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# Identify key factors to improve organizational systemibility from the perspective of sustainability paradigm in the oil and gas industry

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**Abstract**

This article identifies the key factors influencing organizational systematization promotion from the perspective of the sustainability paradigm in the oil and gas industry. This is a fundamental mixed paper (qualitative and quantitative). The qualitative population consisted of 25 expert subjects working for of oil and gas sector. The quantitative statistical population included all managers and senior specialists with at least 10 years of managerial work experience in various oil and gas sectors. The number of statistical samples was determined as 381 people through Cochrane correlation and was selected using a convenient sampling method. Data analysis was done in two qualitative and quantitative parts. In the qualitative part, by using the theme analysis, the output of the interviews was designed and presented in the form of a model of the key factors of improving system stability from the perspective of the sustainability paradigm in the oil and gas industry. In the quantitative part, the components of the qualitative model were converted into a questionnaire and after checking and confirming the validity and reliability, respectively, with the theme approach and checking the internal consistency of the items with Cronbach's alpha index, they were distributed among the statistical sample. The results of the conceptual model validation indicate the approval of the model extracted from the qualitative part of the research; thus, the measurement model and the structural model have a good statistical fit. The results showed that the dimensions of improving organizational system ability from the perspective of the sustainability paradigm in the oil and gas industry include (quality of human factors, structural quality, stability and unity of procedure at macro levels, commitment to the core process, and process monitoring and performance management) and oil and gas industries policymakers should pay special attention to them to promote systemability from the perspective of sustainability policies in this industry.

Keywords: systemability, sustainability paradigm, organizational reliability, sustainable supply chain, oil and gas industry
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## 1 Introduction

Improving performance, considering efficiency and effectiveness in supply chains, is among the basic challenges of supply chain management policymakers. One of the advantages of achieving high performance at the level of a supply

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chain is providing fast, affordable, and quality products and services to customers and global markets. Accordingly, it is necessary to investigate and examine supply chains and their constituent components measuring and improving performance at micro and macro levels to improve activities [4].

Measurement is considered a key advantage in industrial and systems engineering activities, especially in supply chains, and most organizations use performance measurement as a key to control and plan their plans and management systems. Therefore, the importance of measuring supply chain performance particularly adds to the importance of improving its reliability. Moreover, approaches including evaluating the reliability of the system from the perspective of quality and durability are adopted in addition to the results-based common indicators including providing fast, affordable, and quality products and services to evaluate the performance of the entire supply chain as a complex socio-economic system [8]. Systemability is one of the evaluation approaches from the reliability perspective, which offers a critical and creative perspective on the performance evaluation category from both quantitative and qualitative aspects. Generally, reliability is the ability of a system, such as a supply chain as a complex socio-economic system to perform a specific function under stated conditions within a specified time frame.

Therefore, this is defined in statistical terms, for simpler systems of natural sciences and engineering, and even from the point of view of supply and maintenance of production devices in factories.

For the first time, Cox [2] proposed Systemability as an indicator from the perspective of system performance evaluation, indirectly through the study of the relationship between the environmental condition and the hazard rate in evaluating the adaptability of the system to ideal and predetermined conditions. He presented the indicators of relative hazard (disturbance) and cumulative hazard of deviation in the system in connection with the evaluation of the systemability of variables [14]. In these studies, it was assumed that each variable in the system is influenced by various factors, including qualitative indicators, and the values of deviation from the standard for all the aforementioned indicators were considered as a specific rate between zero and one. In this model, values close to 1 indicate the strong influence of external influencing factors on the variable, and values close to zero indicate a favorable environment and close to the ideal (laboratory) environment and the lack of influence of external factors on the said variable in the system.

Reinhart et al., [15] identified the obstacles related to the optimization of production processes and factory operations by designing systemability indicators as a basis for evaluating the strength and continuity of assembly processes in interaction with the complexities between environmental factors in the business system and considered studying the factors and systematization promotion barriers at different levels necessary to obtain a proper understanding of industrial environments [7].

Pham [12] has introduced systemability as a more quantifiable concept compared to the findings of previous researchers. Pham's [12] systemability considers the system error rate in its environment under changes of a random variable relative to a controlled and isolated situation (in the form of an internal reliability function). Pham has introduced a new mathematical function called systemability, which considers the error rate of the system in its environment under changes of a random variable relative to a controlled and isolated state (in the form of an internal reliability function). The basic mathematical model presented by him has defined systemability as an integral of an exponential function with the variable of error changes from the main function and uncertainties caused by the real environment compared to the laboratory environment at a certain time.

The development of quantitative models of system stability by Persona et al. [9, 10] to quantitatively evaluate this variable is suggested in the industry sector and areas, including operation management, process agility and flexibility, equipment maintenance, expected quality and ideality of production materials, and industrial environment conditions forecasting. Later, Pham [13] in his new research presented the estimated systemability function to improve the outputs and bring it closer to the real-world situation, using the Taylor series expansion to predict and estimate the likely behavior of variables in the (real) field environment. Along with Pham's efforts, Borgia et al. [1] also redefined the reliability related to the (ideal) laboratory environment in the form of a systemability function with the help of the ratio of the gamma statistical distribution to the Willbull distribution. Borgia et al. [1] redefined the reliability related to the (ideal) laboratory environment in the systemability function with the help of the relative function of the Gamma statistical distribution and the Weibull distribution. Next, Pham [13] presented the estimated systemability function using Taylor series expansion to estimate the behavior of variables in the (real) field environment. The development of quantitative models of systemability by Persona et al. [9, 10] for the quantitative evaluation of this variable in the industry sector has been suggested in other fields including operation management, repairs and maintenance of devices, expected and ideal quality of materials required for production and the industrial environment conditions forecasting. Despite this, other models have been presented to evaluate the reliability of supply chains evaluate systemability [22]. A quantitative model of systemability was presented by Persona et al. [9] in preventive maintenance. The aforementioned researchers emphasized the sensitivity of non-quantitative indicators and considered the importance of identifying and evaluating qualitative indicators affecting systemability as essential to system knowledge and proper evaluation of its performance.

