categories. Table 4 lists the output of the software related to the frequency of the codes given to the categories separately for interviewees.

Table 4

The coding frequency of sustainable supply chain categories for the interviewees

Category	Frequency	Percent
Political factors	9	90.00
Macro policies	8	80.00
Manufactured products	8	80.00
Supply chain failures	8	80.00
Organizational performance	8	80.00
Economic factors	7	70.00
Organizational factors	7	70.00
Industry supply chain	7	70.00
Technology	6	60.00
Organizational productivity	6	60.00
Social factors	4	40.00
Customer	2	20.00
Sustainable supply chain	2	20.00
Total	10	100.00

According to Tables 1 and 2, through summarizing all the dimensions and categories, the qualitative model of the research is as follows.

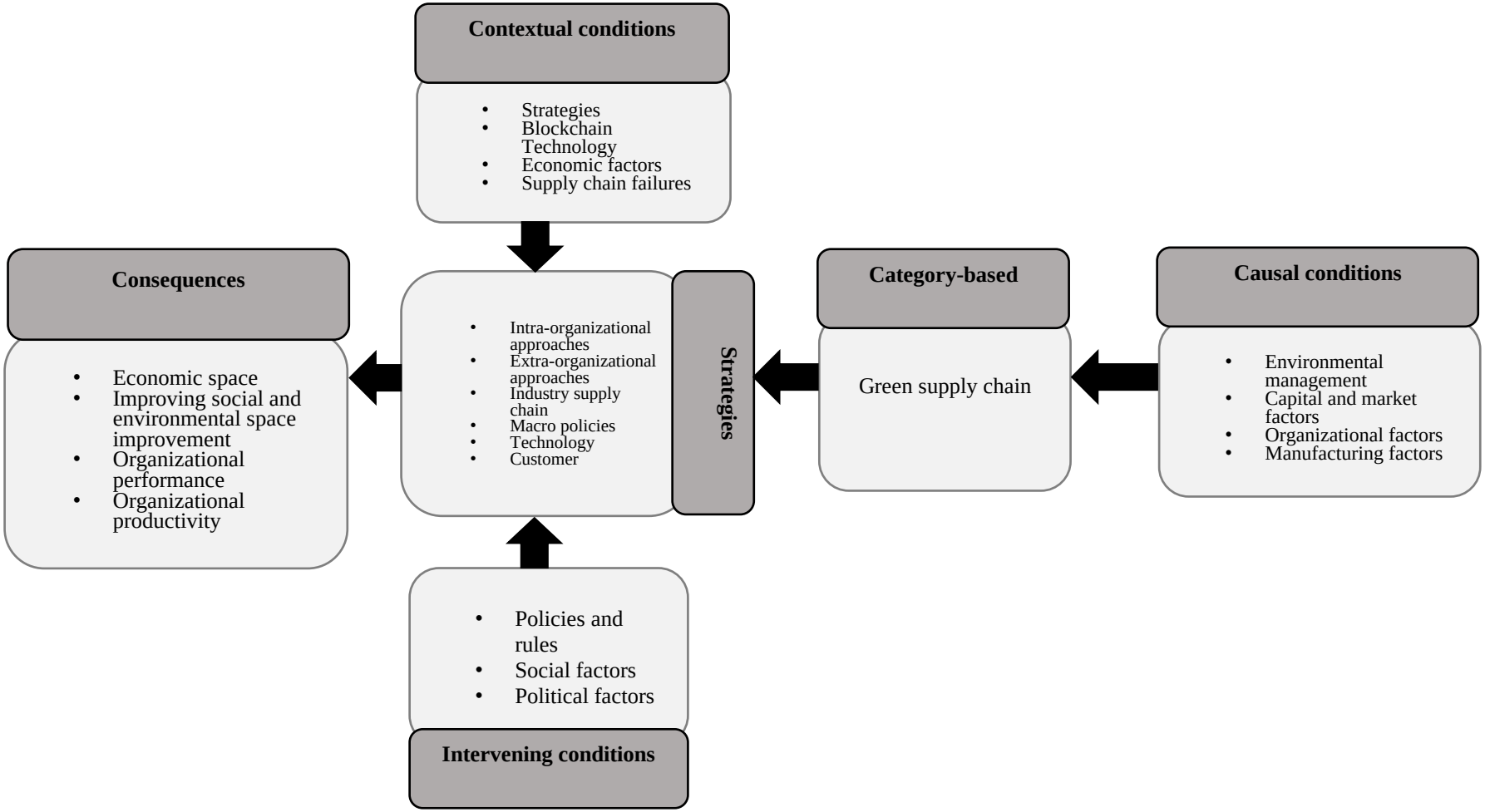

Figure 1

The paradigm model of sustainable supply chain coding in the NISOC

Based on the results in the qualitative part, a questionnaire was compiled and distributed among the employees, and the data were obtained from the questionnaire. Analysis and measurement of the model were conducted using the structural equation method with SmartPLS software.

