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# Design and Development of a Value-Based Performance Excellence Model for a Sustainable Power Supply Chain at the National Level: A Comprehensive Approach to Organizational Improvement and Sustainable Development

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**Abstract**
This study examines organizational capabilities as a critical success factor in the electricity industry and analyzes their role in achieving sustainable development. Sustainable development, as a multidimensional concept, requires simultaneous attention to economic, social, and environmental aspects. In this regard, empowering organizations through enhancing effective leadership, strategic thinking, appropriate structure, and strong organizational culture is essential to increase resilience and responsiveness to complex challenges. The research findings indicate that transparency, the adoption of modern technologies, and the enhancement of knowledge and human capital significantly contribute to improving organizational performance and reducing operational risks.Moreover, regional and international collaborations in energy exchange and investment in electricity import and export infrastructures create new opportunities for strengthening the competitive position of organizations. On the other hand, formulating incentive policies and managerial mechanisms to reduce energy losses and increase efficiency can guide employees toward achieving organizational goals, resulting in cost reduction and increased profitability. This study presents a comprehensive framework for developing organizational capacities that can serve as a guideline for managers in navigating the dynamic environment of the electricity industry. Ultimately, the research emphasizes that only through the effective integration of technology, risk management, and human capital development can sustainable development and long-term competitiveness be achieved.

**Keywords:** *Performance excellence, Organizational capabilities, Organizational focus, Sustainable supply chain, Electricity supply chain*

## Introduction

The generation, transmission, and distribution of electricity are foundational pillars of modern society, underpinning economic development, industrial growth, and social welfare. Ensuring a stable and reliable electricity supply has become increasingly complex due to a convergence of factors, including rapid technological advancements, evolving regulatory landscapes, heightened environmental concerns, and the multifaceted expectations

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of stakeholders across diverse sectors such as industry, agriculture, and residential communities. As the energy sector transitions towards more sustainable practices, the need for comprehensive, integrated frameworks that encompass the entire power supply chain has become not only a strategic priority but a necessity for long-term resilience and sustainability (Kabeyi and Olanrewaju, 2022). Despite significant strides in operational efficiency and technological innovation, current performance management models within the energy sector often fall short of addressing sustainability across the entire supply chain. These models tend to focus narrowly on internal operational metrics, overlooking the broader implications of economic, social, and environmental sustainability. This fragmented approach leads to inefficiencies in resource allocation, increased operational risks, and missed opportunities for value creation at both the organizational and societal levels (Kao et al., 2021). Moreover, a critical research gap exists in the integration of performance excellence models with sustainability principles within national-level energy supply chains. Although various studies have examined isolated aspects of sustainable energy practices, few have addressed the holistic integration of sustainability within a comprehensive performance framework. This gap is particularly pronounced in regions where energy stability, economic growth, and environmental protection are intertwined, and where the consequences of an unsustainable supply chain can have far-reaching societal and economic impacts (Ogbu, 2023). Addressing this gap requires a paradigm shift towards a value-based performance excellence model that not only optimizes operational efficiency but also aligns with broader sustainability goals. Such a model should incorporate key organizational capabilities—including leadership, strategic thinking, and knowledge capital—while fostering resilience, stakeholder satisfaction, and social responsibility. By embedding sustainability at the core of performance evaluation, this model can serve as a transformative tool for electricity companies, enabling them to navigate the complex interplay of operational excellence and sustainable development (Permana et al., 2021).

This study proposes a novel framework that integrates value-based performance excellence with a sustainable supply chain approach, tailored specifically to the electricity sector. The model aims to provide a strategic roadmap for enhancing organizational performance while addressing the economic, environmental, and social dimensions of sustainability. By applying this framework to the electricity supply chain in Iran, the research seeks to demonstrate its applicability in real-world contexts, offering insights that can be extended to other national and regional energy systems. Ultimately, this research contributes to the global discourse on sustainable energy by providing a robust, scalable model that aligns with the United Nations Sustainable Development Goals (SDGs), fostering long-term energy security, and promoting a sustainable future for all stakeholders involved.

**Research Contributions**

This paper offers a significant contribution to the field of performance management and sustainable energy by addressing a critical gap in the integration of value-based performance excellence models within

national-level power supply chains. While existing studies primarily focus on either operational efficiency or isolated aspects of sustainability, this research bridges these domains through a comprehensive, holistic framework.

**First**, the proposed model introduces a novel **value-based approach** that aligns performance excellence with economic, environmental, and social sustainability dimensions. Unlike traditional models that emphasize internal efficiency, this framework integrates key organizational capabilities—such as leadership, strategic thinking, and knowledge capital—into the broader context of sustainable development.

**Second**, the model extends the application of performance excellence beyond isolated operational metrics by incorporating the entire **electricity supply chain**, from generation to distribution. This approach not only enhances organizational resilience but also ensures a more sustainable, efficient, and stakeholder-focused energy system.

**Third**, this study provides empirical validation through its application in Iran's electricity sector, demonstrating how the model can be adapted to real-world national contexts. By doing so, it establishes a practical framework that other countries, especially those in developing regions, can adopt to improve energy stability, economic efficiency, and social responsibility.

**Ultimately**, the research contributes to the broader academic discourse on sustainable energy by offering a scalable, adaptable model that aligns with the **United Nations Sustainable Development Goals (SDGs)**, providing a roadmap for long-term energy security and sustainable development. This integration of performance excellence with sustainability principles positions the study as a pioneering effort in redefining how energy companies can achieve both operational and sustainable success.

## Research Background

Wang and Zeng (2017) proposed a functional competence model, building on Nguyen and Zeng's earlier framework, to define organizational knowledge, skills, and needs as key determinants of individual capability within organizations. Their model emphasized aligning organizational structures with environmental factors, such as goals and workforce dynamics, to enhance outcomes.

Aquaye et al. (2018) introduced a model for measuring environmental performance in supply chains using multi-country input strategies, applying it to metal production in BRICS nations. Their findings underscored the impact of imports and economic growth on carbon footprints, offering insights for sustainable development in these regions. Similarly, Bola-Efe et al. (2019) explored value management (VM) in Nigeria's construction industry, concluding that the effective use of VM could enhance sustainability, improve quality, and promote cost efficiency, provided its principles are integrated into organizational practices.

Rehman et al. (2019) investigated the influence of management control systems on organizational performance, highlighting the critical roles of cybernetics, rewards, and compensation. Their findings revealed that management planning and cultural dimensions had limited effects, suggesting targeted interventions for performance improvement, particularly in the textile sector. In a systematic review, Carter et al. (2020) mapped the evolution of sustainable supply chain management (SSCM) research,

noting a shift towards integrating the triple bottom line in logistics. Building on these principles, Mastrocinque et al. (2020) developed a multi-criteria model for SSCM, focusing on the photovoltaic energy sector and its sustainability challenges.

Laurett et al. (2021) identified 25 variables spanning natural farming, innovation, and environmental considerations as measures of sustainable agriculture. Meanwhile, Fietz and Günther (2021) emphasized the importance of adaptive organizational cultures for fostering sustainable development. Peterson et al. (2021) analyzed consumer evaluations of sustainability, finding that customer satisfaction played a central role in support for sustainable business practices.

Politis and Grigoroudis (2022) evaluated contemporary business models, concluding that while some address sustainability challenges, they fall short of becoming universal benchmarks. Dai et al. (2022) examined the interplay between corporate social responsibility, transformational leadership, and sustainability, with findings highlighting the mediating role of cultural change. Similarly, Piwowar-Sulej and Qaisar (2023) reviewed the influence of leadership styles, showing that transformational and sustainable leadership positively impact organizational sustainability.

Recent studies, such as Zhang et al. (2023) and Shinu (2023), explored the effects of green supply chain management and entrepreneurial innovation on business value and sustainability, respectively. Zhang and Li (2024) identified the mediating role of ambidextrous innovation in linking CEO intellectual capital to SME growth, while Almanza Floyd et al. (2024) highlighted health, safety, and human resources as critical for competitiveness and sustainability in manufacturing.

Despite extensive research in sustainability and supply chain domains, there remains a gap in examining the relationship between the Excellence Performance Model (EPM) and sustainability across the entire energy supply chain, particularly in its role in value creation within sustainable frameworks.

## Research Methodology

Value-based models focus on increasing shareholder value, ensuring efficient operations, customer satisfaction, and stakeholder engagement. Implementing such models in utility sectors enables organizations to align their operations with community expectations, thereby enhancing overall effectiveness. By utilizing value-based approaches, companies can define their strategic goals, prioritize initiatives, measure performance, and continuously improve processes.

This research presents a model to assess the performance excellence of electricity supply companies across the entire production, distribution, and transmission chain, incorporating a value creation approach within the context of a sustainable supply chain. Given the lack of studies exploring indicators related to organizational capabilities across the entire electricity supply chain, this research aims to fill that gap. To extract these indicators, the Theme Analysis method and expert interviews were employed. Furthermore, any action taken must be aligned with organizational focus. In this model, the strategies of Iran's electric power companies serve as the primary indicators.

The integration of sustainable development indicators to evaluate performance

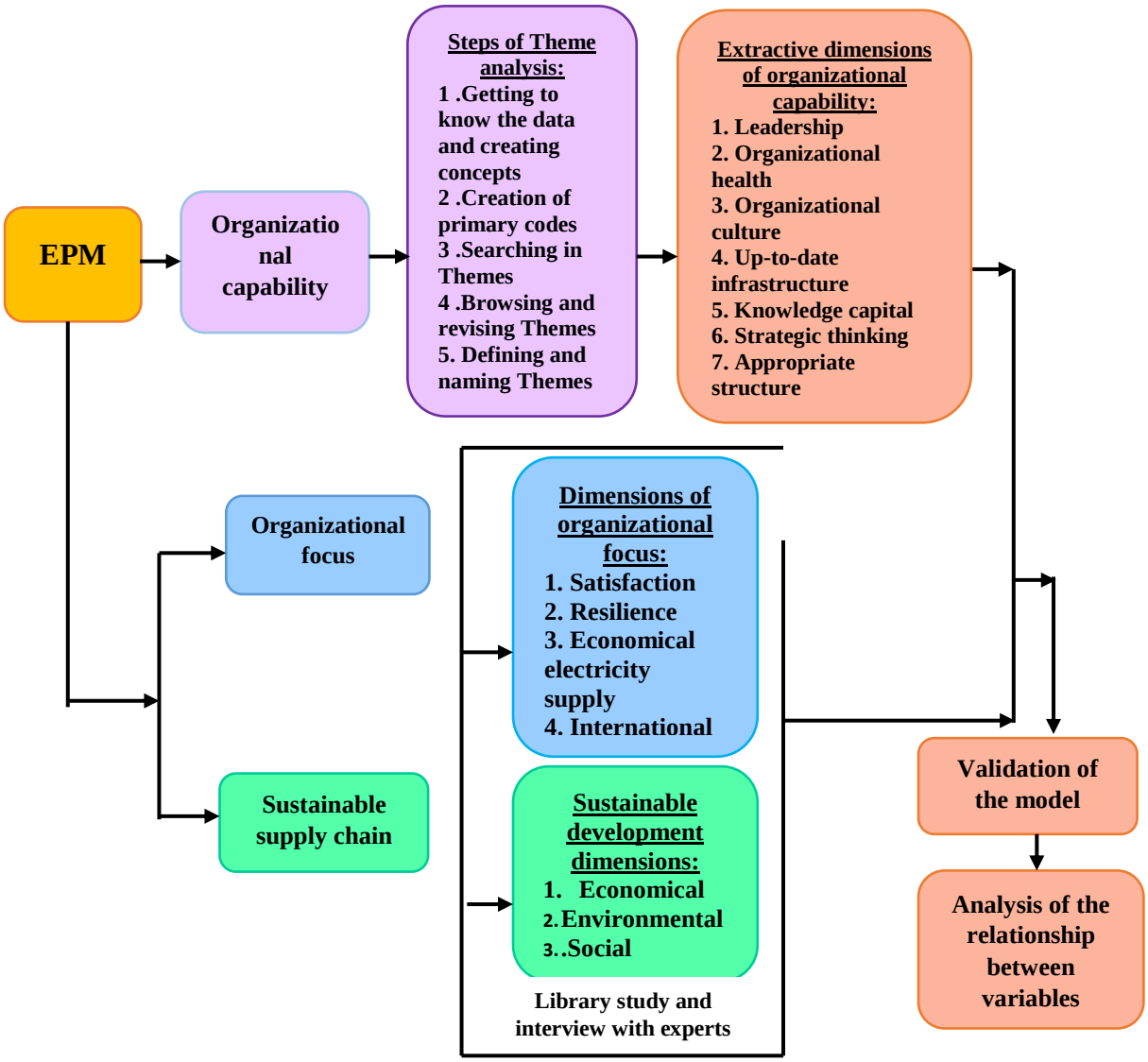
excellence is a key feature of this model, which were developed using library studies and expert opinions. After identifying these indicators, a questionnaire was designed, and pilot analysis, along with confirmatory factor analysis tools such as KMO and Bartlett's test, were employed to measure its reliability and validity. Finally, Structural Equation Modeling (SEM) was applied to investigate the relationships between latent variables, simultaneously considering observable variables.

**Population of the Research**

The **population of the research** in the quantitative section comprises all **employees in the** electricity **sector**, totaling **9,000 individuals**. From this population, a sample of **294 participants** was selected randomly for the study. This sample was chosen to ensure it adequately represents the broader workforce and to enable the generalization of the findings to the entire population of electricity sector employees. Figure 1 illustrates the general stages of the research methodology.

**Figure 1.**

*General stages of the research method (source: research findings)*



## Results

### Thematic analysis

In general, the Theme analysis process has been carried out in five stages as follows:

**First step- Getting familiar with the data and creating concepts:** Qualitative data were collected as audio files and to be mixed with the investigated data, all the interviews were implemented in writing in Word file format. In order to create a deep familiarity with the obtained data, the text of the interviews was read several times.

**Second step- Creating initial codes:** For this purpose, the interview text was converted into paragraphs, additional sentences were deleted; and then, the primary codes were extracted by the researcher. These codes were reviewed and revised by expert experts. This review was done to ensure familiarity with the data. The review was again conducted by an expert in organizational industrial psychology and along with these revisions, reflective notes were created to ensure the reliability of the data at this stage (Braun and Clarke, 2006); Then selective coding was done for each group of expressions that together formed a similar concept.

**Third step- Searching in Themes:** Themes are created through components of ideas that are meaningful if they are examined alone. At this stage, inductive reasoning was used to analyze the data and find the default themes in accordance with the research literature; Therefore, based on the existing performance management system, we expected to find codes consistent with the existing literature on the subject and in order for the analysis to be reliable and follow-up, notes were taken by the researcher; As a result, each of the selected codes that were related to each other formed a sub-theme.

**Fourth step-Browsing and revising Themes:** At this step, in order to ensure that the identified themes have created a coherent pattern, they were checked once again to ensure that these themes accurately reflected the meaning of the data (Braun and Clarke, 2006). Some of the themes overlapped and others had to be divided into smaller themes. For referential adequacy, the obtained themes were compared with the Initial raw data.

**Fifth step - Defining and naming Themes:** This step is focused on naming the themes and the development of the theme stops here (quoted from Noel et al., 2017). To ensure the validity of the data analysis, a human resources expert was asked to review the themes. Finally, all themes were merged under the title of a main theme according to the desired model.

### Statistical example of theme analysis

Since the sample in qualitative research is not representative of the society, therefore its sampling methods are also special and some experts have invented methods for sampling. In this type of researches, more targeted sampling is used and the sample is selected based on the purpose of the research and individual judgment. In this research, the managers and assistants of planning and operation of the three sectors of production, distribution and transmission in the entire statistical population of Iran, who had sufficient expertise and experience, were selected for the interview. Unlike the quantitative research method, where the research samples are determined at the beginning, in the qualitative research methods, the number of samples is determined during the research and continues until it reaches theoretical saturation; this means that no new data is obtained after

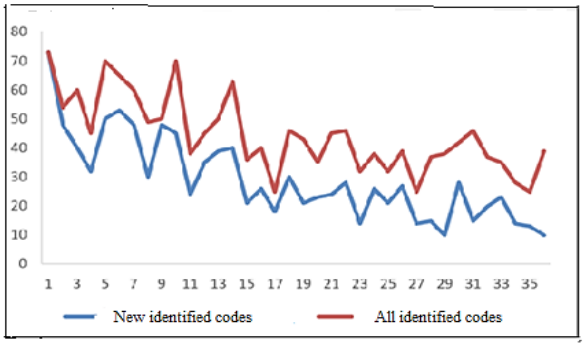
interviewing the participants, which is called theoretical sampling. Table 1 shows the demographic characteristics of the members of this sample.