Accordingly, despite the efforts of the mentioned researchers to quantify the concept of systemability and evaluate it through numerical calculations, according to their admission, the said concept has its complexities based on its initial definition, and the efforts to perform numerical calculations modeling of this concept has only been able to cover a very small portion of it. Therefore, the roots of systemability and the factors involved in that concept, both from the positive and facilitating aspect and the negative aspect and as obstacles, are still being investigated and identified by active researchers in this field. According to Persona et al. [11], each of the efforts made to quantify the level of systemability in industrial settings, has so far been able to estimate and predict a small part of the variables in a small part of the process in the form of mathematical models. Systematability is a much more complex concept than it can be easily quantified and measured at the factory level or in supply chains. All the quantitative models of systemability evaluation at the supply chain level have a basic weakness, which is the simplicity of quantitative models and the impossibility of introducing qualitative variables affecting systemability and improving system reliability. Systemability can be considered from a quantitative perspective as a new reliability function for different industrial environments [11]. However, from a qualitative point of view, systemability refers to the business environment and the sociability of change to improve the situation. Industrial applications often see the difference between laboratory reliability testing under standard conditions and the reliability of a component or system when operating in different environments and real-world conditions. In effect, the reliability variable is significantly influenced by environmental factors. Environmental factors may change the failure rate, reliability, and systems availability [18, 20].

Despite the advances in renewable energy sources, a large part of the global economy is still significantly dependent on the oil and gas sector. But this sector has a negative and significant impact on the environment and society. A sustainable supply chain management system in the mentioned industry can help reduce and resolve some environmental and social issues [21]. However, the research conducted on sustainable management in oil and gas supply chains is limited in cases, and the determinants that influence the adoption and implementation of sustainable supply chain management practices and their impact on operational and business performance are deeply analyzed [3]. The overlooked variables and factors from the pathological aspect of chains mainly focused on the systemability and reliability of the chain from the perspective of qualitative factors. Accordingly, this article tries to fill this research gap by identifying and analyzing the impact of sustainability determinants in the supply chain related to Iran's oil and gas.

The identification of systemic obstacles to the acceptance of the sustainability approach and paradigm and its application at the chain level is a big challenge of research on supply chains sustainability, especially in the oil and gas industries [5, 7]. the acceptance and alignment of organizational systems within the supply chain are significant for the effective and successful implementation of sustainability processes, especially in the oil and gas industry; hence, it is necessary to address the research issue, especially in the oil industry-related supply chains. So far, various researchers have tried to reveal the qualitative barriers to implementation regarding the adoption of sustainable systems in oil and gas industries supply chains at different levels, especially in developing countries, using different theoretical bases and approaches [5, 17, 19, 20]. Further, it is an innovative aspect of this article to address sustainability performance in terms of entering the theoretical foundations of reliability theory from natural sciences in the form of systemability in the absence of research in this field. From the systemability point of view, from the theoretical foundations perspective of reliability in economic and social systems, the factors to ensure the correct adjustment of a system can be defined as hard factors and soft factors. This article identifies the key factors for promoting organizational systemability from the perspective of the sustainability paradigm in the oil and gas industry, and thus, researchers have focused more on soft factors and their identification.

## 2 Methods and tools

This is a qualitative and quantitative fundamental paper. The main rationale of the current article in using the theme analysis research plan is the lack of systematic studies from a qualitative perspective in the field of oil and gas industries in Iran, especially in terms of involved and affecting factors. Therefore, in this paper, the researcher is trying to present it for the first time. In this article, data were collected through field observations and semi-structured interviews as techniques for collecting qualitative data and forming a conceptual model. Also, the questionnaire tool has been used to evaluate and validate the research model. The validity and reliability of the questionnaire have been checked and confirmed by theme approaches and internal consistency checks, respectively.

The qualitative section statistical population includes conducting semi-structured interviews with experts active in the oil and gas industries, who were selected by purposeful sampling. The experts have at least a master's degree in related to administrative sciences fields and have been active in oil and gas-related companies as managers and assistants of different departments in the said companies. After achieving theoretical saturation, 25 experts have been selected from within the statistical community to collect the data for the qualitative section. At the beginning of each interview, the objectives of the research were explained to the interviewee. Then the importance and necessity of the research were explained followed by the research variables definitions. Thus, the interviewees presented their experiences and observations regarding the research topic. Often, they were asked several questions to better explain the issues and objectives of the research, and they provided the researcher with more detailed information. Each interview lasted between 25 and 60 minutes. In the end, the researcher asked the interviewee questions about the interview process and procedure.

In this paper, first, all the extracted factors from the literature were considered as codes. Then, considering the concept of each code, the codes were categorized into similar concepts, and then the research concepts (themes) were formed. According to the theme analysis of 25 interview files, main dimensions, and sub-categories were extracted for systemability promotion, which is presented in the form of a table in the following main category, sub-category, and codes and their frequency.

The quantitative statistical population included all middle and senior managers with at least 10 years of managerial work experience in the field of management in various provincial and national sectors in the lower-level oil and gas industries (extraction, production, and distribution) and the upper-level of the supply chain (distribution). Also, senior specialists in the ranks and headquarters of the National Iranian Oil Company and National Gas Company of Iran and affiliated organizations who had at least 10 years of work experience were included in the research population. The exact number of the statistical population was unknown to the researcher for its size and diversity. Taking into account the goals and quantitative approaches used in the research and due to the unknown size of the statistical population, the number of samples has been calculated using the Cochrane relationship for populations with an unknown number, taking into account the standard deviation of 0.667 in the form of the following equation. Thus, confidence limits of 0.95 with $z_{0.025} = 1.96$ and error level e=0.05 have been calculated for a sample of 381 subjects.

$$n = \frac{Z^2_{\frac{\alpha}{2}}\sigma^2}{e^2} = \frac{1.96^2 \times 0.667^2}{(0.05)^2} = 380.31 \approx 381 \tag{2.1}$$

Later on, following the extracting and finalizing the subjects following the process of conducting the qualitative part of the research, a questionnaire with 59 items was organized in the form of a 5-point Likert scale, and experts were asked to give their opinion about the status of each item in improving systemability from the perspective of sustainability paradigm in Iran's oil and gas industry. Before distributing the questionnaires and collecting the final data, their validity has been investigated and confirmed using the content validity method and its reliability using the re-testing method. The data was collected and distributed in three ways, including face-to-face distribution, letter and fax, and internet distribution of the questionnaire among the members of the statistical sample. Hence, 450 subjects were determined for their availability and willingness to provide answers. Then, 50 questionnaires were distributed by hand (paper printout), 100 by letter and fax, and 300 questionnaires were distributed online among the members of the statistical sample. After two rounds of follow-up regarding the completed questionnaires, the researcher finally received 406 responses, among which 25 were discarded for incomplete information; and finally, 381 completed and valid questionnaires were analyzed to provide the researcher with data analysis.