In the first stage of data analysis, the measurement model should be assessed to determine the acceptable level of validity and reliability in the model. The relationship between variables and observed indicators is determined by examining this model. In PLS, the fitness criteria of the measurement model involve validity and reliability criteria, including:

- Factor loading values must be greater than 0.5;
- Convergent validity must be greater than at least 0.5;
- Cronbach's alpha coefficient and composite reliability values must be more than the minimum threshold of 0.7 (Azar and Gholamzadeh, 2015).

Further, the coefficient of determination (R^2) and the coefficient of prediction (Q^2) were used to evaluate the fit of the research model. The basic criterion for evaluating endogenous variables is the coefficient of determination (R^2). The R^2 values of 0.19, 0.33, and 0.67 in the PLS path models are described as weak, medium, and strong, respectively. Table 5 shows that most of the R^2 values are greater than 0.67, which are at the average level. The Q^2 index indicates the predictive power of the model. This index is more than zero for the endogenous variable. The values of 0.02, 0.15, and 0.35 show the low, medium, and strong predictive relationships in a latent variable. The results are given in Table 5.

Table 5

The evaluation results of the measurement model

Variable	AVE (Average variance extracted)	CR (Composite reliability)	Cronbach's alpha coefficient	Q^2	R^2
Environmental management	0.657	0.939	0.925	0.351	0.864
Market and capital factors	0.763	0.951	0.938	0.522	0.885
Organizational factors	0.552	0.945	0.937	0.615	0.700
Manufactured products	0.535	0.820	0.711	0.451	0.851
Supply chain	0.867	0.929	0.847	0.456	0.553
External solutions	0.530	0.867	0.809	0.120	0.259
Internal solutions	0.505	0.932	0.918	0.315	0.695
Macro policies	0.506	0.836	0.758	0.153	0.335
Industry supply chain	0.519	0.880	0.837	0.236	0.503
Customer	0.606	0.883	0.835	0.271	0.410
Technology	0.708	0.878	0.788	0.249	0.489
Strategies	0.746	0.959	0.951	0.366	0.541
Economic factors	0.720	0.958	0.950	0.437	0.868
Blockchain technology	0.692	0.953	0.944	0.561	0.914
Supply chain failures	0.706	0.964	0.958	0.151	0.158
Political factors	0.666	0.889	0.833	0.450	0.732
Social factors	0.654	0.850	0.734	0.510	0.779
Policies and laws	0.603	0.912	0.885	0.488	0.911
Organizational performance	0.507	0.884	0.848	0.435	0.845

Variable	AVE (Average variance extracted)	CR (Composite reliability)	Cronbach's alpha coefficient	Q^2	R^2
Improving the social and environmental environment	0.779	0.934	0.905	0.618	0.925
Improving the economic environment	0.643	0.933	0.915	0.522	0.188
Organizational productivity	0.664	0.855	0.742	0.053	0.879

The results of validity and reliability of measurement model are given in Table 5, which indicates that all the values are in the appropriate range. Therefore, the fitness of the measurement model is confirmed. According to Table 5, the values of Q^2 are greater than 0.15, implying that the independent variable has a predictive relationship, and there is an average relationship between all the variables and the independent variable.

Divergent validity is checked with the Fornell-Larcker criterion value. The Fornell-Larcker criterion value claims that a variable should have more dispersion among its own indicators compared to other latent variables. Therefore, from a statistical point of view, the average variance extracted (AVE) of each spatial variable must be greater than the highest square of the correlation of that variable with other spatial variables (Rasuli et al., 2017).