**Table 1.**
*Demographic characteristics of the thematic survey respondents*

| Characteristic | Level | No. | Percentage | Characteristic | Level | No. | Percentage |
|---|---|---|---|---|---|---|---|
| sex | Male | 30 | 83 | Major | Electrical engineering | 4 | 10 |
| | Female | 6 | 17 | | Electronic Engineering | 6 | 17 |
| Position | manager | 6 | 17 | | Computer Engineering | 6 | 17 |
| | deputy | 10 | 27 | | Industrial Management | 4 | 10 |
| | Senior expert | 16 | 43 | | mechanical engineering | 6 | 17 |
| | expert | 4 | 13 | | chemical engineering | 4 | 10 |
| Work experience | 10-15 years | 4 | 10 | Level of Education | Bachelor | 10 | 28 |
| | 16-20 years | 8 | 22 | | MA | 20 | 54 |
| | 21-25 years | 13 | 36 | | PhD. | 6 | 18 |
| | More than 26 | 11 | 32 | | | | |

To compile the codes, each interview was reviewed separately and the number of each code is shown in Figure 2, that after 36 interviews, the collected data have reached informational saturation. The total number of codes is 136 codes, among which the number of agreements is 62, and as a result, the reliability coefficient for encodings has been calculated as 90.5%; therefore, the analyzed data have the necessary reliability.

**Figure 2.**
*Saturation of qualitative data obtained from interviews*

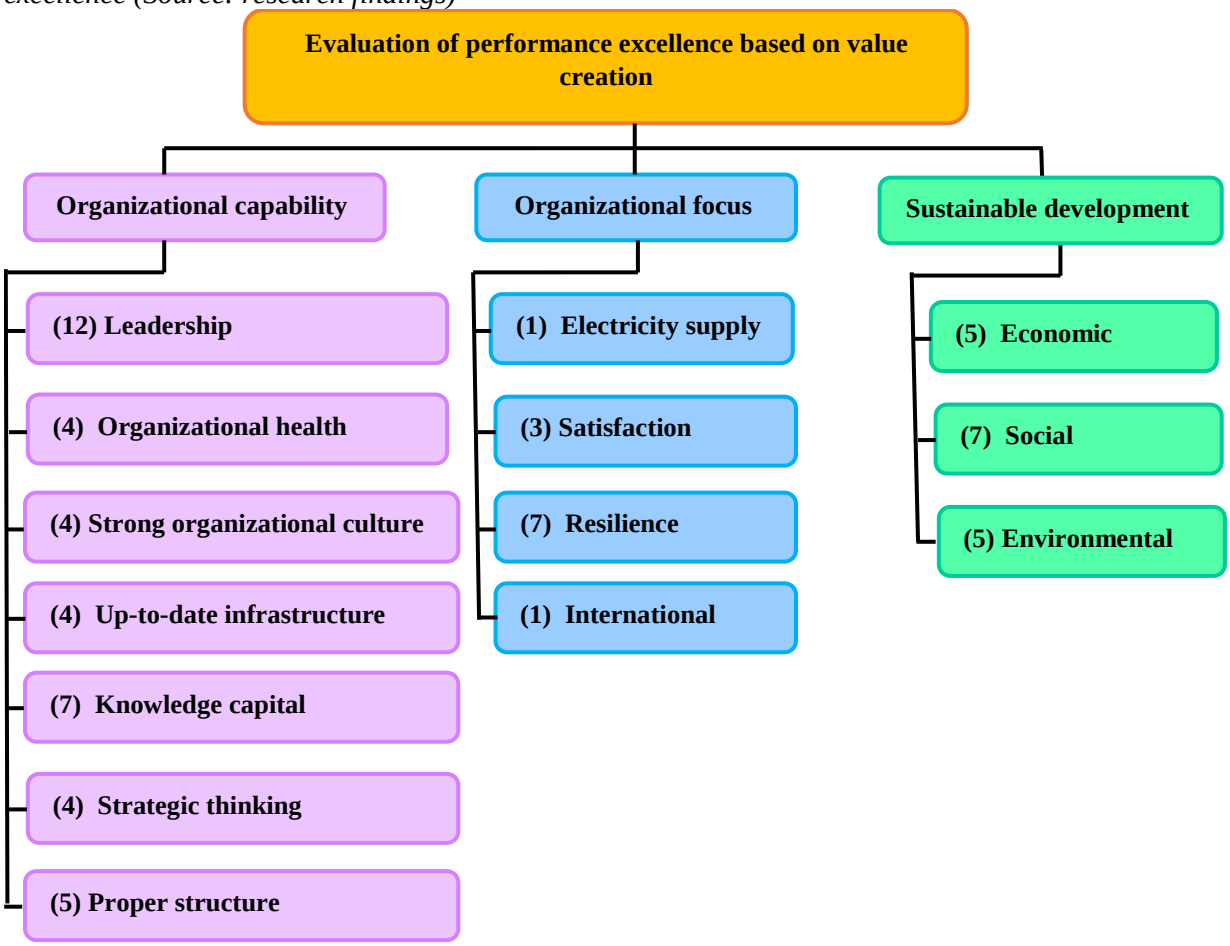



## Identified Factors

In order to measure the organizational capability, after conducting library and document studies, taking advantage of experts' opinions and theme analysis, 40 questions to measure 7 main dimensions including: leadership (effective communication with society), appropriate structure (software), organizational health, strong organizational culture (acceptance of change), up-to-date infrastructure (hardware), knowledge capital (human capital and intellectual capital and knowledge) and strategic thinking were designed. Also, in order to measure the organizational focus, 21 questions were asked to measure the 4 main dimensions of economic electricity supply, satisfaction (increasing the level of satisfaction of subscribers, applicants and other stakeholders), improving resilience (resilience of the network in crises), and international(transformation to the centrality

of electricity exchange at the regional level) and in order to measure sustainable development with three economic, social and environmental dimensions, a 17-question questionnaire was designed. Finally, in the questionnaire, the extent to which Iran's electric power companies enjoy each of the concepts has been asked in the form of questions with a 5-point Likert scale. The scoring method of the questionnaire is 1 (equivalent to too little option) to 5 (equivalent to too much option). Also, the questionnaires were designed as an electronic link and were provided to the main sample of the research. Figure 3 summarizes the main indicators and the number of questions in each section.

**Figure 3.**
*Summary of designed indicators along with the number of questions to measure performance excellence (Source: research findings)*




## Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) is used to assess whether the measured variables of a construct align with the researcher's conceptualizing of the construct. The process involves two steps: confirmatory factor analysis and trust (Thompson, 2004). Essentially, CFA enables researchers to measure the relationship between a latent construct and its observable variables (Hair et al., 2014). The structural and measurement sections are discussed in detail below. In this

study, 44 managers and experts participated in verifying authenticity and reliability. Figures 4, 5 and 6 show the CFA results where all factors are reliable.

**Figure 4.**

Second-order confirmatory factor model of validation of organizational capability questionnaire (Source: research findings)

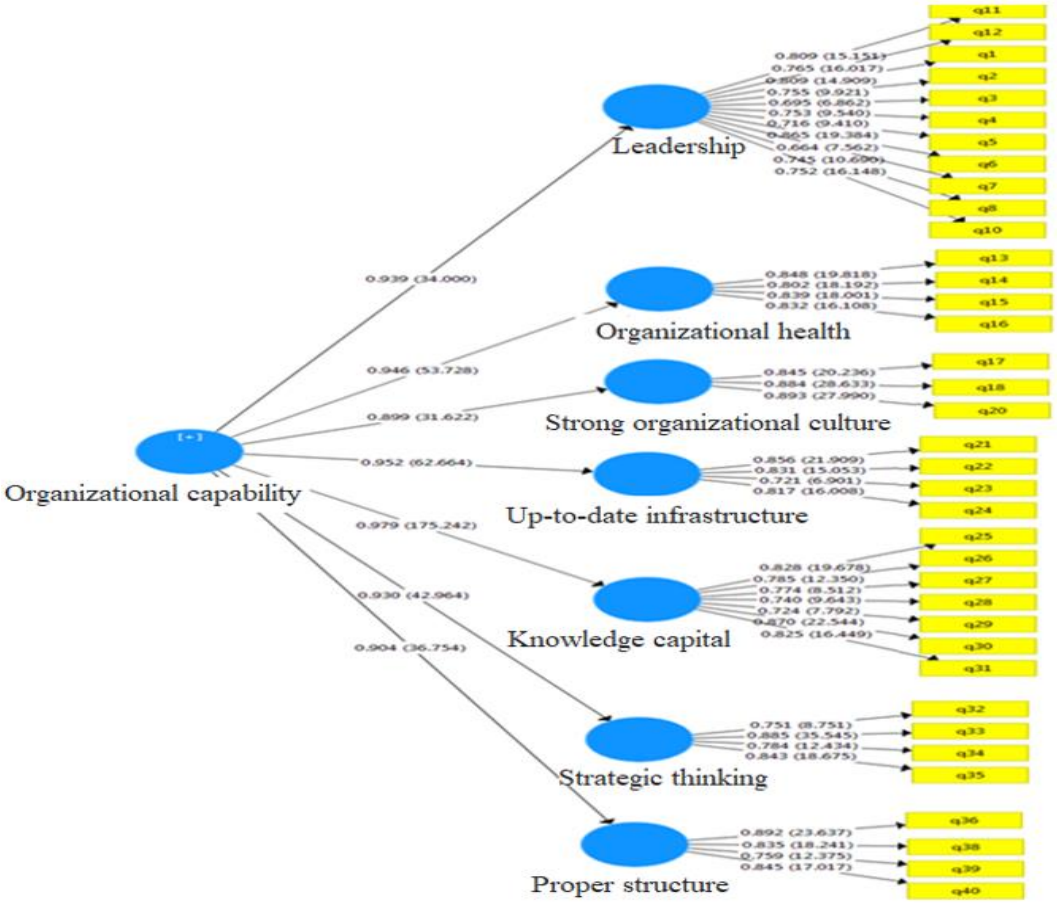


**Figure 5.**

*Second-order confirmatory factor model of validation of Organizational Focus Questionnaire (Source: research findings)*

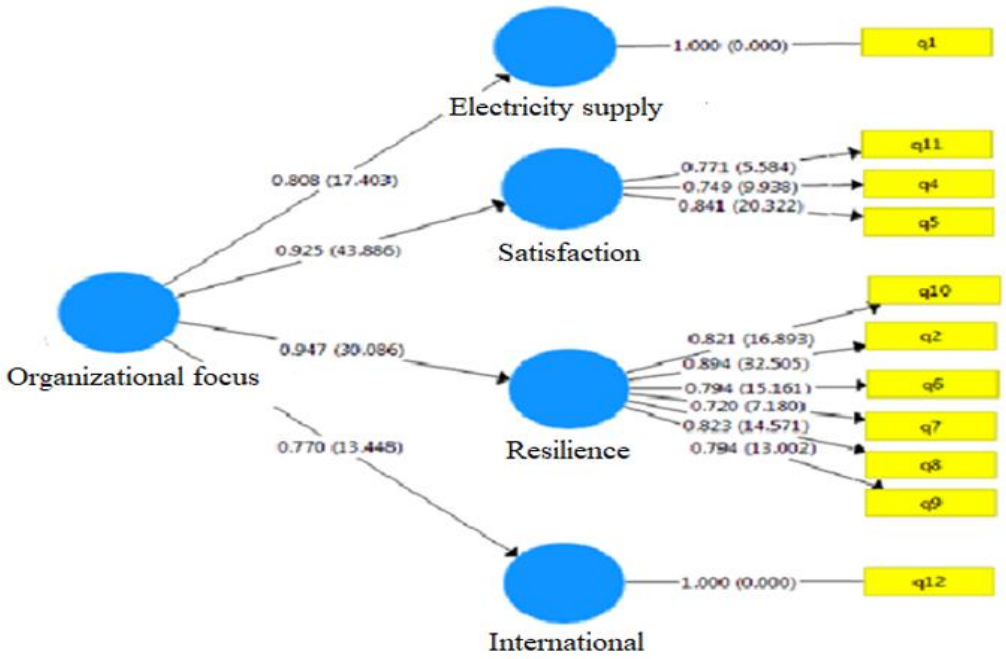
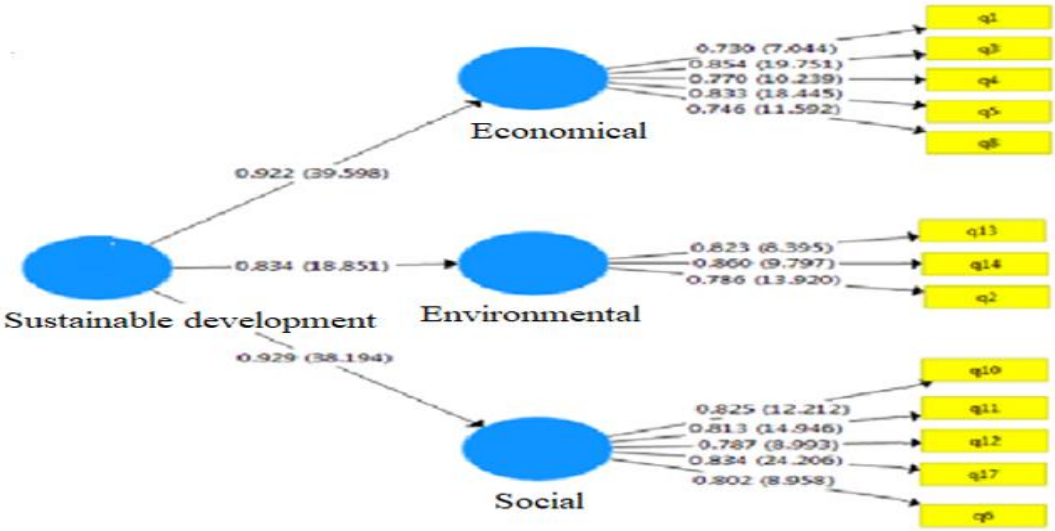



**Figure 6.**

*Second-order confirmatory factor model of validation of sustainable*




Additionally, the convergence of the model is assessed using the average variance (AVE), where all measurements must exceed 0.5 (Hair et al., 2014). To address the second level of the measurement model, Cronbach alpha (CA) and composite reliability (CR) were used to evaluate the reliability of the research model. CA is a method that ensures that the internal reliability of each sample is different and must exceed 0.7 (Cronbach and

Meehl, 1955). The results are shown in Table 2 and all indicators confirm the validity and reliability of the proposed model.

**Table 2.**

*Average variance extracted values, Cronbach's alpha and composite reliability of research constructs (Source: research findings)*

| Structures | Cronbach 's alpha | Composite reliability | Convergent validity (AVE) |
|---|---|---|---|
| Strategic thinking | 0.833 | 0.889 | 0.668 |
| Leadership | 0.926 | 0.937 | 0.576 |
| Up-to-date infrastructure | 0.821 | 0.882 | 0.652 |
| Proper structure | 0.853 | 0.901 | 0.696 |
| Knowledge capital | 0.901 | 0.922 | 0.63 |
| Organizational health | 0.85 | 0.899 | 0.69 |
| Strong organizational culture | 0.845 | 0.907 | 0.764 |
| Organizational capability (total) | 0.979 | 0.98 | 0.875 |
| International | 1 | 1 | 1 |
| Resilience | 0.893 | 0.919 | 0.655 |
| Electricity | 1 | 1 | 1 |
| Satisfaction | 0.700 | 0.831 | 0.621 |
| Organizational focus (total) | 0.927 | 0.922 | 0.749 |
| Social | 0.871 | 0.907 | 0.66 |
| Economy | 0.847 | 0.891 | 0.621 |
| Environmental | 0.763 | 0.863 | 0.678 |
| Sustainable development (total) | 0.939 | 0.924 | 0.802 |

**Structural Equation Model**

The structural equation model is a method for investigating the relationships between hidden variables, which also considers observable variables at the same time. Hidden variables are the main factors that are displayed in a pattern or conceptual model. Observable variables are the same items (speech) or questions related to measuring the main factors. This method is a special causal structure between a set of latent variables and observable variables. Using the structural equation modeling method, the relationships between hidden variables can be investigated with each other, as well as the measurement items of each hidden variable with the relevant variable.