In the qualitative part of the research, by using the theme analysis method, the interviews' collected data were designed and presented as a conceptual model of the research in the form of a model of key factors to improve systemability from the perspective of the sustainability paradigm in the oil and gas industry. In the quantitative part, the presented model was validated and finalized using the first and second-order confirmatory factor analysis approach. Thus, after collecting the data, the conceptual model of the research has been tested from a statistical point of view, using Smart PLS 4 software.

## 3 Findings

A group of 25 research experts was interviewed, including senior and middle managers active at the ministry level and provincial general managers in the oil and gas industry. The 13 (52%) interviewed subjects held Ph.D. degrees in various specialized categories, with 12 (48%) interviewed subjects holding a Master's degree in administrative sciences-related fields. The demographic information of the statistical population included five variables of gender, marital status, age, education level, and work experience. Table 1 presents the demographic variables of the research, which was analyzed through the collection of 381 questionnaires.

Table 1: Statistical population demographic information

| **Variable** | **Level** | **Percentile** | **Variable** | **Level** | **Percentile** |
|---|---|---|---|---|---|
| Gender | Male | 322 (84.51%) | Education | Bachelor Degree | 49 (12.89%) |
| | Female | 59 (15.49%) | | Master Degree | 229 (60.26%) |
| Age | Less than 35 | 3 (0.79%) | | PhD | 102 (26.84%) |
| | 35-40 | 108 (28.42%) | Marital status | Single | 11 (2.89%) |
| | 41-45 | 126 (33.16%) | | Married | 369 (97.11%) |
| | 46-55 | 70 (18.42%) | Work service | Less than 10 | 17 (4.47%) |
| | Over 55 | 73 (19.2%) | | 10-20 | 127 (33.42%) |
| Total | 381 | | | 21-25 | 181 (47.63%) |
| | | | | Over 25 | 55 (14.47%) |

Table 2 presents the themes extracted from the theme analysis in the form of systemability promotion factors from the perspective of the sustainability paradigm in the oil and gas industry.

Table 2: Key factors to improve systemability from the perspective of sustainability paradigm in the oil and gas industry

| Main-category | Sub-category | Codes | Sign | Frequency |
|---|---|---|---|---|
| Structural quality | The quality of organizational structures for sustainability | The presence of a suitable variety of skills, abilities, and experiences following strengthening the principles of sustainability in human resources active in relevant organizations of the oil and gas industry. | V1 | 25 |
| | | Establishing an atmosphere of mutual trust between organization members and policymakers regarding proper guidance and implementation of sustainability activities. | V2 | 11 |
| | | The absence of organizational resistance culture against the process of changes in line with the implementation and execution of sustainability policies in the oil and gas industry. | V3 | 35 |
| | The quality of inter-organizational structures for sustainability | The presence of effective communication channels between macro sustainability policymakers in the oil and gas industry with employees and officials at different levels of the chain. | V4 | 8 |
| | | The presence of mutual trust between the macro-policy makers of sustainability in the oil and gas industry with the operational managers and supervisors of the different layers of the supply chains in that industry. | V5 | 5 |
| | | The high commitment of contractors and suppliers in the implementation of sustainability policies in the oil and gas industry | V6 | 19 |
| | | Commitment to solving challenges related to lack of coordination and implementation of sustainability principles in different levels of the chain | V7 | 14 |
| | The quality of information and communication structures | The presence of sufficient transparency regarding the information flows related to sustainability in the upstream of the oil and gas supply chain | V8 | 25 |
| | | The presence of sufficient knowledge of interactions in the business environment regarding different levels of oil and gas supply chains from a sustainability perspective. | V9 | 16 |
| | | Utilizing the approaches of information and communication technology in continuous improvement and promotion of sustainability of the oil and gas industry | V10 | 13 |
| | | Utilizing information systems with compatible and suitable structures in the management of data related to sustainability in the oil and gas industry | V11 | 8 |
| | The quality of financial structures within the industry | Absence of structural limitations in budget allocation in line with the implementation of sustainability activities in the oil and gas industry | V12 | 11 |
| | | The presence of appropriate investment structures in providing the initial costs of sustainability in the oil and gas industry | V13 | 16 |
| | | Relying on stable and reliable financial resources and the absence of temporary cost resource allocation structures in providing sustainable costs in the oil and gas industry | V14 | 18 |
| | The quality of financial structures at the macro level | Absence of pressure in order to reduce the costs and the final price of the products through the reduction of the sustainability charge in the oil and gas industry from the upstream bodies and institutions. | V15 | 12 |
| | | The absence of legal and extra-legal obstacles in providing funds related to the promotion of sustainability in the oil and gas industry | V16 | 16 |
| Human factors quality | The quality of human factors from an organizational perspective | The dominance of the culture of attention to promoting effectiveness instead of efficiency regarding activities related to sustainability among employees in the oil and gas industry. | V17 | 6 |
| | | The presence of a sense of social responsibility and incentives with immaterial and extra-organizational roots in human resources in the proper implementation of activities related to sustainability in the oil and gas industry. | V18 | 18 |
| | | Law-abiding and conscientious human resources towards activities related to sustainability in the oil and gas industry at different levels (chain and organizational) | V19 | 14 |
| | The quality of human factors from an inter-organizational point of view | The presence of a sense of business ethics and principles appropriate to sustainability goals among suppliers and contractors involved in the oil and gas industry | V20 | 18 |
| | | Using contractors and suppliers committed to implementing sustainability policies in the oil and gas industry | V21 | 13 |