Table 6

The divergent validity of the research variables

	Causal conditions					Strategies					Contextual conditions				Intervening conditions			Consequences			
Variable	**Market and capital factors**	**Organizational factors**	**Productive goods**	**Environmental management**	**Sustainable supply chain**	**External solutions**	**Internal solutions**	**Industry supply chain**	**Macro policies**	**Technology**	**Customer**	**Strategies**	**Economic factors**	**Blockchain technology**	**Deficits of supply chain**	**Policies and regulations**	**Social factors**	**Political factors**	**Improving environmental and social space**	**Improving economical space**	**Organizational productivity**	**Organizational performance**
1	0.873																					
2	0.188	0.743																				
3	0.122	0.194	0.731																			
4	0.19	0.17	0.693	0.81																		
5	0.633	0.159	0.66	0.63	0.931																	
6	0.008	0.026	0.014	0.046	0.006	0.728																
7	0.078	0.041	0.037	0.028	0.004	0.314	0.711															
8	0.1	0.104	0.013	0.073	0.03	0.195	0.335	0.72														
9	0.069	0.089	0.037	0.025	0.027	0.343	0.251	0.518	0.711													
10	0.131	0.143	0.059	0.112	0.064	0.162	0.3	0.813	0.39	0.842												
11	0.203	0.135	0.159	0.129	0.02	0.323	0.628	0.255	0.243	0.236	0.778											
12	0.152	0.124	0.193	0.095	0.137	0.257	0.049	0.061	0.097	0.014	0.006	0.864										
13	0.241	0.246	0.285	0.23	0.189	0.211	0.015	0.043	0.049	0.082	0.045	0.518	0.848									
14	0.231	0.224	0.287	0.219	0.19	0.236	0.018	0.044	0.072	0.003	0.062	0.61	0.148	0.832								
15	1.58	0.179	0.693	0.136	0.61	0.023	0.047	0.086	0.044	0.125	0.177	0.122	0.241	0.229	0.84							
16	0.168	0.193	0.132	0.663	0.105	0.039	0.028	0.091	0.088	0.13	0.095	0.061	0.188	0.171	0.651	0.777						
17	0.554	0.136	0.604	0.567	0.663	0.032	0.014	0.049	0.054	0.088	0.052	0.078	0.138	0.126	0.542	0.15	0.809					
18	0.194	0.197	0.127	0.166	0.692	0.045	0.02	0.12	0.109	0.145	0.127	0.109	0.217	0.198	0.798	0.146	0.668	0.816				
19	0.055	0.023	0.033	0.065	0.038	0.167	0.249	0.137	0.17	0.031	0.226	0.214	0.21	0.208	0.031	0.015	0.023	0.03	0.882			
20	0.103	0.067	0.106	0.08	0.01	0.183	0.244	0.097	0.171	0.02	0.206	0.214	0.203	0.205	0.064	0.053	0.015	0.052	0.166	0.802		
21	0.001	0.066	0.03	0.046	0.05	0.773	0.245	0.104	0.211	0.036	0.272	0.236	0.161	0.186	0.03	0.098	0.086	0.051	0.229	0.278	0.815	
22	0.071	0.047	0.063	0.077	0.002	0.217	0.337	0.183	0.204	0.04	0.244	0.235	0.245	0.236	0.05	0.022	0.01	0.036	0.858	0.863	0.289	0.712

According to Table 6, the results of divergent validity show that each variable has more dispersion among its own indicators compared to the other latent variables, which confirms this criterion.

Figure 2 manifests the results of the above analyses based on the significance level of each relationship, and it shows the results based on the standard coefficients.