In this section, based on Demorgan's table, 294 samples of experts from different production, distribution and transmission units of Iran's electric power companies were prepared to answer the questions of the questionnaire, which were selected to evaluate the causal relationships between the model indicators. Table 3 shows the demographic characteristics of the members of this sample.

**Table 3.**

*Demographic characteristics of the SEM (Source: research findings)*

| Characteristic | Level | No. | Percentage | Characteristic | Level | No. | Percentage |
|---|---|---|---|---|---|---|---|
| Sex | Male | 284 | 96.6 | Level of Education | Diploma | 1 | 0.34 |
| | Female | 10 | 3.4 | | Associate Degree | 23 | 7.82 |
| Age | 26-35 years | 9 | 3.06 | | Bachelor | 151 | 51.36 |
| | 36-45 years | 102 | 34.69 | | MA | 95 | 32.31 |
| | 46-55 | 143 | 48.64 | | PhD. | 24 | 8.16 |
| | More than 55 | 40 | 13.61 | Work experience | Less than 10 | 1 | 0.38 |
| Area | Production | 98 | 33.33 | | 11-15 years | 12 | 4.08 |
| | Distribution | 116 | 39.46 | | 16-20 years | 108 | 36.73 |
| | Transmission | 80 | 27.21 | | 21-25 years | 125 | 42.52 |
| | | | | | More than 26 | 48 | 16.33 |

In this research, structural equation modeling with partial least squares (PLS) method has been used. The partial least squares method, which is a variance-based approach, needs fewer conditions compared to covariance-based techniques. Four causal relationships have been evaluated in the form of the following hypothesis:

Main hypothesis 1: Organizational capability has an effect on organizational focus.

Main hypothesis 2: Organizational capability has an effect on sustainable development.

Main hypothesis 3: Organizational focus has an effect on sustainable development.

Main hypothesis 4: The electricity industry sector as a moderating variable affects hypotheses and relationships 1 to 3.

The structural equation model according to the research assumptions is presented in Figure 7.

**Figure 7.**

*Structural equation model to investigate the impact of organizational capability on sustainable development with the mediating role of organizational focus (Source: research findings)*


In the following, according to the confirmation of the structural equation model in Figure 7, it is possible to answer the hypotheses of the research by referring to it. In order to respond to the hypotheses of the research, the estimation of the coefficients of direct and indirect paths is used in the structural part of the model. Table 4 shows this.

**Table 4.**

*Findings obtained from the structural equation model to examine hypotheses 1 to 3 (Source: research findings)*

| Hypothesis | Path | Path coefficient | Statisticst | Significance level | Test result |
|---|---|---|---|---|---|
| Organizational capability affects organizational focus | Organizational focus < Organizational capability | 0.786 | 29.911 | 0/0001** | ok ( positive effect ) |
| Organizational capability affects sustainable development | Sustainable development < Organizational capability | 0.455 | 7.574 | 0/0001** | ok ( positive effect ) |

| Hypothesis | Path | Path coefficient | Statisticst | Significance level | Test result |
|---|---|---|---|---|---|
| Organizational capability affects sustainable development | Sustainable development < Organizational focus < Organizational capability | 0.344 | 7.194 | 0/0001** | ok ( positive effect ) |
| Organizational focus affects sustainable development | Sustainable development < Organizational focus | 0.438 | 7.574 | 0/0001** | ok ( positive effect ) |

For example, the standard value of the path coefficient "organizational focus > sustainable development" is 0.438. In other words, it can be said that 19.18% of the sustainable development variable is predicted by organizational focus and it is significant at the 95% confidence level and it can be concluded that organizational focus has a meaningful impact on sustainable development.

Also, according to the coefficient of the indirect path of the independent variable of organizational capability on sustainable development, it can be said that organizational capability has an indirect effect on sustainable development at the rate of 0.344 and because the significance level of the path is less than 0.05, this path is significant at the error level of 0.05 ; Therefore, organizational capability has a significant effect on the dependent variable of sustainable development indirectly and through the mediating variable of organizational focus. In total, the total impact of organizational capability on sustainable development (direct and indirect) is equal to a significant amount of 0.799. In addition, to evaluate the main hypothesis 4, the industry sector variable has been proposed as a qualitative moderating variable and by using the group analysis method, the path coefficients of all three hypotheses have been calculated separately by sections, and then the difference between the groups in each hypothesis has been compared with an appropriate test. Table 5 shows this.

**Table 5.**

*Findings obtained from the SEM comparing the impact of organizational capability on sustainable development (Source: research findings)*

| Hypothesis | Path | Statistics t | Significance level | Significance level of the group analysis test comparing groups | | |
|---|---|---|---|---|---|---|
| | | | | Distribution and Transmission | Production and Transmission | Production and Distribution |
| Main hypothesis1 | Organizational focus < - Organizational capability - Production | 6.619 | 0.0001 | 0.631 | 0.885 | 0.853 |
| | Organizational focus < - Organizational capability - Distribution | 17.232 | 0.0001 | | | |

| Hypothesis | Path | Statistics t | Significance level | Significance level of the group analysis test comparing groups | | |
|---|---|---|---|---|---|---|
| | | | | Distribution and Transmission | Production and Transmission | Production and Distribution |
| Main hypothesis2 | Organizational focus < - Organizational capability - Transmission | 13.399 | 0.0001 | 0.45 | 0.987 | 0.997 |
| | Sustainable Development < - Organizational focus - Production | 3.063 | 0.002 | | | |
| | Sustainable Development < - Organizational focus - Distribution | 7.382 | 0.0001 | | | |
| | Sustainable Development < - Organizational focus - Transmission | 6.016 | 0.0001 | | | |
| Main hypothesis3 | Sustainable Development < - Organizational capability - Production | 8.251 | 0.0001 | 0.697 | 0.022 | 0.005 |
| | Sustainable Development < - Organizational capability - Distribution | 3.422 | 0.0001 | | | |
| | Sustainable Development < - Organizational capability - Transmission | 4.114 | 0.0001 | | | |

The results of Table 5 show that: because the significance level of two-by-two comparisons of the groups in the first main hypothesis, i.e. the effect of organizational capability on organizational focus, is greater than 0.05 in all cases; therefore, there is no significant difference between the impact of organizational capability on organizational focus among different industry sectors; so, the industry sector cannot be a moderating variable in this hypothesis.

Because the significance level of two-by-two group comparisons in the second main hypothesis, i.e., the effect of organizational focus on sustainable development is greater than 0.05 in all cases; therefore, there is no significant difference between the impacts of organizational focus on sustainable

development among different industry sectors; so, the industry sector cannot be a moderating variable in this hypothesis.

Because the significance level of two-by-two group comparisons in the third main hypothesis, i.e. the effect of organizational capability on sustainable development in the production and distribution group and the production and transmission group, is less than 0.05; therefore, there is a significant difference between the impact of organizational capability on sustainable development in the production and distribution sector as well as the production and transmission sector; so, the industrial sector as a moderating variable overshadows the impact of organizational capability on sustainable development.

## Discussion and Conclusion

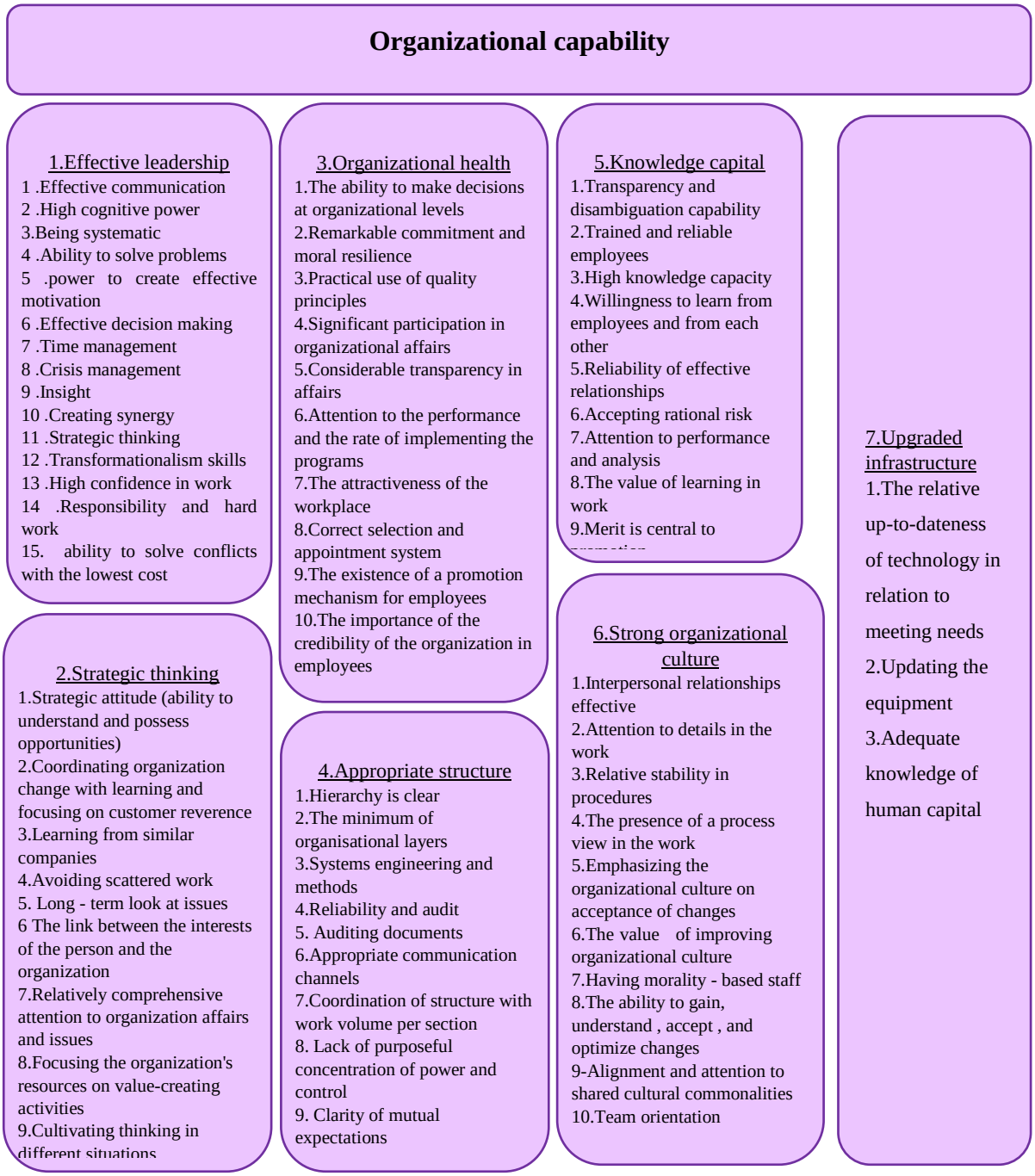
This research makes several important contributions that distinguish it from previous studies in the field of performance excellence in the electricity industry. The key achievements of this research are as follows:

**Comprehensive model for performance excellence:** This study introduces a comprehensive model aimed at enhancing the performance of electricity companies across all three sectors: generation, transmission, and distribution. The model is based on organizational values, encompassing both tangible and intangible factors, and is designed to promote excellence throughout the electricity supply chain. In the proposed model, key organizational capabilities are identified and include various components such as effective leadership, strategic thinking, organizational health, and organizational culture. These characteristics are clearly shown in the figure 8.

**Sustainability in the supply chain**: A significant contribution of this research is the integration of sustainable supply chain dimensions within the performance excellence model. This focus supports clean energy initiatives, enhances the economic efficiency of electricity production, and ensures that the interests of society are considered, a crucial aspect that has been given particular attention in this study.

**Holistic approach to performance excellence**: Unlike traditional models of organizational excellence, which often rely on external, one-size-fits-all frameworks and focus on performance as a mere component of the supply chain, this model addresses the **entire supply chain** (production, transmission, and distribution). It takes a holistic view that reflects the interconnectedness of all stages in the energy supply process.

**Figure 8.**
*Organizational capability indicators (Source: research findings)*




**Customized organizational assessment tools**: One of the unique aspects of this model is the development of a **customized questionnaire** tailored to the specific conditions, structural characteristics, and sensitivities of the organization. This tool effectively measures organizational capabilities, allowing for a qualitative and comprehensive evaluation.

**Long-term strategic focus**: The model incorporates long-term strategic considerations, drawing on insights from senior managers, experts, and practitioners. This ensures that the model is aligned with

the evolving strategies of electricity companies and remains relevant in the future. Figure 9 emphasizes organizational focus in the electricity industry and introduces four key areas:

- Becoming the focus of electricity exchange at the regional level by creating necessary infrastructure for electricity export and import, and entering power plant construction in regional countries.
- Improving network resilience in crises through optimization and development of infrastructure, diversifying the profitability of electricity investments, and network automation.
- Improving the level of satisfaction of subscribers and stakeholders by proper supply and demand management and focusing on safety principles.
- Economical electricity supply by continuously reducing grid losses, ensuring uninterrupted service delivery, and minimizing outages.

This Figure highlights that organizational focus is a crucial factor in enhancing performance and achieving sustainable development in the electricity industry, playing a key role in network optimization and stakeholder satisfaction.

**Social responsibility and justice-oriented approach**: A distinctive feature of this model is its emphasis on **social responsibility**, promoting a justice-oriented approach. It emphasizes the importance of sustainable benefits, both material and non-material, and upholds universally accepted transcendental values that align with the principles of sustainable development.