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|---|---|---|---|---|
| | | The presence of a high level of social responsibility in human resources active at different levels of the chain, including procurement, supply outside the official (government) system in the oil and gas industry in relation to the implementation of the sustainability principles | V22 | 12 |
| | | The presence of appropriate high social and moral values among employees and at different levels (individual, organizational, chain, industry and society) outside the official (government) system of the oil and gas industry, which is in line with sustainable values. | V23 | 22 |
| | The quality of human factors from a social point of view | Appropriate and sufficient awareness among members of society (as energy consumers) regarding the importance of implementing sustainable practices in the oil and gas industry. | V24 | 7 |
| | | The presence of appropriate and sufficient awareness of the society (energy consumers) regarding the necessity of cost allocation (extra cost of energy consumption) for the implementation of sustainable practices in the oil and gas industry. | V25 | 15 |
| | | The presence of a suitable level of social responsibility among members of the society for the implementation of sustainable practices in the oil and gas industry. | V26 | 19 |
| | | The presence of a high social awareness regarding the risks and complications caused by not implementing sustainable practices in the oil and gas industry and putting pressure on the officials in case of negligence. | V27 | 19 |
| | | A high level of socialization regarding moral values and social duties regarding the necessity of implementing sustainability principles in the oil and gas industry | V28 | 35 |
| | Human factors quality from a managerial point of view | The commitment of senior management in carrying out sustainability efforts in accordance with planning and macro policies in the oil and gas industry | V29 | 28 |
| | | The presence of mutual trust between managers and other members of the organization regarding the proper direction of resources and the correct management of sustainable activities in the oil and gas industry. | V30 | 28 |
| | | The awareness of the senior management of the oil and gas industry about the benefits of sustainability for the industry and society and the need to make decisions compatible with the environment and in line with the sustainability principles | V31 | 13 |
| | | The presence of a culture of attention to effectiveness instead of efficiency regarding activities related to sustainability among senior managers and key people in the oil and gas industry. | V32 | 14 |
| Stability and unity of direction at macro political-economic levels | Macro-level stability in favor of expanding sustainability opportunities | Establishing political stability (in related upstream institutions of the country) for the implementation of policies related to the development of sustainable opportunities in the oil and gas industry. | V33 | 13 |
| | | Establishing relative stability and long-term alignment of macro policies in various areas with direct effects and related to promoting sustainability in the oil and gas industry. | V34 | 16 |
| | | The lack of influence of stabilization trends in the oil and gas industry from the changes in the macro political environment of the country | V35 | 13 |
| | | Non-interference of political parties and factions in issues related to the oil and gas industry, especially in the field of policy making in the field of sustainability for the benefit of their party-faction interests. | V36 | 12 |
| | | Establishing relative economic stability at the macro level and its favorable impact on policymaking in the field of sustainability in the oil and gas industry | V37 | 11 |
| | Unity of direction in the direction of expansion of sustainability opportunities | The presence of a systematic and specific framework in the design and implementation of macro policies related to the oil and gas industry in line with the development and expansion of sustainable opportunities for members of active chains. | V38 | 16 |

| | | | | |
|---|---|---|---|---|
| | | The presence of a high level of coordination between various government and private institutions and bodies in the implementation of policies related to the promotion of sustainability in the oil and gas industry. | V39 | 11 |
| | | Maintaining the procedure from the point of view of continuous support in the implementation of laws by different governments, without taking into account the considerations related to changes in party and factional politics in governance to adopt environmentally friendly policies in the long term of the oil and gas industry. | V40 | 7 |
| | | Alignment of resource stabilization policies in other energy fields with macro policies related to the oil and gas industry for the development and expansion of sustainability opportunities. | V41 | 9 |
| Process monitoring and performance management based on sustainability promotion | Evaluation and monitoring | Establishing a suitable link between the sustainability evaluation systems outputs and rewards and incentives at different levels in the oil and gas industry | V42 | 17 |
| | | Using formal and pre-determined criteria to measure sustainability performance in different sectors in the oil and gas industry | V43 | 11 |
| | | Using formal and predetermined criteria to determine the implementation status of sustainability approaches at different levels of supply chains in the oil and gas industry. | V44 | 11 |
| | | Using appropriate monitoring tools in evaluating and measuring the performance of processes related to sustainability in the oil and gas industry | V45 | 6 |
| | Performance of suppliers and contractors | The presence of appropriate and sufficient recorded processes in evaluating the performance of suppliers and contractors involved in the oil and gas industry | V46 | 8 |
| | | Utilization of performance monitoring and measurement tools in the oil and gas industry related to sustainability at the level of suppliers and contractors | V47 | 9 |
| | | Utilizing appropriate standards related to sustainability assessment to review suppliers and contractors active in the oil and gas industry | V48 | 9 |
| | | The necessity of obtaining environmental permits and certificates for suppliers and contractors related to the oil and gas industry in accordance with the sustainability principles | V49 | 7 |
| | Capability management to promote sustainable performance | The presence of appropriate and sufficient training programs from the perspective of promoting sustainable performance for human resources active in the oil and gas industry | V50 | 10 |
| | | Providing the necessary and sufficient tools and facilities to human resources to implement sustainable approaches in the oil and gas industry | V51 | 10 |
| | | Establishing appropriate motivational activities in line with planning to improve performance from the perspective of implementing human resource sustainability activities in the oil and gas industry. | V52 | 8 |
| | | The absence of a gap between education and professional needs to improve performance related to sustainability in human resources active in the oil and gas industry. | V53 | 11 |
| Commitment to process | Reliance on procedures and processes instead of depending on people and charisma | Emphasis on the codified, written and predetermined central process verses the person-orientation in adopting and determining micro and macro policies of sustainability in the oil and gas industry. | V54 | 11 |
| | | Applying priority in citizenship and implementation of protective laws at the upstream and governance levels regarding improving the level of sustainability in the oil and gas industry over non-aligned policies within the process, circulars and small | V55 | 19 |
| | The presence and acceptability of sustainability processes and procedures | The presence of appropriate regulations and acceptable sustainability standards at operational levels related to improving the level of sustainability in the oil and gas industry | V56 | 9 |
| | | The presence of coherent strategic plans and procedures to promote the sustainability of supply chains in the oil and gas industry. | V57 | 11 |
| | | The presence of a coherent and transparent reward and punishment system with the aim of leading human resources in the proper implementation of sustainable activities in the oil and gas industry. | V58 | 10 |

| | | |
|---|---|---|
| High acceptability of procedures and regulations related to promoting sustainability at different levels of active employees in the oil and gas industry | V59 | 8 |

The summary of the theme analysis approach output shows that a total of 826 open codes were extracted without repetition, which were finally summarized in the form of 59 guided codes. Also, the aforementioned codes were formed in the framework of 5 main categories and 16 sub-categories and the conceptual model of the key factors of systematicity based on the theoretical literature of sustainability in the oil and gas industry.