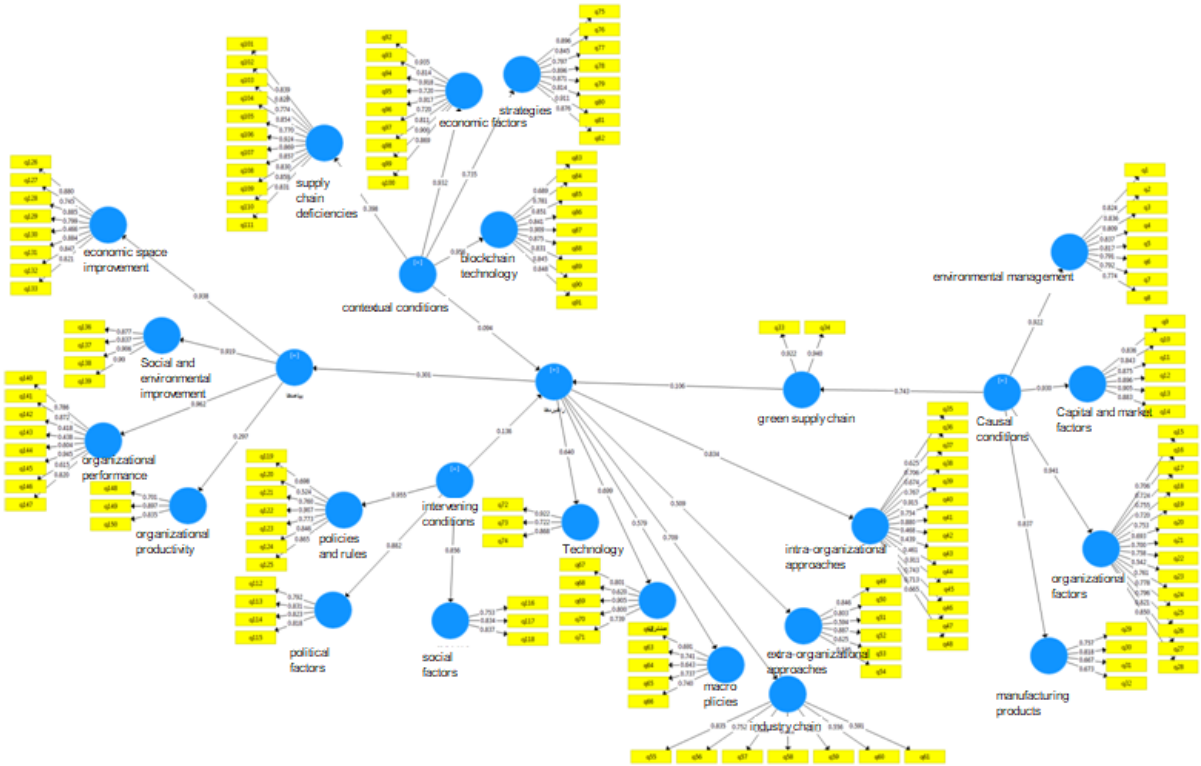

Figure 2

The test of the general research model based on standard coefficients

The factor loading coefficients between the variables can be used to obtain the paths of the variables. According to Figure 2, the factor loading coefficients indicate the existence of a linear causal relationship and the intensity and direction of this relationship between two variables; if this value is equal to or more than 0.4, the reliability of the model is acceptable.

Figure 2 shows the value of the path coefficients. If the factor loading value between the questionnaire's questions and the latent variables is greater than 0.4, we conclude that the question used for that structure has measured the desired latent variable well. In this study, all the path coefficients are above 0.4, and the factor loadings are confirmed (see Figure 2). The value of the beta coefficient is between 1 and –1. When the absolute value is greater than 0.3, the effect is stronger.