**Figure 9.**
*Organizational focus indicators (Source: research findings)*

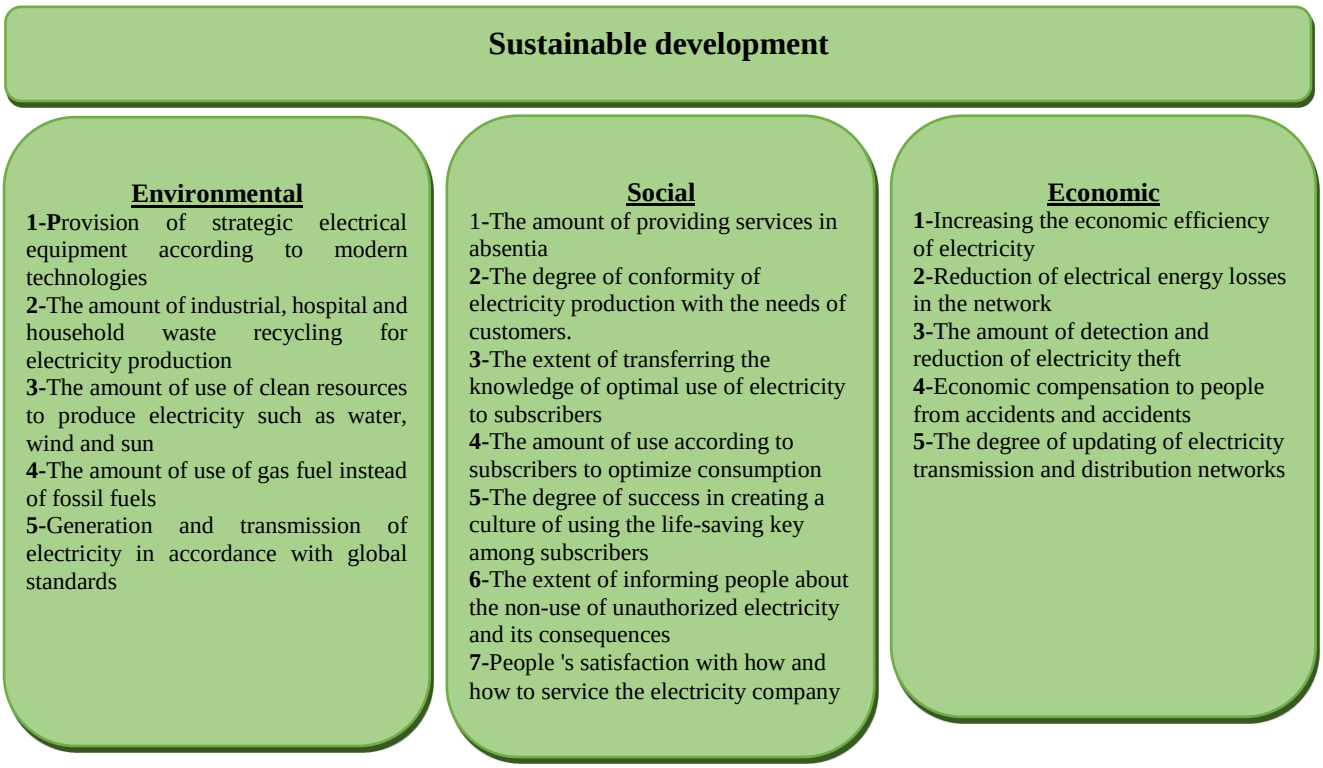
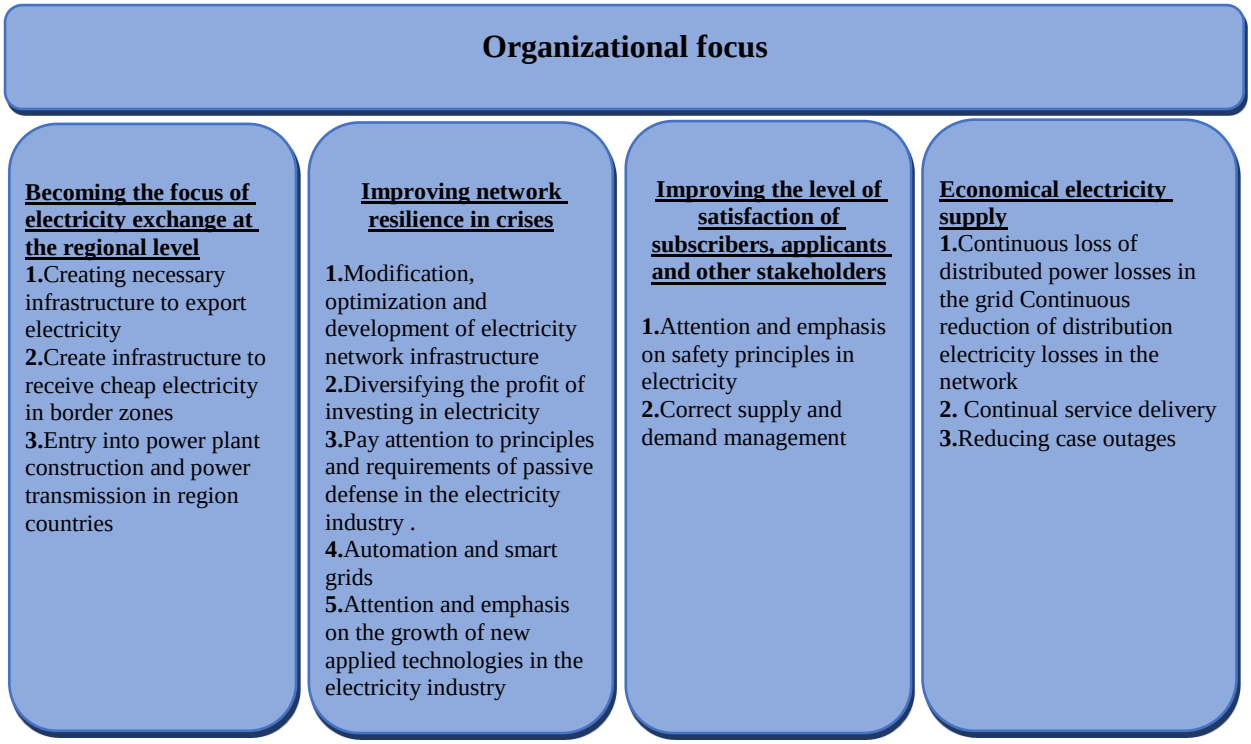


**Figure 10.**
*Sustainable development indicators (Source: research findings)*




**Quantitative measurement of sustainable development**: This model provides a clear framework for measuring the impact of organizational capabilities and focus on sustainable development. Through expert interviews and surveys, key pillars of sustainable development were identified, and statistical methods were employed to quantify the relationships between these factors, revealing the distance between the current state and the desired level of organizational excellence. Figure 10 illustrates the three main dimensions of sustainable development: environmental, social, and economic, each defined by specific and relevant indicators. These indicators are designed to assess the performance of electricity companies in the context of a sustainable supply chain. The primary goal of this model is to integrate sustainable development into the processes of electricity generation, transmission, and distribution, thereby reducing environmental impacts, improving social interactions, and increasing economic efficiency. This image effectively demonstrates the essential role of the proposed model in balancing economic, social, and environmental objectives.

**Value engineering techniques**: In addition to its focus on performance excellence, this research highlights the **application of value engineering techniques** across various parts of the industry. The findings provide a solid foundation for the implementation of value engineering practices to enhance operational efficiency and sustainability.

## Sector-specific moderation effects

The findings of this research indicate that the **industry sector** plays a significant role in moderating the relationship between organizational capabilities, organizational

focus, and sustainable development; specifically, the following can be stated:

■The industry sector does **not moderate the relationship between organizational capability and organizational focus**. This suggests that organizational capability holds equal importance across various industry sectors, as its effect on organizational focus does not vary significantly between sectors.

■However, the industry sector does **moderate the relationship between organizational focus and sustainable development**. This indicates that the impact of organizational focus on sustainable development differs among sectors, likely due to varying market conditions, regulatory environments, and resource availability.

■Most notably, the **industry sector significantly moderates the effect of organizational capability on sustainable development**. The influence of organizational capability on sustainable development is stronger in certain sectors, such as the production sector, compared to others like transmission or distribution. This highlights the need to consider sector-specific dynamics when assessing the effectiveness of organizational capabilities in achieving sustainable development.

Overall, the results emphasize the importance of considering the unique characteristics of the electricity industry sector when analyzing the interplay between organizational capability, organizational focus, and sustainable development. The sector-specific factors, including market conditions, regulatory frameworks, and technological advancements, play a critical role in shaping how these variables interact and influence each other. The model proposed in this research offers a comprehensive and adaptable framework that can be utilized to drive improvements in performance excellence and sustainability across the electricity supply chain.

## Managerial Recommendations

To enhance the performance of organizations operating in the electricity sector and achieve sustainable development, it is essential to reconsider managerial strategies from not only an economic perspective but also social and environmental dimensions. This requires adopting innovative management approaches with a focus on integrating advanced technologies, risk management, and human capital development. Therefore, senior managers are advised to systematically redesign their structures and processes, establishing new frameworks aimed at long-term efficiency and sustainability.

First and foremost, strengthening an organizational culture based on sustainable values can serve as a crucial factor in improving overall organizational performance. Creating an environment where transparency, fairness, and accountability are embedded at all managerial levels will not only boost employee motivation but also foster innovation and teamwork. Furthermore, continuous performance evaluation based on comprehensive and multidimensional indicators enables managers to assess not only economic efficiency but also the social and environmental impacts of their actions, allowing for necessary improvements.

The utilization of modern technologies such as smart grids, big data analytics, and advanced automation systems is another recommended strategy that can enhance the resilience of electricity networks during crises. By leveraging these technologies,

organizations can improve efficiency and prevent potential crises while simultaneously reducing operational costs. Coupled with the development and implementation of comprehensive risk management policies, this approach can significantly reduce organizational vulnerabilities and enhance the speed of emergency responses.

Moreover, international and regional collaborations in the field of energy exchange will create new opportunities for expanding electricity markets. Investing in the necessary infrastructure for electricity export and import, as well as participating in joint projects with neighboring countries, can strengthen the organization's competitive position in global markets. Additionally, prioritizing investment in employee training and capacity building as a cornerstone of sustainable development should remain a top priority for managers. This approach not only increases productivity but also enhances the organization's competitive ability in adapting to environmental changes.

Finally, the development of incentive policies aimed at improving efficiency and reducing network losses can motivate employees to strive towards achieving organizational goals, thereby reducing costs and increasing profitability. By integrating innovative management approaches and making intelligent use of resources, organizations in the electricity sector can achieve sustainable development and long-term competitiveness.

## Research Limitations

This research encountered several limitations that should be considered when interpreting the results. First, the focus of this study on the management of Iran's electricity industry may limit the generalizability of the findings to other countries. Second, the study only examines the relationship between organizational capabilities, organizational focus, and sustainable development indicators, without considering other potential factors or variables that might influence these relationships. Additionally, the possible impacts of external or contextual factors on organizational capabilities and sustainable development indicators were not investigated.

Finally, it is recommended that researchers in other countries, especially those in developing countries, validate these models to establish a foundation for comparison and the development of effective standards. It is important to note that the proposed model should not be used as a direct decision-making tool but rather as a support mechanism in the decision-making process. Given the diversity of managerial solutions, varying perspectives on performance evaluation criteria, and unique mental models, achieving a universally accepted standard model for performance evaluation is not feasible. Therefore, the framework and research direction in this field remain open to interpretation and adaptation by managers.

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**Availability of data:** All the data of this manuscript are available and will be provided if needed.

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**RESEARCH ARTICLE** **Open Access**

# Designing a Model to Identify and Rank the Factors Influencing the Selection of Suppliers of the Iran Steel National Industrial Group

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**Abstract**
The aim of the current research was to design a model for identification and ranking of factors influencing the selection of suppliers of Iran's National Steel Industrial Group. In terms of the method, the current research is part of the descriptive research and based on its main purpose, it is an exploratory and confirmatory study, and in terms of the applied purpose. The framework used is a combination based on multi-criteria methods. In this regard, based on the research literature and experts' opinion, evaluation criteria and the selection of the appropriate supplier are determined using the Delphi method. After filtering the criteria, based on the DEMATEL technique, the desired criteria affecting the evaluation and selection of suppliers will be determined and the relationship between them and the modeling of these relationships will be done. In the third step, the ANP method is used to weight the criteria. Finally, in the fourth stage, the questionnaire to determine structural modeling relationships is completed by the experts of the organization and using the data obtained from the questionnaires, the method of structural equations is used to confirm the exploratory model. The technique used in the current research was an in-depth interview-Delphi method, a statistical population of 10 knowledgeable experts on the subject of the research, and a non-probability chain sampling method. The results of the research showed that the factor of product authenticity and compliance with the standards and requested analysis of the product are in the first rank and the factors of authentic or exclusive representative of goods and after-sales services (guarantee and warranty) are in the second and third ranks, respectively.
Keywords: *MCDM, DEMATEL, Supply chain, Steel industry, Network analysis process*

## Introduction

Today's companies are facing intense competition. Competition makes companies increasingly use new applications to improve quality and reduce costs and production time. Therefore, producers must be coordinated with the dynamic conditions of the market and be receptive to change (Klein, 2023). In today's business world, companies cannot compete without close cooperation with external partners. The concept of supply chain management emerged in this direction and seeks to optimally manage the physical and informational flows that are exchanged between actors of the supply chain (Kumar & Shankar, 2024). Supply chain management is a complex concept and a system that includes three key parts: the supply focus on obtaining

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raw materials for the manufacturer, the manufacturer's focus on converting the obtained raw materials into the final product, and the distribution focus on delivering products to customers through distributors, warehouses and retailers (Liu et al., 2024).

An important point that should be noted is that, basically, in order to maintain competition in the market, the producer should first focus on reducing production costs and production time cycle. Therefore, companies must outsource many parts of their products to suppliers (Rossi et al., 2023). Suppliers are significantly important for the company due to their role and overall impact on the competitiveness of supply chains. Therefore, the evaluation and selection of suppliers is considered a critical issue from the management and operational point of view, and achieving the competitive advantage of the companies, the goals of the entire supply chain, reducing the purchase costs and supply risk and increasing the product quality (Wu et al., 2024; Silvestri et al., 2024; Mollashahi et al., 2024). In the process of choosing the right suppliers, the buyer can provide the required parts and services with the right quality, the right price, the right amount and the right time. For this reason, in order to choose the right suppliers, their performance must be evaluated. The evaluation includes categorizing the supplier's performance based on a set of positive, negative or neutral criteria is possible (Torabi & Heidari, 2023). Therefore, evaluating suppliers and selecting the best ones is a basic and complex decision-making problem with the aim of reducing the initial number of potential suppliers to the final options (Kiani et al., 2023; Amini et al., 2023).

Since the process of evaluating and deciding on the selection of suppliers is based on multiple quantitative and qualitative criteria, the process of selecting a supplier is a multi-criteria issue that is based on subjective criteria, based on individual opinions and experiences, available information. And sometimes it is solved based on techniques and algorithms supporting the decision process (Amini et al., 2023). On the other hand, since decision-making is a very complex process based on several indicators, criteria and goals, it is inherently a difficult issue, especially since the information that is the basis for decision-making is often vague and incomplete. To overcome this difficulty, logic and fuzzy method are used in multi-criteria decision making process. Despite the large volume of studies in the field of supplier evaluation and selection, there is a great void and lack of comprehensive studies of the supply chain in the steel industry, especially in Iran's steel industries.

The steel industry is one of the leading industries in the world and one of the basic and strategic industries of the world. It is one of the important and influential goods in the industrial growth and development of countries, it is called the mother industry. After oil and gas, steel is the second largest commodity in global trade, and a large number of industries such as transportation, construction, machinery manufacturing, mining and other industries related to energy production and transmission are dependent on the steel industry. Therefore, the improvement and development of steel is of special importance in the economic development of countries. In terms of steel production conditions, Iran has many relative advantages, which ranks 15th in the world

with an annual production of 16 million tons of steel (Morshedi & Nezafati, 2021). National Steel Industrial Group of Iran is also considered one of the largest steel producers in Iran, which was established in Ahvaz city in 1342 as the country's first steel rolling mill to produce all types of plain, ribbed and corner rebars. Now this huge complex is one of the important exporters of steel products, while providing a major part of the country's needs (Shahpouri et al., 2024).

As can be seen, the role of the supply chain in the steel industry is very significant, and on the other hand, National Steel Group has a special role in Iran's economy. However, in the field of comprehensive investigation of the supply chain in the National Steel Group, no comprehensive, scientific and preparatory study has been conducted and this company still lacks a model for selecting suppliers. Therefore, in this research, an attempt is made to design and present a model to identify and rank the factors influencing the selection of suppliers of Iran's National Steel Industrial Group.

## Literature Review

### Supply chain

Supply chain is a network of processes aimed at supplying goods and services. This chain includes suppliers, manufacturers, distributors and sellers who cooperate in a coherent manner in order to increase the level of customer satisfaction (Sadri etal., 2024). Supply chain is a dynamic entity that contains information, product and financial flows. The term supply chain refers to the flow of materials and products, information and money that flows from customers to retailers, then to distributors/wholesalers, then to the final product manufacturer and finally to suppliers and vice versa (Chaudhuri et al., 2023). The important point in this regard is to check the performance of the supply chain. In this regard, it should be acknowledged that the proper functioning of the supply chain plays a key role in the success of an organization and the sustainable achievement of its goals and especially its profitability (Jahangiri et al., 2023). Supply chain performance refers to the broad activities of the supply chain to meet customer requirements, which include the ability to access products and services, timely delivery and timely performance of services, inventory and capacity in the supply chain for proper performance to meet the needs of the final customer (De Moor et al., 2024). Supply chain performance transcends company boundaries; Because it includes the main materials, parts, subassemblies and final products and services and their distribution through different channels to the final customer (Mahmoodi et al., 2023). In the same way, the performance of the supply chain cuts the functional boundaries of the organization, such as procurement, production, distribution, marketing and sales, and research and development. In this regard, a big challenge is how to evaluate the performance of business chain activities in front of companies and organizations (Helli et al., 2024).