The items identified as systematicity promotion factors with an emphasis on the sustainability paradigm in Iran's oil and gas industries were prepared and organized in the form of a questionnaire to validate the model (Table 2), and distributed among the statistical sample after checking and confirming the validity and reliability. Later on, the collected data was entered into SmartPLS according to the conceptual model and statistically analyzed with the confirmatory factor analysis approach.

In the following, statistical findings related to model validation, Average Variance Extracted (AVE), Composite Reliability, and consistency reliability for the model's latent components are reported in Table 3.

Table 3: Summary of statistical report of main criteria of model quality assessment

| **Construct** | **Significance** | $R^2$ | **AVE** | **Cronbach's alpha** | **Composite Reliability** |
|---|---|---|---|---|---|
| Evaluation and monitoring | 0.000 | 0.948 | 0.811 | 0.921 | 0.928 |
| Commitment to the process | 0.000 | 0.929 | 0.826 | 0.957 | 0.961 |
| Relying on procedures and processes instead of depending on people and charisma | 0.000 | 0.922 | 0.970 | 0.969 | 0.971 |
| Stability at macro levels | 0.000 | 0.842 | 0.505 | 0.754 | 0.765 |
| Stability and unity of direction at macro levels | 0.000 | 0.366 | 0.679 | 0.775 | 0.815 |
| Performance of suppliers and contractors | 0.000 | 0.973 | 0.780 | 0.919 | 0.979 |
| Capability management to promote sustainable performance | 0.000 | 0.960 | 0.907 | 0.966 | 0.966 |
| The presence and acceptability of processes and procedures | 0.000 | 0.972 | 0.865 | 0.948 | 0.950 |
| Process monitoring and performance management | 0.000 | 0.936 | 0.816 | 0.924 | 0.929 |
| The unity of macro-level procedures | 0.000 | 0.751 | 0.827 | 0.981 | 0.982 |
| Quality of organizational structures | 0.001 | 0.284 | 0.638 | 0.901 | 0.963 |
| Structural quality | 0.000 | 0.610 | 0.736 | 0.917 | 0.972 |
| Human factors quality from an organizational point of view | 0.009 | 0.223 | 0.797 | 0.806 | 0.842 |
| Human factors quality from an inter-organizational point of view | 0.000 | 0.467 | 0.720 | 0.752 | 0.984 |
| Human factors quality from a social point of view | 0.000 | 0.707 | 0.635 | 0.753 | 0.977 |
| Human factors quality from a managerial point of view | 0.000 | 0.470 | 0.618 | 0.738 | 0.961 |
| Information and communication structures quality | 0.000 | 0.721 | 0.863 | 0.730 | 0.850 |
| Financial structures quality at the macro level | 0.000 | 0.402 | 0.690 | 0.850 | 0.851 |
| Financial structures quality within the industry | 0.001 | 0.402 | 0.762 | 0.788 | 0.889 |
| Inter-organizational structures quality | 0.000 | 0.461 | 0.761 | 0.741 | 0.845 |
| human factors quality | 0.004 | 0.336 | 0.629 | 0.775 | 0.911 |

Table 3 shows that the relationship and impact of the main structures on systemability from the perspective of the sustainability paradigm is significant at the 95% confidence level. Convergent validity is the positively correlated measure with alternative measures of the same construct, which is based on Average Variance Extracted (AVE). The minimum average variance described as equal to 0.5 indicates appropriate convergent validity; this means that a latent variable can explain more than half of the dispersion of its indicators on average. According to the results listed in the above table, considering that the average variance explained for each of the main constructs of the model is more than 0.5, therefore, the convergent validity of the research model is confirmed.

Cronbach's alpha is a criterion for reliability control, which shows the internal correlation of the indicators. Table 3 indicates that Cronbach's alpha values for all measured constructs are greater than 0.7. Therefore, based on Cronbach's alpha, the one-dimensionality of all structures is confirmed. Considering that Cronbach's alpha only provides an estimate of reliability from the perspective of internal consistency of the underlying variables, the composite reliability index is also used in path models of PLS type. It can be seen that the composite reliability values for all measurement models are greater than 0.7. Therefore, the one-dimensional composite reliability of the model is confirmed again based on all measurement models. Examining the values related to the discriminant validity of the constructs (Fornell-Larker criterion) in the research model also showed that the values of the second root of each construct's AVE are higher than the highest correlation of that construct with other constructs of the model. Therefore, the model is acceptable from the point of view of the differential validity index.

Figure 1 shows the final output of estimates related to the coefficients of the path-structural model and the factor loadings of obvious variables. In addition, Figure 2 presents the t-statistic values for the relationships between observable variables and latent variables in the research model framework. The Figure 1 findings show that all the observable variables' factor loadings related to each of the existing constructs are more than 0.6, which indicates the appropriateness of the factor loadings in investigating the reliability of the representatives. In other words, the results of the above table show that each structure had properly converging representatives. Figure 2 findings show that all t statistic values for the connections between the components of the model (latent with latent and latent with observable) are greater than the value of 1.96. Therefore, the significance of all items and relationships defined between variables (latent and observable) is confirmed at the 95% confidence level.

The two predictive fit Criterion ($Q^2$) and Goodness of Fit (GOF) were used to evaluate the latent constructs in the model to evaluate the fit of the research model. In Stone-Geisser Criterion (1975), three values of 0.02, 0.15, and 0.35 have been determined as low, medium, and strong predictive power, respectively, to compare and analyze the condition of the predictive fit criterion. According to the findings reported in the figures and tables, the predictive criterion values for all the existing structures of the model have been estimated in the strong range. For the model's overall Goodness of Fit (GOF), the average shared values ( ) was 0.669 and the average $R^2$ index for the latent variables was 0.602. Therefore, the value of the GOF index was 0.403. Wetzles et al. [25] have specified three criteria of 0.1, 0.25, and 0.36 as weak, medium, and strong numerical values for GOF. According to the GOF value calculated above, it can be said that the whole presented model has a strong fit rate. Finally, the above Tables and Figures findings conclude that the dimensions of the factors model for promoting systemability from the perspective of the sustainability paradigm, which includes (human factors quality, quality structural, Stability, and unity of direction at macro-political-economic levels, process monitoring and performance management based on promoting sustainability and commitment to the central process) can be proposed as factors to improve systemability in the oil and gas industry.