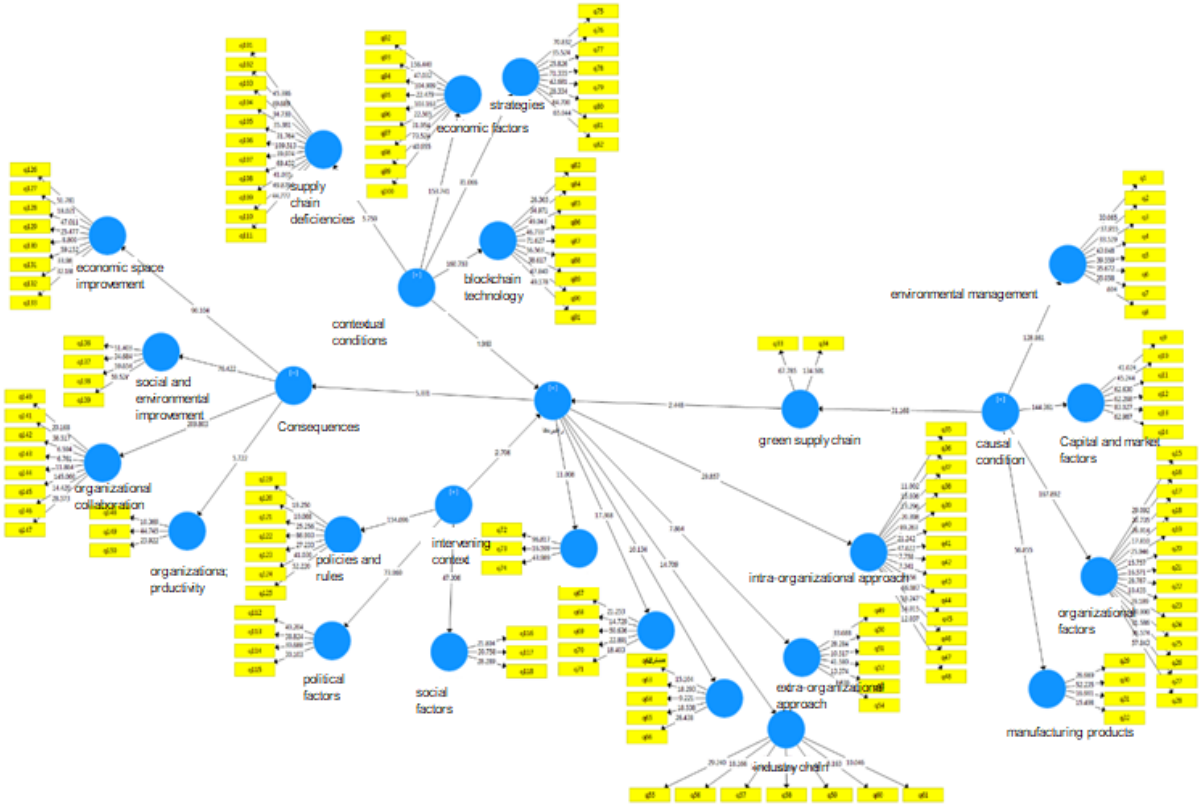

Figure 3

The test of the overall research model based on the significance T-value

In order to reject and accept the research paths, we used the T-value of the model. The significance of the relationships between the variables can be obtained from the T-value between the variables. As can be seen in Figure 3, the desired paths have a T-value greater than 1.96, and the coefficient of the path is positive, which is confirmed.

The T-value is actually the main criterion for confirming or rejecting hypotheses. If this T-value is greater than 1.64, 1.96, and 2.58, the hypothesis is confirmed at a significance level of 90%, 95%, and 99% levels, respectively. In Figure 3, the T-value is greater than 1.96, so the main hypotheses of the research are confirmed at a significance level of 95%. In addition, the positivity of the path coefficients shows the positive effects of the structures on each other; therefore, the main hypotheses are confirmed.

The quantitative part was analyzed in two parts. In the first part, the structural equations of the paradigm model were obtained from the interviews and research background. In the second part, the effect of the supply chain management variables was examined.

In the quantitative parts, to check the quality or validity of the model, we used CV Com and CV Red. The values of each index is related to the variables. The indices are positive and greater than zero, so the model has acceptable quality and fitness. The goodness of fit (GOF) index was used to check the fitness of the model. After performing the calculations, a numerical value of the GOF index equal to 0.60 is obtained, which is a strong index and shows the overall high quality of the model.

5. Conclusions and recommendations

This research identified the variables relying on the opinion of experts to provide a sustainable supply chain model based on the grounded theory method. At open coding, 78 open codes were identified among 305 concepts. In the axial coding, 78 initial codes were identified in the form of 13 categories, including

organizational productivity, sustainable supply chain, industry supply chain, macro policies, organizational performance, social factors, economic factors, organizational factors, political factors, technology, manufactured products, customer, and supply chain failures. Surveys showed that the category of organizational factors with 48 repetitions was in the first place, economic factors was in the second place with 45 repetitions, and organizational performance was in the third place with 31 repetitions. Among 10 interviewees, 9 people (90%) mentioned the category of political factors. Therefore, the category of organizational factors and political factors were prioritized in terms of the number of repetition and generality and inclusiveness, respectively, showing the importance of these categories. The category of sustainable supply chain and the category of customer were also mentioned by two interviewees, i.e., 20%, which had the lowest frequency percentage. The reliability of the model was evaluated using the Kappa index. The value of the Kappa index was 0.711, so it was placed at the level of valid agreement.

Further, by reviewing the research backgrounds of 72 open codes in 9 categories of strategies, we classified blockchain technology, improving the economic environment, improving the development and environmental environment, policies and laws, internal organizational solutions, external organizational solutions, environmental management, market factors, and capital category.

Silvestre (2015) stated that supply chains face more obstacles in developing and emerging economies. However, improving the sustainability of supply chains in developing countries has essential values for all countries around the world because there are more developing countries in the market (Hong et al., 2018). Integrating social, environmental, and economic aspects has continuously influenced management decisions, and especially, supply chain management and operations management. Organizations have tried to rethink and redefine the concept of operation management using the supply chain approach.