### Making a decision in the field of supplier selection

Decision-making issues in the field of supplier selection have attracted a lot of attention due to the increase in competition between companies, and companies are forced to choose suitable suppliers and maintain and continue the relationship with them. Are Basically, the theories and discussions raised in the field of supplier

selection are mainly focused on two important issues: first; Identification of evaluation criteria and decision-making methods (Ahmadpour et al., 2023). In the field of criteria selection, decision-makers must carefully select the criteria that reflect their competitive priorities, ideals, and goals due to the fact that they are faced with multiple and sometimes conflicting criteria (Keyhanizadeh, 2024). In this context, Burgess et al. (2023) believe that important criteria such as past performance, production facilities and ability, price, technical ability, financial situation, communication system, reputation and position in the industry, interest in business, organization and management, Operational controls, agreement or compatibility, history of working relationships, amount of past transactions, training facilities, reciprocal arrangements are effective. They believe that the nature of purchase is effective in determining the type and importance of factors in selecting and providing suppliers (Burgess et al., 2023). Some other theoreticians have also come to the conclusion that among these criteria, the quality, price and delivery performance of suppliers are the most important promotional and patronage criteria in industrial markets (De Meyer et al., 2024; Romano et al., 2023).

In the following, new standards were introduced and discussed in this regard. For example, Ersahin et al. (2024) criteria such as supplier's support for the product, supplier's reputation, product quality, increase in credit by the supplier, personality of sellers, friendly relations with suppliers, closeness of suppliers, improvement of the organization By the supplier, reciprocal transactions, the behavioral image with the supplier were evaluated as very important in this regard (Ersahin et al., 2024). Also, Xu et al. (2023) have also introduced five criteria as the main supplier evaluation criteria, which are: stability of the supplier, basic economic criteria, geographic proximity, and product-related services (Xu et al., 2023). From the point of view of Chaudhuri et al. (2023), evaluation and supplier selection criteria are classified into four groups, which are: technology issues, financial criteria, organizational culture and strategy, and financial criteria. Finally, based on the view of Junaid et al. (2023), a supplier selection and evaluation system based on four indicators of quality, timely delivery, price, and services will be able to be reviewed and evaluated (Junaid et al., 2023). In relation to decision-making methods, some researchers used classical methods such as Analytical Hierarchy Process (AHP), Network Analysis Process and TOPSIS to solve supplier selection problems with clear numerical evaluation information. In this regard, Maretto et al. (2022) using the application of AHP in the selection of suppliers in the communication system showed that hierarchical analysis can help improve group decision-making in the selection of suppliers that improves the customer's situation. slow down On the other hand, due to the systematicity of the purchase decision process, using the proposed AHP model reduces the time required for supplier selection. It should also be acknowledged that due to the complexity of decision-making issues, decision-making information is more ambiguous than before. In this regard, da Silva and colleagues believe that linguistic variables such as reputation are suitable for describing quantitative evaluation information. Many fuzzy decision-making methods have been

proposed to convert linguistic variables into triangular fuzzy numbers (Da Silva et al., 2023).

-Wulandari et al., (2024) in an article titled: "Hybrid MCDM Career Recommendation System for Information System Student Using AHP, VIKOR and Weighted Euclidean Distance" showed that the approaches used in this research are AHP, VIKOR, and weighted Euclidean distance. Subsequently, the TOPSIS method is used as a comparison to VIKOR. The consistent weights from AHP are used to calculate the course ideal mark and the weighted Euclidean distance score. By using AHP weight for VIKOR and TOPSIS calculation, there are differences in the results of the top alums, which their course mark used as the benchmark for the ideal score. AHP-VIKOR method gives higher ideal course mark compared to AHP-TOPSIS in some of the courses. Suggestions to students are given based on calculating the closeness of student marks to ideal marks on each specialization track.

-Acar et al., (2024) in an article titled: "Sustainable stationary hydrogen storage application selection with interval-valued intuitionistic fuzzy AHP" showed that the evaluation criteria are derived from four dimensions of sustainability: economic, environmental, social, and technical performance, each further decomposed into sub-criteria. The study's novelty lies in using a novel intuitionistic fuzzy AHP, offering a more nuanced and robust understanding of the trade-offs between the various options and effectively capturing the vagueness and subjectivity inherent in human decision-making. Through this methodology, CHG emerged as the most promising option with a preference score of 0.487, closely followed by UH with a score of 0.453. The lowest preference score was accorded to MH, with a score of 0.301. These quantitative insights underscore the relative sustainability performance of each technology under the defined criteria. The findings contribute to the growing body of literature on sustainable hydrogen storage, providing policymakers and practitioners with a multicriteria decision-making tool that captures the complexity of sustainability considerations. This study underlines the critical role of holistic, multicriteria evaluations in advancing sustainable hydrogen storage.

-Muerza et al., (2024) in an article titled: "Selection of an international distribution center location: A comparison between stand-alone ANP and DEMATEL-ANP applications" showed that the both approaches rank the alternatives similarly, although they assign varying degrees of importance to decision criteria. The research was constrained by a limited number of alternatives and respondents, as well as imprecision in human judgments. Future research will explore additional sustainability and social criteria, more alternative locations, and incorporate fuzziness for a more comprehensive selection of the optimal International Distribution Center (IDC) location.

-Mizrak et al., (2024) in an article titled: "Prioritizing cybersecurity initiatives in aviation: A dematel-QSFS methodology" showed that "Regulatory Compliance" and "Threat Detection Systems" are the most influential factors, emphasizing the need for strict adherence to standards and advanced threat detection capabilities. Additionally, the significance of "User Training" and "Data Encryption Protocols" underscores the importance of comprehensive training

programs and strong encryption measures. By incorporating strategic management theories such as the Resource-Based View (RBV), Contingency Theory, and Risk Management Theory, this study presents a strategic framework to assist aviation organizations, policymakers, and researchers in developing effective cybersecurity strategies, ensuring the safety and security of global air travel.

-Shanta et al., (2024) in an article titled: "Municipal solid waste management: Identification and analysis of technology selection criteria using Fuzzy Delphi and Fuzzy DEMATEL technique" showed that 14 criteria were categorized as causal elements that have the most significant influence on the MSWM technology selection process and 7 criteria were categorized as effect. The selection of MSWM technology demands greater consideration of the top three ranked criteria, namely T4- Access to Technology (AT), T8-Feasibility (F), and the Ec6-Infrastructure requirements (IR). By identifying the pertinent criteria, structures and interrelationships, the outcome of the study can facilitate a better understanding of causal relationships among the criteria that require specific consideration from the decision-makers and allow them to select appropriate MSW management technology.

-Pang et al., (2024) in an article titled: "Key Factors Influencing Sustainable Population Growth: A DEMATEL-ANP Combined Approach" showed that with a data volume of 4000, the optimized model achieves an accuracy of 0.973, precision of 0.981, recall of 0.969, and an F1 score of 0.89, demonstrating the model's superior performance. The DEMATEL method analyzes the direct relationships among the factors. The results show that economic development and technological advancement have impact scores of 3.91 and 3.43, respectively, indicating their strong influence on other factors and their role in promoting sustainable demographic growth. Education and gender equality, health services, and technological advancement each have impact scores of 3.39, meaning they are significantly affected by other factors and are sensitive in the growth process. Finally, the ANP method is used to calculate the weights of each factor, determining their relative importance in sustainable social demographic growth. The results highlight that economic development level and technological advancement and innovation are core factors influencing sustainable social demographic growth, with significant direct and indirect impacts on other factors and a crucial role in the overall system.

-Taebi et al., (2024) in an article titled: "Identification and prioritization of suitable supplier selection criteria based on the four dimensions of sustainability with a multi-criteria decision-making approach" showed that the price and economic benefit have the most value for the organization, and then the control of water consumption, energy and resources, research and development and green innovation, transparency of information and preservation of work values and ethical principles are more important than other criteria. Managers can use the results of this research to evaluate and select a sustainable supplier.

-Gholamian (2024) in an article titled: "A multi-objective model based on group decision-making and interval-valued Pythagorean fuzzy sets for the supplier selection and order allocation problem" showed that the new decision support system

uses three steps in order to evaluate and select suppliers of the problem, which are: In the first step, indicators and decision-making options were extracted through research background checks, interviews with experts, and documents available in the organization. In the second step, by implementing the data coverage analysis model, the decision-making options were ranked and the effective units were identified. Finally, in the third step, with the implementation of UTASTAR, the efficiency of Sapco's efficient units was determined in order to select the most favorable supplier.

-Keshavarz-Ghorabaee (2024) in an article titled: "Evaluation and selection of a sustainable supplier by providing a decision support system based on a new data envelopment analysis model and cumulative star utility" showed that the performance of the proposed approach in solving the supplier selection and order allocation problem.

-Nasri et al., (2023) in an article titled: "Defining and prioritizing criteria for sustainable supplier selection in the oil and petrochemical industry (case study: National Iranian Oil Company)" showed that the weights of each criterion related to sustainable supplier selection are extracted by the ANP method. It has been concluded in this study that when selecting suppliers for the oil industry, decision-makers should pay attention to both financial indicators and environmental indicators.

-Sayyari et al., (2023) in an article titled: "Strategic International Business Innovation:A New Approach in Development of Iran's Pharmaceutical Industry)" showed that causal conditions with (0.39), contextual conditions with (0.55), and intervening conditions with (0.34) have an effect on strategies, and strategies have an effect on outcomes with (0.85).

The investigation of the background of the research shows that, firstly, in the important and influential steel industry, the dimensions of identification and ranking of factors affecting the selection of suppliers have not been done, and secondly, most of the issues raised are general and may not meet the specialized needs of the steel industry. In this regard, it seems that other important dimensions can also play a role in identifying and ranking the factors influencing the selection of suppliers of Iran's National Steel Group Company, which is evident in previous researches, and this indicates the existence of a theoretical gap in this field.

## Methodology

This study is an exploratory and confirmatory study with the aim of designing and evaluating the structural model of the factors influencing the selection of suppliers of Iran's National Steel Industrial Group, therefore, in terms of practical purpose and in terms of method, it is included in the category of descriptive-superior research. The framework used in this research is a combined method based on multi-criteria methods. Because there is a degree of uncertainty in decision-making, which is caused by the subjective evaluation of qualitative or quantitative criteria by several decision-makers, it is preferred to use fuzzy logic to resolve the ambiguity, because despite the ambiguity and uncertainty, traditional approaches are ineffective. Basically, fuzzy logic and theory in the supplier selection process enables researchers to model the multi-criteria decision making process using incomplete or ambiguous information of the decision

makers (Bazargan, 2024). Therefore, based on research literature and experts' opinion, evaluation criteria and selection of suitable supplier are determined by Delphi method. After filtering the criteria, based on the DEMATEL technique, the desired criteria affecting the evaluation and selection of suppliers will be determined and the relationship between them and the modeling of these relationships will be done. In the third step, the ANP method is used to weight the criteria. Finally, in the fourth stage, the questionnaire for determining structural modeling relationships is completed by the experts of the organization and using the data obtained from the questionnaires, the method of structural equations is used to confirm the exploratory model (Mason, 2023).

The technique used in this studyis an in-depth interview-Delphi method. In this regard, we should briefly mention that the Delphi technique is used in cases where, due to the existence of conflicting and insufficient facts and information about a particular subject, there is a need for separate ideas and judgments of people about a subject. The structured process should be turned into a single result agreed upon by them. The Delphi method can be done with the cooperation of people who have knowledge and expertise in the research topic and provide valuable ideas. These people are known as the Delphi panel. The most important difference between the Delphi method and other joint decision-making methods is the expertise of experts who do not directly communicate with each other. The selection of experts for the Delphi panel is one of the most important steps of this method. Unlike quantitative surveys, these people are not selected based on probability sampling. Because the Delphi technique is a qualitative approach, not a quantitative one. This technique is a simple and practical method for group decision-making and requires experts who have a deep understanding and knowledge of the research topic and are committed to completing the questionnaire in successive rounds. In this case, people are selected in order to use their knowledge in a specific problem and based on indicators that originate from the nature of the subject and research problem (Gall, 2023). When the researcher does not know all the necessary people to be a member of the panel, the chain sampling method is used, which is one of the non-probability methods. In this method, the researcher first identifies a person or a group of knowledgeable people and through them reaches other suitable people. This work continues until the opinions are close to each other and the answers are almost similar. As a result, 10 people were identified as experts from Iran's National Steel Group using the Delphi method, and interviews were conducted with them, and in these interviews, they were asked to give their opinions about the factors influencing the evaluation and selection process. The suppliers of the organization should state in detail. Finally, 10 factors resulted as the most effective factors, which are: price and cost of transportation, delivery time, product authenticity and compliance with the required standards and analysis of the product, product quality, supplier's resume, sending samples or the possibility of testing specialty products. and ordering before the full delivery of the order, after-sales services (guarantee, warranty), supplier's responsiveness (at the stage of returning, inquiry and placing an order or tracking the shipment of goods), product packaging, having a valid or exclusive

representative. In Table 1, the demographic characteristics of the interviewees are given:

**Table 1.**

*Demographic characteristics of the interviewees*

| Indicator | Type | Qty | percentage |
|---|---|---|---|
| **Gender** | Female | 2 | 20 |
| | Male | 8 | 80 |
| **Age** | Between 35 and 45 years | 3 | 30 |
| | From 46 to 55 years | 5 | 50 |
| | More than 56 years | 2 | 20 |
| **Education** | MA | 3 | 30 |
| | Ph.D | 7 | 70 |
| **Experience** | From 15 to 20 years | 3 | 30 |
| | From 21 to 29 years | 5 | 50 |
| | More than 30 years | 2 | 20 |

**The reason for the combination of DEMATEL and ANP**

To choose the right framework, several actions and scenarios are necessary. Many multi-criteria decision-making approaches have been proposed in the supplier evaluation and selection literature, each of them has its advantages and disadvantages. It is difficult to choose the best method for evaluating and selecting a labor provider, that's why companies use a variety of different methods. Therefore, the most important issue in the supplier selection process is to design a suitable model for selecting the most suitable supplier. Among the multi-criteria decision-making methods, hierarchical analysis process and network analysis process, which consider qualitative aspects, are widely used. These methods are used to evaluate the weight of the indicators using the pairwise comparison matrix and expert judgment (Delavar, 2021). Due to the fact that the decision-makers' inclinations are not the same regarding related criteria, each of the criteria may be given a certain weight. Also, in the real world, standards are rarely independent. Therefore, if the evaluation factors of suppliers influence each other and there is an internal relationship between the criteria, the NP method is a suitable multi-criteria decision making method. Now, the main reason for the combination of DIMATEL and ANP is that in order to calculate the relationships between the model parameters, ANP forms a pairwise comparison matrix and calculates the eigenvectors corresponding to each of the pairwise comparison matrices and puts it in It places a suitable position in the hypermatrix; Therefore, the use of this technique in calculating the internal and external relationship between elements will require a large number of pairwise comparison matrices. This leads to complexity and spending a lot of time to solve the problem. Dimatel technique can be used to deal with this limitation. However, DEMATEL is not able to form hypermatrix and on the other hand, ANP has such ability. In fact, DEMATEL alone is not able to determine the weight and importance of indicators and it is considered a subset of the large NP system (Bazargan, 2024).

**DEMATEL**

In recent years, the combination of DIMATEL and INP has many uses, because this method has been used as a powerful tool capable of describing and evaluating complex systems by identifying and modeling cause and effect relationships between criteria. (Delavar, 2021). DEMATEL steps are explained as follows in Table 2:

**Table 2.**

*Verbal variables and corresponding fuzzy numbers*

| Fuzzy values of fuzzy scales | |
|---|---|
| Very high impact | (0.75,1.0,1.) |
| High impact | (0.5,0.75,) |
| Low impact | (0.25,0.5,0.7) |
| Very low impact | (0,0.25,0) |
| No impact | (0,0,0.25) |

## Findings

### Calculating the average matrix

At first, based on fuzzy verbal scales that indicate the limit of no influence to high influence (Table 2), all the experts were asked to determine the degree of direct influence of each factor on the other factor through pairwise comparison. As a result, one matrix was created for each expert. n×n (n number of criteria) has fuzzy coefficients defined. After completing H (the number of respondents), the mean matrix (the fuzzy initial direct correlation matrix) is calculated using equation (1):

$$a_{ij} = \frac{1}{H}\sum_{K=1}^{H} c_{ij}^{k} \qquad (1)$$

It is the degree of influence of factor i on factor j.