## 4 Discussion and conclusion

Supply chain management always urgently requires improved efficiency and effectiveness to provide fast, affordable, and quality products and services to customers and global markets. Thus, examining and presenting different improvement approaches from different perspectives to measure the performance of the entire supply chain and each of its members separately is considered one of the necessities of the development and expansion of supply chains to improve value. Therefore, predicting the performance and ensuring the appropriate and acceptable performance of complex socio-economic systems including supply chains has been one of the main concerns of researchers in related research fields. Accordingly, various models have been presented so far to identify and evaluate factors and provide performance improvement solutions in various fields for supply chains. In addition, One of the main challenges in the oil and gas industries' supply chains is the implementation of sustainable approaches to reducing environmental impacts and effective use of resources to reduce its harmful environmental, social, and economic effects along with creating added value and achieving customer satisfaction. Therefore, to investigate this issue, the reliability theory classical view based on the overall system failure rate calculations was explored with a qualitative approach and from the perspective of systemability. Thus, this can be expressed as a theoretical innovation of the current research and the research can be considered fundamental from the point of view of expanding the theoretical concepts of related topics. In this paper, the mentioned category was scrutinized based on the reliability theory. Accordingly, this article identifies the key factors of improving organizational systemability from the perspective of the sustainability paradigm in the oil and gas industry. Hence, a combined approach (qualitative and quantitative) was used. The qualitative part of this paper included conducting semi-structured interviews with experts active in the field of oil and gas industries and selecting by purposeful sampling method. The theoretical saturation was achieved after conducting 25 interviews, and the key factors and dimensions of sustainability systemability in the oil and gas industry were categorized and extracted in the form of 59 guided codes, 5 main categories, and 16 subcategories, and the conceptual model of key

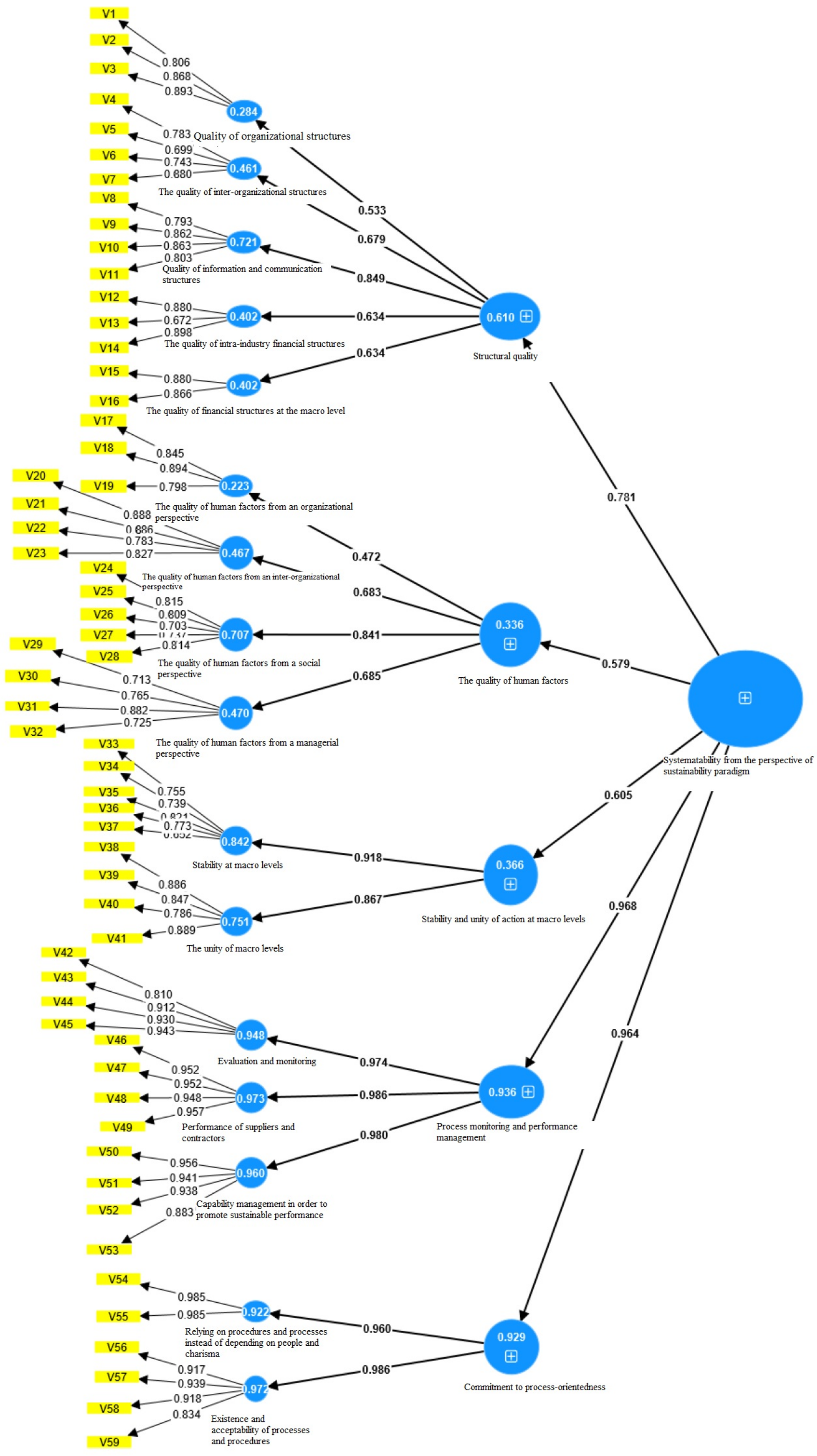

Figure 1: Estimation of coefficients of path-structural model and factor loadings of obvious variables

systemability factors in the oil and gas industry was formed based on the theoretical literature of sustainability. The output of the theme analysis approach was extracted and formed through without repetition 826 open codes analysis. Then, with the purpose of validation, the identified items as the model of factors for improving systemability with emphasis on the paradigm of sustainability in Iran's oil and gas industries were distributed in a questionnaire. Later