The results obtained are in line with the studies of Yoshi et al. (2020), Quintana-Garcia et al. (2021), Rehman Khan et al. (2021), Yang et al. (2019), and Somjai and Jermsittiparsert (2019). In Iran, Mehri Babadi et al. (2022) focused on the convergence of methods of risk management culture, advanced resource planning, ISO 14001 certification, and the long-term market perspective in the large supply chain of oil and gas. Keygobadi (2021) also conducted a quantitative research to evaluate the sustainability of the supply chain in the oil and gas industry and included the components of the sustainable supply chain (local supplier management, operation management, product monitoring, and logistics management), external factors (economic stability, competition, laws and regulations, stakeholder pressure, and energy policy), commitment to sustainability (organizational culture, senior management support, and transparency), and management readiness (risk management, cross-functional teams, and performance management). The results showed the impact of these variables on the stability of the supply chain in the oil and gas industry. The components investigated by Keyqobadi (2021) were consistent with the ones extracted in the present work.

Comparing to the traditional style of supply chain management with emphasis on the economic and financial operations of the business, sustainable supply chain management is defined hinging on integrating environmental and social goals with economic approaches. In this way, sustainable supply chain management puts emphasis on the forward supply chain and is completed with the closed loop supply chain, including the reverse supply chain, reproduction, and product recovery. It can be stated that the concerns of the government, non-profit organizations, and people about the depletion of natural resources, the global warming, using non-renewable resources, and the vast increase in industrial activities in developed and emerging societies have caused many shareholders to focus on sustainable business development. Applying sustainable supply chain management is vital for the competitiveness of the organization concerning quality, reliability, price, flexibility, and responsibility. According to the results, the NISOC should improve its organizational performance in relation to the environment using logistics solutions. The NISOC should properly align its organizational policies, as well as managers

and employees' attitudes, to implement the sustainable supply chain. It is suggested that a precise, principled, and comprehensive mission statement should be prepared according to the conditions of the organization. To implement the pure rule of law, appropriate laws should be formulated in all departments and be communicated to all people and units. Moreover, appropriate rewards and punishments should be specified for the better implementation of laws. Through comprehensive management, all the units are considered a whole, and the necessary ground is provided for the coordination and coherence of the organizational units. Further, all interested people should participate in the given affairs. It is necessary to pay attention to the three dimensions of sustainability, namely environmental, social, and economic dimensions, to achieve sustainable development in a supply chain. The implementation of any plan and program for sustainable development in supply chains requires an integrated approach with three main dimensions. Therefore, decision makers in supply chains should identify and understand the relationships and dependencies between complex factors to accelerate or hinder the achievement of sustainability. The decision-makers of oil-rich regions should study and develop a sustainable supply chain solution for better performance in the industry to promote the productivity of their products. Moreover, they should allocate appropriate financial resources to implement green management in the supply chain. Considering its emphasis on environmental protection, sustainable supply chain is considered a suitable solution to reducing pressure from different sectors and balancing social and economic benefits of the company. It is essential for the company to store the products in a suitable amount in the warehouse and to determine the number of orders optimally so that the storage, transportation, and distribution costs reach their lowest value. Considering the extensive political changes at societies, it is necessary to pay enough attention to the political affairs of the countries and the risk level of the entire market.

Two-way information affects the supply chain at different levels and must be controlled to lower distorted information. Logistics is an essential field each company should focus on and distinguish from competitors. Due to substantial demand for different types of products around the world, people's expectations of each product are changing. If a company requires continuing its work in the long term, it should focus on the field of supply chain and logistics. Special research is needed to lower production cost and improve quality along with reducing delivery time. It is better for company managers to identify intangible (attitude, skill, and knowledge) and tangible (product distribution, customer relationship, and supplier control) variables to know more about performance and improve productivity. Logistics management should be at the top of the management organization considering that it constitutes a major part of the supply chain. Transportation infrastructures are among the key factors in the development of competitiveness and exports of countries and industries. Therefore, the balanced development of logistics indicators guarantees sustainable development. Therefore, improving the position of logistics results in higher competitiveness of export products. Information transparency in commercial networks provides access to the status and location of shipments, probably reducing the uncertainty of cargo arrival. Shipment tracking provides a defined and controlled time sequence of logistics processes in the supply chain. Consequently, a better tracking system can enhance international trade through reducing uncertainty by providing a more reliable, consistent, and predictable flow of goods. Only if the knowledge of logistics and supply chain is promoted will competing with global rivals be possible.

Nomenclature

AVE	Average variance extracted
CGLC	Collaborative green logistics center
GOF	Goodness of fit

GSCM	Green supply chain management
ISM	Interpretive structural modeling
ISO	International Organization for Standardization
MCDM	Multi-criteria decision making
NISOC	National Iranian South Oil Company
PLS	Partial least squares
SEM	Structural equation modeling
SSCM	Sustainable supply chain management

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