### 1. Calculation of the initial normalized direct correlation matrix

After the mean matrix, the obtained matrix is converted into a normalized direct matrix according to the following relations (2 and 3).

(1) $S_1 = \max_{1\le i\le n}\left[\sum_{j=1}^{n} a_{ij}\right]$

(2) $\boxed{D} = \frac{A}{S_1} = a_{ij} = \frac{a_{ij}}{s} = \left[\frac{l_{ij}}{s}, \frac{m_{ij}}{s}, \frac{u_{ij}}{s}\right] = \left(l'', m'', u''\right)$ Type equation here.

The above mathematical relationship indicates that the value of S1 is equal to the largest number of the sum of the limits of the row elements of the average matrix, which after dividing the elements of the average matrix one by one by the value of S, the normalized primary direct correlation matrix can be obtained. Table (3) shows the normalized matrix or the primary direct correlation matrix.

**Table 3.**

*Primary direct correlation matrix*

| W | | | V | | | S | | | M | | | L | | | I | | | H | | | D | | | B | | | A | | | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.05 | 0.02 | 0.01 | 0.07 | 0.05 | 0.02 | 0.03 | 0 | 0 | 0.01 | 0.07 | 0.05 | 0.3 | 0.01 | 0 | 0.7 | 0.04 | 0.07 | 0.11 | 0.09 | 0.06 | 0.1 | 0.07 | 0.04 | 0.9 | 0.06 | 0.03 | 0.03 | 0 | 0 | A |
| 0.07 | 0.05 | 0.03 | 0.03 | 0 | 0 | 0.07 | 0.04 | 0.02 | 0.04 | 0.01 | 0 | 0.1 | 0.08 | 0.05 | 0.1 | 0.08 | 0.051 | 0.5 | 0.02 | 0.01 | 0.03 | 0 | 0 | 0.03 | 0 | 0 | 0.11 | 0.08 | 0.06 | B |
| 0.11 | 0.09 | 0.07 | 0.05 | 0.03 | 0.02 | 0.03 | 0 | 0 | 0.08 | 0.06 | 0.04 | 0.1 | 0.08 | 0.05 | 0.1 | 0.09 | 0.071 | 0.1 | 0.01 | 0.08 | 0.03 | 0 | 0 | 0.03 | 0 | 0 | 0.01 | 0.09 | 0.07 | D |
| 0.11 | 0.08 | 0.05 | 0.03 | 0 | 0 | 0.03 | 0 | 0 | 0.07 | 0.04 | 0.02 | 0.09 | 0.06 | 0.04 | 0.11 | 0.09 | 0.062 | 0.03 | 0 | 0 | 0.1 | 0.01 | 0.08 | 0.05 | 0 | 0 | 0.11 | 0.01 | 0.08 | H |
| 0.09 | 0.07 | 0.04 | 0.03 | 0 | 0 | 0.08 | 0.05 | 0.03 | 0.09 | 0.06 | 0.04 | 0.07 | 0.05 | 0.02 | 0.09 | 0 | 0 | 0.1 | 0.08 | 0.05 | 0.7 | 0.04 | 0.07 | 0.07 | 0.04 | 0.02 | 0.09 | 0.07 | 0.04 | I |
| 0.08 | 0.05 | 0.03 | 0.03 | 0 | 0 | 0.03 | 0 | 0 | 0.03 | 0 | 0 | 0.03 | 0 | 0 | 0.08 | 0.05 | 0.025 | 0.1 | 0.08 | 0.05 | 0.7 | 0.05 | 0.03 | 0.03 | 0 | 0 | 0.03 | 0.01 | 0 | L |
| 0.11 | 0.08 | 0.06 | 0.04 | 0.01 | 0 | 0.09 | 0.06 | 0.04 | 0.03 | 0 | 0 | 0.03 | 0 | 0 | 0.11 | 0.08 | 0.051 | 0.1 | 0.08 | 0.06 | 0.8 | 0.06 | 0.03 | 0.03 | 0.01 | 0 | 0.11 | 0.08 | 0.06 | M |
| 0.11 | 0.08 | 0.06 | 0.03 | 0 | 0 | 0.03 | 0 | 0 | 0.14 | 0.06 | 0.03 | 0.03 | 0 | 0 | 0.11 | 0.08 | 0.054 | 0.04 | 0.01 | 0 | 0.0 | 0.00 | 0.11 | 0.11 | 0.09 | 0.06 | 0.03 | 0.01 | 0 | S |
| 0.07 | 0.04 | 0.02 | 0.03 | 0 | 0 | 0.03 | 0 | 0 | 0.03 | 0 | 0 | 0.03 | 0 | 0 | 0.09 | 0.06 | 0.036 | 0.09 | 0.06 | 0.03 | 0.8 | 0.05 | 0.03 | 0.03 | 0 | 0 | 0.08 | 0.05 | 0.03 | V |
| 0.03 | 0 | 0 | 0.09 | 0.07 | 0.04 | 0.07 | 0.05 | 0.03 | 0.01 | 0.08 | 0.05 | 0.07 | 0.05 | 0.02 | 0.11 | 0.08 | 0.057 | 0.02 | 0.19 | 0.16 | 0.9 | 0.07 | 0.01 | 0.01 | 0.08 | 0.05 | 0.11 | 0.08 | 0.06 | W |

## 2. Calculation of the effect matrix of total relations (T)

The total relationship matrix shows the intensity of the relative influence of the ruler on the direct and indirect relationships in the system is calculated from the following relations (4) to (7).

$$T = \lim_{H\to\infty} (D^1 \oplus D^2 \oplus \dots\dots \oplus D^H) \quad (4)$$

Each portion $ist_{ij} = (l^t_{ij}, m^t_{ij}, u^t_{ij})$ and is calculated as follows:

5) $(L_{IJ} = D_L \times (I - D_L)^{-1}$

6) $(m_{IJ} = D_m \times (I - D_m)^{-1}$

7) $(u_{IJ} = D_u \times (I - D_u)^{-1}$

In this matrix, I is the singular matrix, and $H_l$, $H_m$, and $H_u$ are each nxn matrix, whose elements form the lower, middle, and upper numbers of the triangular fuzzy numbers of the matrix M, as shown in table (4).

Table 4.

*Total relationship matrix*

| W | | | V | | | S | | | M | | | L | | | I | | | H | | | D | | | B | | | A | | | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.25 | 0.1 | 0.02 | 0.18 | 0.54 | 0.02 | 0.15 | 0.02 | 0 | 0.27 | 0.12 | 0.05 | 0.19 | 0.05 | 0.01 | 0.28 | 0.14 | 0.036 | 0.33 | 0.19 | 0.08 | 0.29 | 0.17 | 0.05 | 0.22 | 0.08 | 0.03 | 0.23 | 0.1 | 0.02 | A |
| 0.25 | 0.09 | 0.03 | 0.13 | 0.11 | 0 | 0.18 | 0.06 | 0.03 | 0.2 | 0.04 | 0.01 | 0.24 | 0.1 | 0.05 | 0.29 | 0.12 | 0.06 | 0.26 | 0.08 | 0.03 | 0.21 | 0.05 | 0.01 | 0.16 | 0.03 | 0.01 | 0.29 | 0.12 | 0.06 | B |
| 0.32 | 0.18 | 0.09 | 0.17 | 0.43 | 0.02 | 0.16 | 0.03 | 0.01 | 0.28 | 0.12 | 0.05 | 0.26 | 0.12 | 0.06 | 0.34 | 0.19 | 0.093 | 0.36 | 0.22 | 0.12 | 0.25 | 0.12 | 0.03 | 0.18 | 0.04 | 0.01 | 0.33 | 0.18 | 0.09 | D |
| 0.32 | 0.14 | 0.07 | 0.15 | 0.2 | 0.01 | 0.16 | 0.02 | 0.01 | 0.26 | 0.09 | 0.03 | 0.25 | 0.1 | 0.05 | 0.34 | 0.16 | 0.081 | 0.28 | 0.1 | 0.03 | 0.32 | 0.18 | 0.1 | 0.2 | 0.05 | 0.01 | 0.32 | 0.17 | 0.1 | H |
| 0.31 | 0.13 | 0.06 | 0.15 | 0.17 | 0 | 0.21 | 0.07 | 0.03 | 0.29 | 0.11 | 0.05 | 0.24 | 0.08 | 0.03 | 0.27 | 0.08 | 0.02 | 0.35 | 0.16 | 0.07 | 0.31 | 0.14 | 0.06 | 0.22 | 0.07 | 0.02 | 0.32 | 0.13 | 0.05 | I |
| 0.24 | 0.09 | 0.04 | 0.11 | 0.1 | 0 | 0.12 | 0.01 | 0 | 0.17 | 0.03 | 0.01 | 0.15 | 0.03 | 0.01 | 0.25 | 0.09 | 0.037 | 0.28 | 0.13 | 0.06 | 0.26 | 0.11 | 0.06 | 0.14 | 0.02 | 0 | 0.2 | 0.05 | 0.02 | L |
| 0.34 | 0.16 | 0.07 | 0.16 | 0.27 | 0.01 | 0.23 | 0.08 | 0.04 | 0.24 | 0.06 | 0.02 | 0.2 | 0.04 | 0.01 | 0.35 | 0.16 | 0.072 | 0.36 | 0.19 | 0.09 | 0.32 | 0.17 | 0.08 | 0.2 | 0.04 | 0.01 | 0.34 | 0.17 | 0.08 | M |
| 0.31 | 0.13 | 0.07 | 0.14 | 0.11 | 0 | 0.16 | 0.02 | 0.01 | 0.32 | 0.09 | 0.04 | 0.18 | 0.03 | 0.01 | 0.33 | 0.13 | 0.066 | 0.27 | 0.07 | 0.02 | 0.23 | 0.05 | 0.01 | 0.25 | 0.11 | 0.07 | 0.25 | 0.06 | 0.02 | S |
| 0.24 | 0.08 | 0.03 | 0.12 | 0.12 | 0 | 0.13 | 0.01 | 0 | 0.18 | 0.03 | 0.01 | 0.16 | 0.03 | 0.01 | 0.27 | 0.11 | 0.045 | 0.28 | 0.12 | 0.05 | 0.27 | 0.12 | 0.06 | 0.15 | 0.02 | 0 | 0.25 | 0.1 | 0.04 | V |
| 0.32 | 0.14 | 0.03 | 0.24 | 0.82 | 0.04 | 0.24 | 0.08 | 0.04 | 0.35 | 0.15 | 0.07 | 0.29 | 0.12 | 0.04 | 0.42 | 0.24 | 0.09 | 0.51 | 0.36 | 0.19 | 0.39 | 0.26 | 0.1 | 0.3 | 0.13 | 0.06 | 0.41 | 0.24 | 0.09 | W |

## 3. De-fuzzing

In order to reach the relationship structure between the criteria through the relationship network map, first de-fuzzification should be done. In this step, we de-fuzzify the fuzzy numbers obtained from the previous step according to formula (8).

8) $(T = M + \frac{(U-L)}{4} = \begin{bmatrix} T_{11} & \cdots & T_{1n} \\ \vdots & \ddots & \vdots \\ T_{m1} & \cdots & T_{mn} \end{bmatrix}$

The modified matrix of the total relationship is according to table (5).

**Table 5.**

*De-fuzzing matrix of total communication*

| | A | B | D | H | I | L | M | S | V | W |
|---|---|---|---|---|---|---|---|---|---|---|
| **A** | 0.33 | 0.29 | 0.44 | 0.50 | 0.41 | 0.23 | 0.37 | 0.17 | 0.71 | 0.34 |
| **B** | 0.40 | 0.18 | 0.26 | 0.33 | 0.40 | 0.32 | 0.24 | 0.23 | 0.24 | 0.33 |
| **D** | 0.49 | 0.22 | 0.36 | 0.55 | 0.50 | 0.37 | 0.38 | 0.19 | 0.60 | 0.48 |
| **H** | 0.47 | 0.25 | 0.47 | 0.37 | 0.48 | 0.34 | 0.33 | 0.18 | 0.34 | 0.44 |
| **I** | 0.44 | 0.28 | 0.44 | 0.49 | 0.34 | 0.31 | 0.38 | 0.28 | 0.31 | 0.43 |
| **L** | 0.25 | 0.15 | 0.36 | 0.39 | 0.33 | 0.18 | 0.20 | 0.13 | 0.21 | 0.32 |
| **M** | 0.49 | 0.24 | 0.47 | 0.53 | 0.50 | 0.24 | 0.29 | 0.03 | 0.43 | 0.48 |
| **S** | 0.30 | 0.35 | 0.27 | 0.34 | 0.44 | 0.21 | 0.39 | 0.18 | 0.25 | 0.42 |
| **V** | 0.34 | 0.17 | 0.38 | 0.39 | 0.37 | 0.19 | 0.21 | 0.14 | 0.24 | 0.32 |
| **W** | 0.62 | 0.41 | 0.62 | 0.82 | 0.64 | 0.49 | 0.49 | 0.32 | 1.05 | 0.45 |

## 4. Preparing a relationship network map

After de-fuzzifying and creating the matrix of total relations, by transferring the information from the matrix T to the directed graph map, the structure and the way of communication between the criteria can be investigated. For this purpose, a threshold value (α) of the level of effects using formula (9). It is necessary to make a decision. After determining the threshold value, only the values of the rows and columns of the T matrix that are greater than α are transferred to the directed graph map.

$$9)\quad \begin{cases} T_{ij} \geq \alpha & T_{ij} = u_{ij} \\ & u_{ij} = 0 \end{cases} \qquad \alpha = \frac{\sum_{i=1}^{n}\sum_{j=1}^{m} T_{ij}}{m \times n}$$

## 5. Reaching the causal diagram structure (cause and effect ranking)

Causal diagram contains the cause and effect relationship between factors and determines the degree of influence and susceptibility of factors. For this purpose, by calculating the sum of the rows and columns of the matrix, the total T parameters (s_i and r_j) are obtained. s_i indicates the total amount of direct and indirect influence of factor i on other factors of the system, and r_i or the sum of i columns of matrix T indicates the total effect that factor i receives from other factors. By calculating the values (s_i and r_j), you can calculate the causal diagram and the cause and effect ranking of the criteria.

(s_i+r_j) defines the set of influence and influence of the desired factor in the system. In other words, the larger (s_i+r_j) a criterion is, the more interaction the desired factor has with other factors. The final value of the effect of each factor on the set of other factors of the system is also obtained from the difference (s_i-r_j). If it is positive, factor i will affect other factors, and if it is negative, factor i will be affected by other factors. according to relations (10) and (11).

$S_i$-$R_j$>0 Effective criteria ($S_i$+$R_j$) The importance of these indicators (10)

$S_i$-$R_j$>0 Effective measure ($S_i$-$R_j$) The relationship of these indicators (11)

By entering the values of ($s_i$+$r_j$) and ($s_i$-$r_j$) in a Cartesian machine, you can show the causal diagram of the factors involved in the problem, in the structure of the causal diagram, the factors below are strongly influenced by their upstream factors. As shown in table (6).

**Table 6.**

*Importance and influence of indicators*

| W | V | S | M | L | I | H | D | B | A | |
|---|---|---|---|---|---|---|---|---|---|---|
| 9.8065 | 7.1308 | 5.2696 | 7.242 | 5.3062 | 8.1108 | 8.39 | 8.1931 | 5.4598 | 7.9204 | R+S |
| 1.8166 | -1.643 | 1.0291 | 0.6579 | -0.257 | -0.704 | -1.051 | 0.0716 | 0.3936 | -0.314 | R-S |
| Effective | Receptive | Effective | Effective | Receptive | Effective | Receptive | Effective | Effective | Receptive | Relationships |

**Rating of factors with ANP**

In order to rank and prioritize factors, fuzzy network analysis will be used, a new theory developed from the hierarchical analysis process, proposed by Saaty to overcome the problem of mutual dependence and feedback between criteria and options. ANP controls the dependency within criteria (internal dependency) and between different criteria (external dependency). In order to facilitate the implementation of the Super Decision software as well as pairwise comparisons, first the factors are symbolized as in Table (7) and then the network analysis steps have been performed as follows.