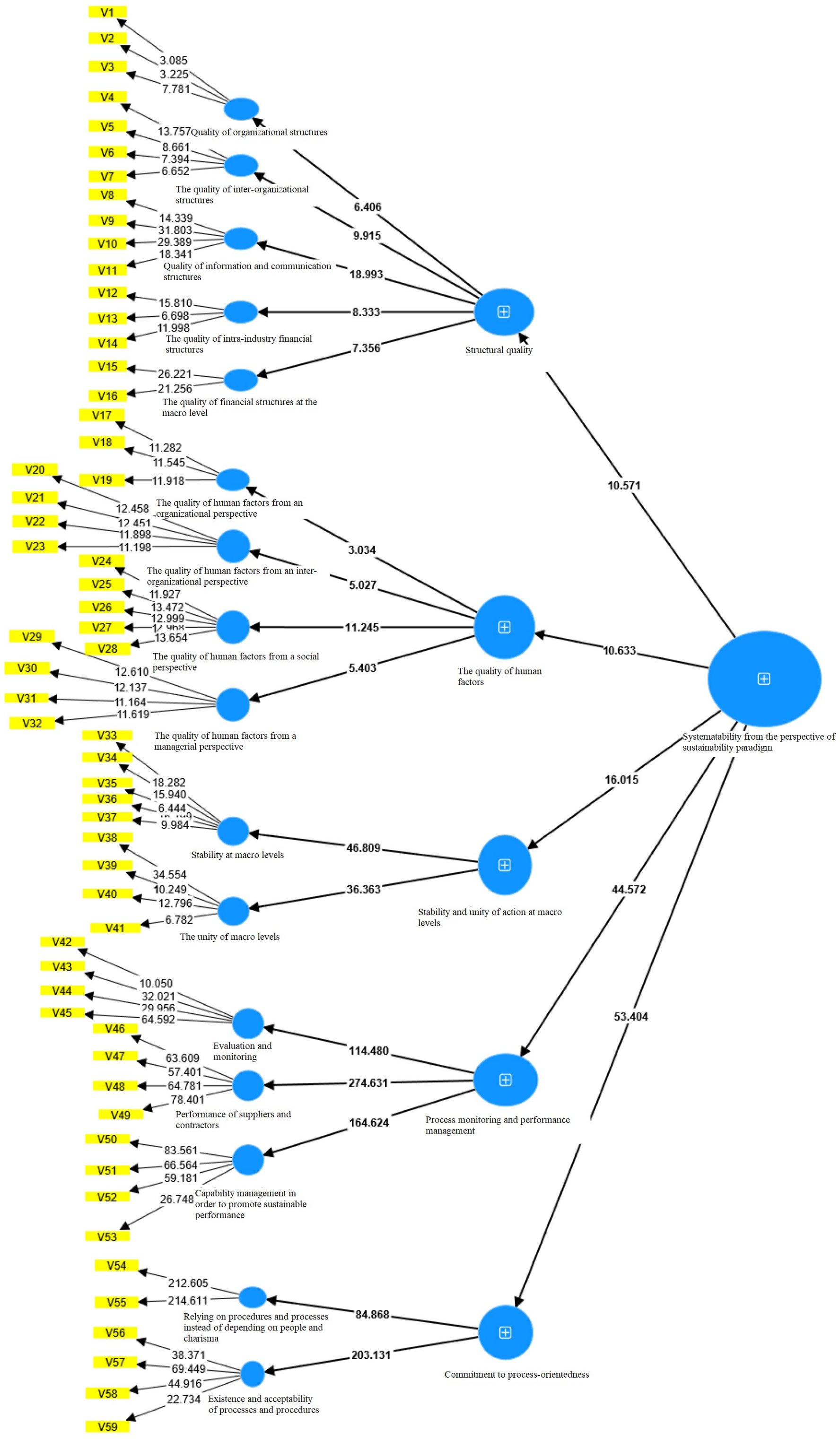

Figure 2: Estimating the values of t-value statistics for the research model

on, the prepared and organized questionnaire was checked and its validity and reliability were confirmed and it was distributed among the statistical sample. After collection, the data was entered into SmartPLS according to the conceptual model and statistically analyzed with the confirmatory factor analysis approach. The findings showed that the key dimensions of improving systemability and system reliability in supply chains include 5 sections: systemability from the perspective of human factors quality (human systemability), systemability from the perspective of structural quality (structural adaptability), stability and unity of direction at macro-political-economic levels, process monitoring and performance management based on promoting sustainability and commitment to the central process and not relying on charismatic people in operational processes and operational decisions in the field of sustainability.

Today, measurement is considered a key advantage in industrial engineering and systems management activities, and most organizations use performance measurement as a key to control and set their plans and management systems. Therefore, the importance of measuring supply chain performance highlights the fundamental research such as the current paper over time while attracting the attention of analysts of socio-economic systems such as supply chains. sustainable supply chain management is a multidimensional and relatively complex concept including economic, social, and environmental sustainability; therefore, measuring its performance will require the involvement of various indicators.

In this article, the researchers have tried to evaluate the oil and gas industry's performance and its promotions by examining the key factors of improving the organizational systemability from the perspective of the sustainability paradigm for the oil and gas industry and to create a perspective from a different aspect to the discussion of performance in supply chains.

Findings show that structural quality includes 5 sub-categories at the macro level; namely, organizational structures quality for sustainability, inter-organizational structures quality for sustainability, information and communication structures quality, financial structures within the industry quality, and financial structures quality, and it can be confirmed as a factor to promote systemability with the intensity of the effect of 0.781 and the statistic value of $t = 10.571$. The human factors quality includes 4 subcategories; namely, human factors quality from an organizational perspective, human factors quality from an inter-organizational perspective, human factors quality from a social perspective, and human factors quality from a management perspective, and it can be confirmed as an important factor to promote systemability with the effect intensity of 0.579 and the statistic value of $t=10.633$. Stability and unity of direction at macro-political-economic levels include 2 sub-categories; namely, stability at macro-levels in favor of the expansion of sustainability opportunities and unity of direction in the path of expansion of stabilization opportunities, and it can be confirmed as an important factor to promote systemability with the effect intensity of 0.605 and the statistical value of 0.15 $t = 16$. Also, process monitoring and performance management based on sustainability promotion includes 3 sub-categories; namely, evaluation and monitoring, the performance of suppliers and contractors, and capacity management to improve performance to expand opportunities for sustainability, it can be confirmed as an important factor to promote systemability with the effect intensity of 0.968 and a value of statistic $t=44.572$. Commitment to process includes 2 sub-categories; namely, relying on procedures and processes instead of subordination to people and charisma and the presence and acceptability of sustainability processes and procedures, it can be confirmed as an important factor to promote systemability with the effect intensity of 0.964 and the value of the statistic $t = 53.404$.