**Table 7.**

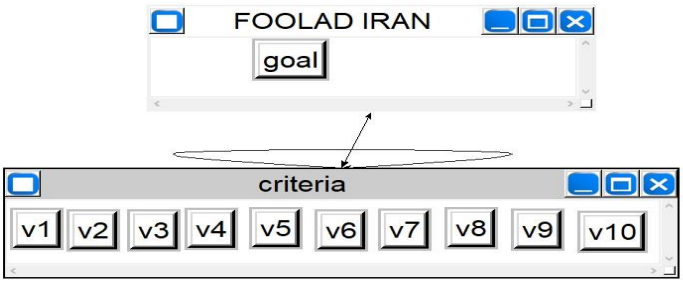
*Notation of factors*

| Basic content | Symbol |
|---|---|
| Price | V1 |
| Delivery time | V2 |
| Authenticity of the product and compliance with the standards and requested analysis of the product | V3 |
| Product quality | V4 |
| Resume of the provider | V5 |
| Sending samples or the possibility of testing specialized and manufactured goods before full delivery | V6 |
| After-sales service (guarantee and warranty) | V7 |
| Responsiveness of the supplier (in inquiry and ordering, follow-up, etc.) | V8 |
| Product packaging | V9 |
| Authentic or exclusive representative of goods | V10 |

***Step 1- Making a network diagram of the research:*** in this step, the problem should be divided into criterion levels and sub-criteria and options, if any, and the relationships between them should be determined. A very important point in this step is the existence of relationships between criteria. These relationships can be determined through two-by-two comparisons by asking experts. The network diagram of this research is shown in Super Decision software in Figure (1).

**Figure 1.**

*Research network diagram*




**Step 2- Formation of pairwise comparisons matrix:** In this step, the elements of each level are compared to other related elements at a higher level in a pairwise manner and pairwise comparisons matrices are formed. Also, at the end, a pairwise comparison of internal relationships should be made. These pairwise comparisons are done for all the experts and then collected through the geometric mean in the form of a cumulative matrix and entered into the Super Decision software. Table (8) shows an example of pairwise comparisons.

**Table 8.**

*Examples of fuzzy pairwise comparisons of research factors*

| Expert **1** | v1 | v2 | v3 | v4 | v5 | v6 | v7 | v8 | v9 | v10 |
|---|---|---|---|---|---|---|---|---|---|---|
| v1 | | (4,5,6) | (1,1,1) | (1,1,1) | (4,5,6) | (6,7,8) | (3,4,5) | (5,6,7) | (5,6,7) | (7,8,9) |
| v2 | | | (0.2,0.25,0.333) | (0.166,0.2,0.25) | (6,7,8) | (3,4,5) | (2,3,4) | (1,1,1) | (1,1,1) | (1,2,3) |
| v3 | | | | (1,1,1) | (4,5,6) | (2,3,4) | (1,1,1) | (2,3,4) | (1,1,1) | (4,5,6) |
| v4 | | | | | (9,9,9) | (9,9,9) | (7,8,9) | (6,7,8) | (6,7,8) | (6,7,8) |
| v5 | | | | | | (4,5,6) | (4,5,6) | (1,1,1) | (2,3,4) | (0.25,0.333,0.5) |
| v6 | | | | | | | (0.16,0.2,0.25) | (0.16,0.2,0.25) | (1,1,1) | 0.(4,5,6) |
| v7 | | | | | | | | (6,7,8) | (3,4,5) | (1,1,1) |
| v8 | | | | | | | | | (2,3,4) | (0.166,0.2,0.25) |
| v9 | | | | | | | | | | (0.25,0.333,0.5) |
| v10 | | | | | | | | | | |

Before the start of the third step, according to the limitations of the Superdesign software, all pairwise comparisons for experts were transformed by using the geometric mean as a cumulative transformation, and after that using the surface center method and relation 1-4 to de-fuzzification.

$df_{ij} = \frac{|(u_{ij}-l_{ij})+(m_{ij}-l_{ij})|}{3} + l_{ij}$ Relationship 1-4

**Table 9.**

*Diphased pairwise comparisons*

| | v1 | v2 | v3 | v4 | v5 | v6 | v7 | v8 | v9 | v10 |
|---|---|---|---|---|---|---|---|---|---|---|
| v1 | | 3.4418 | 1.0718 | 1.0000 | 6.4625 | 7.0000 | 2.3097 | 5.8916 | 5.8420 | 6.1059 |
| v2 | | | 0.3164 | 0.2532 | 5.5241 | 0.8259 | 0.3465 | 1.6141 | 0.8959 | 2.6955 |
| v3 | | | | 1.0000 | 6.5629 | 3.5568 | 1.0000 | 4.5436 | 3.9233 | 5.0610 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| v4 | | 9.0000 | 7.7231 | 1.8661 | 7.0000 | 6.6649 | 6.0419 |
| v5 | | | 0.2236 | 0.2759 | 0.8959 | 1.2821 | 0.2383 |
| v6 | | | | 0.2349 | 0.7798 | 1.0000 | 0.4189 |
| v7 | | | | | 7.0000 | 4.5731 | 1.0000 |
| v8 | | | | | | 3.0000 | 0.2000 |
| v9 | | | | | | | 0.2123 |
| v10 | | | | | | | |

***Step 3- formation of the initial super matrix***: using the weight of the obtained pairwise comparisons, we form the initial super matrix. The primary supermatrix is the same weights that were obtained from pairwise comparisons in the second step. The output of the super matrix in the Super Decision software of this research is reported in Table (10).

**Table 10.**

*Initial supermatrix of factors*

| | **V1** | **V2** | **V3** | **V4** | **V5** | **V6** | **.....** | **V10** | **Goal** |
|---|---|---|---|---|---|---|---|---|---|
| **V1** | 0 | 0.149947 | 0.058014 | 0.059858 | 0.124989 | 0.047115 | ..... | 0.095288 | 0.210154 |
| **V2** | 0.128191 | 0 | 0.043519 | 0.041036 | 0.137328 | 0.192109 | ..... | 0.062869 | 0.068091 |
| **V3** | 0.196122 | 0.183366 | 0 | 0.107072 | 0.185341 | 0.255275 | ..... | 0.226858 | 0.169276 |
| **V4** | 0.241945 | 0.11816 | 0.11147 | 0 | 0.144462 | 0.157128 | ..... | 0.136738 | 0.22007 |
| **V5** | 0.02011 | 0.028938 | 0.035747 | 0.04081 | 0 | 0.037777 | ..... | 0.040549 | 0.021351 |
| **V6** | 0.055944 | 0.027968 | 0.124185 | 0.240845 | 0.051303 | 0 | ..... | 0.043059 | 0.035569 |
| **V7** | 0.140429 | 0.204111 | 0.187924 | 0.154042 | 0.08543 | 0.023515 | ..... | 0.215764 | 0.138852 |
| **V8** | 0.047006 | 0.145609 | 0.055622 | 0.03334 | 0.079188 | 0.071132 | ..... | 0.063914 | 0.04735 |
| **V9** | 0.050903 | 0.033789 | 0.110447 | 0.093241 | 0.069495 | 0.062889 | ..... | 0.114961 | 0.029633 |
| **V10** | 0.119349 | 0.108112 | 0.273072 | 0.229756 | 0.122463 | 0.153061 | ..... | 0 | 0.059654 |
| **Goal** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |

***Step 4 - Creating the balanced supermatrix:*** After creating the initial supermatrix, the balanced supermatrix must be created. This matrix for this research is presented in table (11).

**Table 11.**

*Balanced super matrix*

| **V1** | **V1** | **V2** | **V3** | **V4** | **V5** | **V6** | **V7** | **V8** | **V9** | **V10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **V2** | 0 | 0.134953 | 0.052213 | 0.053872 | 0.11249 | 0.042403 | 0.073807 | 0.060335 | 0.088378 | 0.08576 |
| **V3** | 0.115371 | 0 | 0.039167 | 0.036932 | 0.123596 | 0.172898 | 0.046892 | 0.149214 | 0.060704 | 0.056582 |
| **V4** | 0.17651 | 0.165029 | 0 | 0.096365 | 0.166807 | 0.229748 | 0.164755 | 0.160016 | 0.228257 | 0.204172 |
| **V5** | 0.21775 | 0.106344 | 0.100323 | 0 | 0.130016 | 0.141415 | 0.115317 | 0.08867 | 0.144811 | 0.123064 |
| **V6** | 0.018099 | 0.026044 | 0.032173 | 0.036729 | 0 | 0.033999 | 0.032164 | 0.022812 | 0.045935 | 0.036494 |
| **V7** | 0.05035 | 0.025171 | 0.111767 | 0.216761 | 0.046173 | 0 | 0.032822 | 0.059683 | 0.082648 | 0.038753 |
| **V8** | 0.126386 | 0.1837 | 0.169131 | 0.138638 | 0.076887 | 0.021163 | 0 | 0.157551 | 0.07489 | 0.194187 |
| **V9** | 0.042305 | 0.131048 | 0.05006 | 0.030006 | 0.071269 | 0.064019 | 0.107082 | 0 | 0.035172 | 0.057523 |
| **V10** | 0.045813 | 0.03041 | 0.099402 | 0.083917 | 0.062546 | 0.0566 | 0.086535 | 0.027153 | 0 | 0.103464 |
| | 0.107414 | 0.097301 | 0.245764 | 0.20678 | 0.110217 | 0.137755 | 0.240627 | 0.174566 | 0.139205 | 0 |

***Step 5*** **-** creation of the limit supermatrix (limited - limited): the balanced supermatrix must be raised to the infinite power so that each row becomes a convergent number. And that number is the weight of that criterion or subcriterion or option. The output of limited Super Manris for pre-futures and post-futures is specified in table (12).

**Table 12.**

*Limiting super matrix*

| | V1 | V2 | V3 | V4 | V5 | V6 | V7 | V8 | V9 | V10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **V1** | 0.079738 | 0.079738 | 0.079738 | 0.079738 | 0.079738 | 0.079738 | 0.079738 | 0.079738 | 0.079738 | 0.079738 |
| **V2** | 0.068332 | 0.068332 | 0.068332 | 0.068332 | 0.068332 | 0.068332 | 0.068332 | 0.068332 | 0.068332 | 0.068332 |
| **V3** | 0.147859 | 0.147859 | 0.147859 | 0.147859 | 0.147859 | 0.147859 | 0.147859 | 0.147859 | 0.147859 | 0.147859 |
| **V4** | 0.120154 | 0.120154 | 0.120154 | 0.120154 | 0.120154 | 0.120154 | 0.120154 | 0.120154 | 0.120154 | 0.120154 |
| **V5** | 0.030338 | 0.030338 | 0.030338 | 0.030338 | 0.030338 | 0.030338 | 0.030338 | 0.030338 | 0.030338 | 0.030338 |
| **V6** | 0.071495 | 0.071495 | 0.071495 | 0.071495 | 0.071495 | 0.071495 | 0.071495 | 0.071495 | 0.071495 | 0.071495 |
| **V7** | 0.122838 | 0.122838 | 0.122838 | 0.122838 | 0.122838 | 0.122838 | 0.122838 | 0.122838 | 0.122838 | 0.122838 |
| **V8** | 0.058143 | 0.058143 | 0.058143 | 0.058143 | 0.058143 | 0.058143 | 0.058143 | 0.058143 | 0.058143 | 0.058143 |
| **V9** | 0.066251 | 0.066251 | 0.066251 | 0.066251 | 0.066251 | 0.066251 | 0.066251 | 0.066251 | 0.066251 | 0.066251 |
| **V10** | 0.143944 | 0.143944 | 0.143944 | 0.143944 | 0.143944 | 0.143944 | 0.143944 | 0.143944 | 0.143944 | 0.143944 |

Finally, after calculating the bounded super matrix, the final weight of each factor can be obtained by normalizing the obtained weights. These weights are reported in table (13) for all the factors of this research.

Table 13.

*Weight of factors*

| Agent title | Weight | Symbol | Rank |
|---|---|---|---|
| Price | 0.07974 | V1 | 5 |
| Delivery time | 0.06833 | V2 | 7 |
| Authenticity of the product and compliance with the standards and requested analysis of the product | 0.14786 | V3 | 1 |
| Product quality | 0.12015 | V4 | 4 |
| Resume of the provider | 0.03034 | V5 | 10 |
| Sending samples or the possibility of testing specialized and manufactured goods before full delivery | 0.07149 | V6 | 6 |
| After-sales service (guarantee and warranty) | 0.12284 | V7 | 3 |
| Responsiveness of the supplier (in inquiry and ordering, follow-up, etc.) | 0.05814 | V8 | 9 |
| Product packaging | 0.06625 | V9 | 8 |
| Authentic or exclusive representative of goods | 0.14394 | V10 | 2 |

As it is clear in the table above, the factor of product authenticity and compliance with the standards and requested analysis of the product with a weight of 0.147 in the first rank and the factors of authentic or exclusive representative of the product and after-sales services (guarantee and warranty) with weights of 0.143 respectively. and 0.122 are in the second and third ranks.

## Discussion and Conclusion

Basically, the supplier selection process is a strategic management activity for the supply of raw materials and services. Choosing the right supplier leads to reducing the purchase risk, increasing customer satisfaction and developing positive relationships between the supplier and the buyer, while choosing the wrong supplier can

cause economic problems and subsequently affect the performance of the organization. The supplier evaluation process is a multifaceted process, the first and basic stage of which is the development of performance evaluation indicators and the identification of decision-making panels. In making decisions that involve prioritizing, ranking, or choosing between priorities, researchers use techniques collectively known as multi-criteria decision-making approaches. Their goal is to help decision makers choose preferred options or directly select individual options that best meet their needs. One of the most important problems in many decision-making methods is the accurate evaluation of relevant data. Often in real decision-making applications, the data are ambiguous. Therefore, it is desirable to develop decision-making methods that use fuzzy data.

Steel is one of the important and influential goods in the industrial growth and development of countries. Also, the role of the supply chain in the steel industry is very significant, and on the other hand, the National Steel Group has a special role in Iran's economy. Therefore, due to the lack of an operational model for the evaluation and selection of suppliers in Iran's National Steel Industrial Group Company, the current research aims to identify and rank the factors affecting the selection of suppliers and use the combined FANP/DEMATEL approach to the important issue of the problems of Iran's steel industry. has paid in the selection of suppliers. Therefore, in this research, it has been tried to identify and prioritize the factors influencing the selection of suppliers of Iran National Steel Industrial Group in the form of a model. In order to realize this issue, the authors of the present study took three important steps: in the first step, based on library studies and referring to the literature related to the subject, they extracted a set of factors influencing the selection of suppliers, and in the second step, by conducting interviews In a semi-structured way, 10 experts related to the subject in Iran's National Steel Industrial Group were asked to express their opinions about the factors affecting the evaluation and selection process of the organization's suppliers in detail. Finally, 10 factors were found to be the most effective factors, which are: price and cost of transportation, delivery time, product authenticity and compliance with the required standards and analysis of the product, product quality, supplier's resume, sending samples or the possibility of testing specialized and customized products. Before the complete delivery of the order, after-sales services (guarantee, warranty), supplier's response (at the stage of returning, inquiry and ordering or tracking the shipment of goods), product packaging, having a valid or exclusive representative. Finally, in the third step, using the Fuzzy NP technique, the factors identified in the previous two steps were ranked, and the results indicated that the factor of product authenticity and compliance with the standards and requested analysis of the product ranked first and the factors of authentic or exclusive representative. Goods and after-sales services (guarantee and warranty) are ranked second and third, respectively. The findings of this study were consistent with the findings of Keshavarz-Ghorabaee (2024), Gholamian (2024), Pang et al. (2024) and Acar et al. (2024), but it did not have much alignment with the research findings of Taebi et al. (2024), Mizrak & Akkartal (2024), Muerza (2024) and Nasri et al (2023).