In discussing and comparing the findings with other researches findings and considering the uniqueness of this paper's subject and the findings, it is possible to cautiously consider part of the findings of this article regarding the model of factors for promoting sustainability from the aspects of the quality of human factors consistent with findings of Sletten [20] and Menon [7].

The findings of structural quality in the model of sustainability promotion factors are consistent with Rentizelas et al. [16] model. Finally, part of this article's findings regarding the model of sustainability promotion factors from the aspect of commitment to the central process and process monitoring and performance management is consistent with that of Khorasani [6], Wang [24], and Taghizadeh and Ziaei Hajipirloo [23].

## References


[1] O. Borgia, F. De Carlo, N. Fanciullacci, and M. Tucci, *Field reliability estimation through the Systemability function: a case study in the household appliances*, Proc. XVIII Summer School" Francesco Turco", Maurizio Bevilacqua, 2013 , pp. 1–6.

[2] D.R. Cox, *Regression models and life-tables*, J. Royal Statist. Soc.: Ser. B **34** (1972), no. 2, 187–202.

[3] B.B. Gardas, R.D. Raut, and B. Narkhede, *Determinants of sustainable supply chain management: A case study from the oil and gas supply chain*, Sustain. Prod. Consump. **17** (2019), 241–253.

[4] M. Hafi, U. Ujianto, and T. Andjarwati, *The effects of sustainable supply chain management and organizational learning abilities on the performance of the manufacturing companies*, Uncertain Supply Chain Manag. **10** (2022), no. 4, 1345–1358.

[5] M. Jalali, B. Feng and J. Feng, *An analysis of barriers to sustainable supply chain management implementation: the Fuzzy DEMATEL approach*, Sustainability **14** (2022), no. 20, p. 13622.

[6] M. Khorasani, S. Sarker, G. Kabir, and S.M. Ali, *Evaluating strategies to decarbonize oil and gas supply chain: Implications for energy policies in emerging economies*, Energy **258** (2022), p. 124805.

[7] R.R. Menon and V. Ravi, *An analysis of barriers affecting implementation of sustainable supply chain management in electronics industry: a Grey-DEMATEL approach*, J. Modell. Manag. **17** (2022), no. 4, 1319–1350.

[8] M. Movahedipour, J. Zeng, M. Yang, and X. Wu, *An ISM approach for the barrier analysis in implementing sustainable supply chain management*, Manag. Decision **55** (2017), no. 8, 1824–1850.

[9] A. Persona, H. Pham, and F. Sgarbossa, *Age replacement policy in a random environment using systemability*, Int. J. Syst. Sci. **41** (2010), no. 11, 1383–1397.

[10] A. Persona, F. Sgarbossa, and H. Pham, *Systemability function to optimisation reliability in random environment*, Int. J. Math. Oper. Res. **1** (2009), no. 3, 397–417.

[11] A. Persona, F. Sgarbossa, and H. Pham, *Systemability: A new reliability function for different environments*. H. Pham (Ed.), Quality and reliability management and its applications, Springer London, 2016, pp. 145–193.

[12] H. Pham, *A new generalized systemability model*, Int. J. Perform. Eng. **1** (2005), no. 2, 145–155.

[13] H. Pham, *Systemability theory and its applications*, I.B. Frenkel, A. Karagrigoriou, A. Lisnianski and A. Kleyner (Eds.), Applied reliability engineering and risk analysis: probabilistic models and statistical inference, Wiley Online Library, 2013, pp. 377–388.

[14] R. Raut, B.E. Narkhede, B.B. Gardas, and H.T. Luong, *An ISM approach for the barrier analysis in implementing sustainable practices*, Benchmark.: Int. J. **25** (2018), no. 4, 1245–1271.

[15] G. Reinhart, R. Lindermaier, R.-G. Gräser, B. Eich, and J. Milberg, *Robust assembly processes as a means of achieving systemability*, CIRP Ann. **45** (1996), no. 1, 7–10.

[16] A. Rentizelas, A.B.L. de Sousa Jabbour, A.D. Al Balushi, and A. Tuni, *Social sustainability in the oil and gas industry: institutional pressure and the management of sustainable supply chains*, Ann. Oper. Res. **290** (2020), 279–300.

[17] R.B. Sánchez-Flores, S.E. Cruz-Sotelo, S. Ojeda-Benitez, and M.E. Ramírez-Barreto, *Sustainable supply chain management-A literature review on emerging economies*, Sustainability **12** (2020), no. 17, p. 6972.

[18] M. Sharma, S. Joshi, M. Prasad, and S. Bartwal, *Overcoming barriers to circular economy implementation in the oil & gas industry: Environmental and social implications*, J. Cleaner Product. **391** (2023), 136133.

[19] V.K. Sharma, A. Sachdeva, and L.P. Singh, *A meta analysis of sustainable supply chain management from different aspects*, Int. J. Supply Oper. Manag. **8** (2021), no. 3, 289-313.

[20] S. Sletten, K. Wangen Jonasmo, and M.C.W. Solheim, *Changing industrial trajectories through business model innovation: a case study of the oil and gas industry in Norway*, Eur. Plann. Stud. **31** (2023), no. 7, 1555–1574.

[21] H. Taghizadeh and M. Ershadi, *Selection in supply chain with combined QFD and ANP approaches (case study)*, Res. J. Recent Sci. **2** (2013), 66–76.

[22] H. Taghizadeh and E. Hafezi, *The investigation of supply chain's reliability measure: a case study*, J. Ind. Eng. Int. **8** (2012), 1–10.

[23] H. Taghizadeh and M. Ziaei Hajipirloo, *Presenting knowledge sharing model with interpretive structural modeling approach (case study)*, J. Executive Manag. **5** (2014), no. 10.

[24] G. Wang, Q. Cheng, W. Zhao, Q. Liao, and H. Zhang, *Review on the transport capacity management of oil and gas pipeline network: Challenges and opportunities of future pipeline transport*, Energy Strat. Rev. **43** (2022), p. 100933.

[25] M. Wetzels, G. Odekerken-Schröder, and C. Van Oppen, *Using PLS path modeling for assessing hierarchical construct models: Guidelines and empirical illustration*, MIS Quart. **33** (2009), no. 1, 177–195.