**Suggestions**

- It is suggested to the future researchers to strengthen and make the model obtained from the current research more practical and to ensure the validity and reliability of the model, to conduct the necessary tests using simulation techniques;
- It is also suggested that the weights and indicators of each criterion be determined more precisely. Also, according to the categories of goods required by steel companies in the categories of standard goods, construction and raw materials, researchers can separate the general model presented in this research into more specialized and detailed models;
- Another suggestion is to conduct research in the fields of evaluation and selection of contractors and projects.

## Research Limitations

This study like other researches, has faced limitations and problems, such as:

- ✓ Due to questionnaires and interviews to collect data, some people refused to provide real answers and gave unrealistic answers;
- ✓ The large number of questions in the questionnaires led to the prolongation of its execution time, which did not affect the accuracy of the participants' answers;
- ✓ Considering that the present research was conducted in a situation where the company was in a financial, management crisis, and there was a constant transfer and change of position of employees, this issue may have affected the results.

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# Designing a Model for Developing Digital Marketing Capabilities in B2B Markets (Medical and Industrial Gas Industry)

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**Abstract**
Having a comprehensive view of digital marketing capabilities is essential for companies to survive in the revolutionized digital world. Specifically, in B2B commerce, is a game-changer, turning complex sales cycles into efficient that boost client engagement and drive rapid growth. Accordingly, the purpose of the present research is to design a model for developing digital marketing capabilities in B2B markets. Emphasizing B2B marketing, this research has adopted a qualitative approach. A model is developed through grounded - theory and in-depth semi-structured interviews with 12 experts of medical and industrial gases industry. The collected data has been analyzed with the three-step coding method and Nvivo10 software. The data has categorized into 6 main categories including; casual conditions (dominance of the Internet, development of international relations in B2B markets and digital marketing features), intervening conditions (manager's attitude and cooperation of different units of organization), contextual conditions (changing the way B2B customers choose suppliers and predominance of classic approach in B2Bmarkets), methods (e-mail marketing, website, etc.), consequences(customer retention and loyalty and increasing the growth rate of the organization) and main phenomenon (development of digital marketing capability in B2B market). This model provides a comprehensive mental framework for the managers of this field regarding the capabilities of digital marketing.

**Keywords**: *B2B market, Digital marketing, Digital marketing capabilities*

## Introduction

The emergence of the Internet and new technology has led to the change of marketing role and its performance (Quinton & Simkin, 2017). Besides, the COVID-19 pandemic not only influenced consumer habits by increasing media consumption, but also led to increasing number of internet users, use of digital devices, and online activities (Masrianto et al., 2022). According to Dataportal (2021), the number of internet users worldwide reached 4.66 billion, which is 59.5% of the global population of 7.83 billion. Meanwhile, digital marketing not only has seamlessly more integrated into the daily lives of people worldwide (Hien & Nhu, 2022) but also, in the last twenty years, digitalization has transformed consumer marketing and specifically B2B marketing (Herhausen et al., 2020). In fact, the digital evolution was accepted as one of the

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important drivers in B2B markets (Cortez & Johnston, 2017).

As business-to-business (B2B) companies are known for their intense competition (Smith, 2024), the burgeoning relevance of digital marketing in B2B companies is emphasized by several notable trends (e.g. Gupta, 2018; Janda, 2018). It is noteworthy that even in the early days of the Internet, it seemed that B2B companies would benefit from greater access to global opportunities, more communication opportunities, and more effective and more supportive business communication ((Alvonitis & Karayanni, 2000). However, despite the well-known benefits of digital marketing, the adoption of this type of marketing in B2B companies has been extremely low (Setkute & Dibb, 2022). Additionally, the distinctive features and different working methods of the B2B companies made the methods used in B2C digital marketing probably not suitable for B2B ones (Setkute & Dibb, 2022). Besides, such companies are facing other obstacles such as lack of awareness and knowledge to achieve the benefits of using digital marketing (Matarazzo et al., 2021; Karjaluoto & Huhtamaki, 2010). In order to overcome such problems, Companies must have digital marketing capabilities in order to improve their performance (Masrianto et al., 2022).

Digital marketing is not only the acceptance of this type of marketing, but also how to plan, implement and manage digital marketing. The concept of digital marketing capabilities is about the company's ability to use the market knowledge for quick commercial changes and adapting itself to new circumstances (Buccieri et al., 2020; Moi et al., 2021). To take advantage of such opportunities in the new marketing landscape, companies need to adjust their strategy in the field of digital marketing to acquire new customers and maintain customer loyalty. Therefore, companies must have digital marketing capabilities (Masrianto et al., 2022) and B2B companies are not an exception. Digital marketing capabilities can help B2B companies to overcome their obstacles in digitalization road, achieve their ultimate goal of optimizing processes similar to business development, create reliable relationships, retrieve relevant information and create new opportunities (Pöyry et al., 2017). In addition, in a business's long-term strategy, digital marketing transformation emerges as a pivotal element.

Based on the fact that, navigating the complexities of B2B enterprises to choose the most effective and suitable marketing strategy is no straightforward task (Hien & Nhu, 2022) and examining the existing theories and researches in this field has shown the lack of investigation on how to create and develop special capabilities of digital marketing in B2B companies, therefore, this research seeks to clarify these capabilities and provide a comprehensive model to develop them.

The results of the study can provide a new perspective in the field of B2B companies attitude to use the benefits of digital marketing capabilities and how to achieve these benefits. Besides, it will show how B2B companies can use digital marketing for their products and services and the comprehensive model can be used by B2B managers and leaders to synchronize their organization with the current world's trend that is joining the digital world.

## Literature Review

### Digital Marketing

According to Philip Kotler, widely regarded as the "Father of Modern Marketing", the advent of digital marketing can be traced back to the early 1980s. The concept of digital marketing involves the promotion of an organization's products and services through digital technologies, including mobile devices, display advertisements, and various digital media platforms such as google Ads, Facebook and so on (Panda & Mishra, 2022). In another definition, digital marketing refers to the entirely of marketing activities conducted online. It encompasses all digital communicationand advertising channels that businesses can utilize to engage with their customers and target audience (Dimitrios et al., 2023). As a result, digital marketing encompasses the full range of tools and activities used to market products and services in the digital realm, including the web, internet, mobile devices, and other digital platforms. Given the increasing importance of digital marketing in business world, numerous studies have been conducted in this field.

In one research, it's believed that the COVID-19 pandemic has significantly transformed marketing, leading to increased reliance on digital channels. The impact of digital marketing during the pandemic has been examined and redefined from the Islamic perspective. Advances in information technology have been pivotal in shaping digital marketing, especially during COVID-19 (Junusi, 2020).

In another study, the significant role of digital marketing adoption in enhansing digital marketing capability has been validated. Moreover, ecosystem readiness for digital trasformation, along with the adoption and capability of digital marketing, has been identified as influential factors. Digital transformation is recognized as a highly impactful determinant affecting both the adoption and capability of digital marketing (Masrianto et al., 2022).

Another study investigates the barriers to digital marketing in small B2B companies, identifying both internal and external challenges. This research highlights a standardized approach to digital marketing across all B2B firms is impractical. Internal factors include limited awareness of the potential benefits of digital marketing, apprehension towards technology, and resistance to technology-driven methods. External factors encompass customer customer demographics, competitive landscape, industry dynamics, and product characteristics (Sektute & Dibb, 2022).

To implement digital marketing, every company requires digital marketing capabilities. Extensive research has been conducted in this area (e.g. Masrianto et al., 2022; Herhausen al., 2020), which are disscussed in the following.

## Digital Marketing Capabilities

Digital marketing capabilities reflect the organizational ability to adapt their resources and to develop new skills in relation to their stakeholders (Wang, 2020). In other definition, these capabilities constitute a specific set of skills supported by technological abilities aimed at acquiring more comprehensive customer insights. This facilitates greater access to both offline and online customer data, empowering businesses to operate more effectively in digital business world (Apasrawirote et al., 2022). The Boston Consulting Group

believes that companies can achieve significant results by increasing digital marketing capabilities and reduce their costs by 30% and increase their income by 20%.

Two gaps in digital marketing capabilities were identified during researches in this field. First of all, the practical gap, which highlights the distance between current managerial practices and their digital marketing capabilities. The second is knowledge gap, which indicates the significant distance between digital marketing developments in B2B companies and the existing scientific knowledge underpinning them (Herhausen et al., 2020).

Another study highlighted the importance of digital marketing capabilities for businesses and their impact on key business performance metrics. The proposed dimensions of the digital marketing capabilities framework aim to identify new research directions for both marketing and IT fields (Apasrawirote et al., 2022).

Also, companies in Indonesia have an average score of 71.97, indicating medium-level digital marketing capabilities. Enhancements can be made by boosting managerial innovativeness, organizational readiness, and perceived usefulness, alongside prioritizing digital transformation and emphasizing digital analytics, CRM, and advertising (Masrianto et al., 2022).

The findings of the research in the field of social media capabilities in B2B marketing suggest that social media capability hinges on understanding the firm's technological capacity and adapting to environmental changes. A four-level Social Media Capability Maturity Model is proposed to enhance this transformation (Wang et al., 2017).

**Digital Marketing Capabilities in B2B Markets**

Digital marketing capabilities in B2B markets has not had a specific definition so far. Although digital marketing is recently being added to the marketing strategies of B2B companies, research in this regard is in its nascent stage (Pandey et al., 2020). A B2B company special features which enables them to benefit digital marketing can be considered as digital marketing capability in B2B markets.

The ultimate goal of advanced technologies in B2B marketing is to optimize processes similar to business development, create reliable relationships, retrieve relevant information and create new opportunities (Pöyry et al., 2017). Digital marketing channels can be used to create awareness, strengthen brand image, attract new customers, improve customer service, improve customer satisfaction and loyalty, increase sales and reduce costs (Taiminen & Karjaluoto, 2015). Until recently, the prevailing belief was that digital marketing is only useful for B2C organizations (Lacka & Chong, 2016), but now we see that this kind of marketing may have advantages for B2B companies as well. Digital marketing capabilities significantly contribute to the profitability of companies to an extent that surpasses the impact of classic marketing capabilities (Homburg & Wielgos, 2022).

Although some B2B firms utilize digital marketing, many are unable to fully benefit due to lack of comprehensive research in this area. A collaborative conceptual framework has been provided to explore future themes. It highlights that certain areas such as digital marketing communications and sales management are experiencing sustained development, while decision support

systems, critical success factors, and electronic marketing orientation have received less scrutiny (Pandey et al., 2020).

Through an examination of the impacts of digitalization on B2B relationship, researchers have underscored the critical importance of focusing on several key areas such as Coopetition, Value co-creation, B2B branding, Innovation networks, Relationship dynamics and power and trust (Hofacker et al., 2020).

Despite research conducted in this field, there is limited literature presenting a comprehensive model for developing digital marketing capabilities in B2B markets.

## Methodology

### Design

Given that the present study seeks to develop a model for developing digital marketing capabilities in B2B markets, it is applied in terms of its objective and exploratory in nature. This research has been conducted using a qualitative approach. Considering the novelty of this topic, the limited knowledge and need for development in Iran, the absence of theory in this area and the inability of existing literature to address the research questions, this study uses the grounded theory method. Grounded theory is recognized as a prominent qualitative research approach extensively in social studies, particularly within marketing and sales research (Gummesson, 2003; Johnson & Matthes, 2018; Johnson & Sohi, 2016; Deeter-Schmelz et al., 2019). As the purpose of this study is to present a comprehensive model for digital marketing capabilities in B2B, Straus and Corbin ground theory has been applied.

### Data Collection

The study sample in the present research consists of 12 individuals active in the marketing sector of companies producing medical and industrial gases. Sampling in this research was conducted using the snowball method, and data collection was carried out through in-depth interviews (Appendix 1). Before conducting the interviews, the interview questions were designed based on the information needed related to the research topic. To ensure that the interview questions adequately addressed the research questions, two preliminary interviews were conducted as pilot tests. As a result of these preliminary interviews, the interview questions were revised, refined, and completed. The data were recorded during the interviews, and after each interview concluded, the audio files were transcribed into texts. In this study, efforts were made to ensure that the interviewees responded to the interview questions freely and independently, without any interference from the researcher in their responses. Additionally, after transcribing the interview text, it was provided to the interviewees for their confirmation.

### Data Analysis

Since the current study was conducted using grounded theory methodology, data analysis began immediately after the first interview concluded (Glaser & Strauss, 1967). Data analysis based on grounded theory comprises three stages: open coding, selective coding, and axial coding. Data analysis was done with the help of Nvivo10 software in this study. After the first interview, the text of interview was entered in the software and open coding operations commenced. Following open coding for each

of the 12 interviews, selective coding began, where similar codes were grouped together for deciding on how to combine and refine them into focused codes. Subsequently, a deeper exploration of each code's nature led to their appropriate naming. These focused codes categorized and conceptualized themes. The last step in the analysis based on grounded theory is axial coding. In this step, the focused codes created in selective coding were gathered around central phenomenon of the research and paradigm model of the research was formed.

## Result

The analysis results indicated that out of the 12 conducted interviews, 405 segments were classified into 6 primary categories: Casual conditions, Intervening conditions, Methods, Contextual conditions, Consequences, and Central phenomenon. The following tables present a summary of the results (Table 1-6).

**Table 1.**

*Categories and classes related to casual conditions*

| Abundance | Open Coding | Axial Coding | Selective coding |
|---|---|---|---|
| ۱ | - | Development of international relations B2B markets | Feeling the need and interest of B2B managers to use digital marketing |
| ۲ | Mastery of digital marketing | Dominance of the Internet and virtual space over all aspects of life | |
| ۵ | It is impossible to avoid digital marketing in the future | | |
| ۴ | High efficiency | Features of digital marketing | |
| ۴ | The distance dimension is not important | | |
| ۴ | Ability to measure digital marketing results | | |
| ۸ | lower cost | | |

**Table 2.**

*Categories and classes related to intervening conditions*

| Abundance | Open Coding | Axial Coding | Selective coding |
|---|---|---|---|
| ۸ | - | The importance of management attitude and thinking | Intervening Conditions |
| ۳ | - | Coordination and integration of the marketing team with other units | |

**Table 3.**

*Categories and classes related to methods*

| Abundance | Open Coding | Axial Coding | Selective Coding |
|---|---|---|---|
| ۱۱ | Specialized content production | Website | |
| ۴ | company's information | | |
| ۲ | Industry news and trends | | |
| ۱ | Social network links | | |
| ۱ | Online tenders and auctions | | |
| ۱ | Online exhibitions | | |
| ۶ | Aparat | Social networks | |
| ۱۱ | Instagram | | |

| Abundance | Open Coding | Axial Coding | Selective Coding |
|---|---|---|---|
| ۵ | Telegram | | Methods of developing digital marketing capabilities/using digital marketing tools |
| ۱ | Twitter | | |
| ۲ | Facebook | | |
| ۵ | LinkedIn | | |
| ۵ | Whatsapp | | |
| ۱ | Youtube | | |
| ۱۱ | Initial customer search suggestions | SEO | |
| ۳ | - | PPC[2] | |
| ۷ | - | Email marketing | |
| ۱ | - | Personal branding | |

**Table 4.**

*Categories and classes related to Contextual conditions*

| Abundance | Open Coding | Axial Coding | Selective Coding |
|---|---|---|---|
| ۳ | - | Changing the way customers choose suppliers | Contextual Conditions |
| ۲ | Ease of using digital marketing opportunities in the industrial market | Predominance of the classical approach in the B2B market | |
| ۶ | Weakness of competitors in using digital marketing | | |

**Table 5.**

*Categories and classes related to consequences*

| Abundance | Open Coding | Axial Coding | Selective Coding |
|---|---|---|---|
| ۲ | branding | Increasing the growth rate of the organization | Consequences |
| ۳ | Creating a competitive advantage | | |
| ۴ | sales increase | | |
| ۹ | Increasing credit and building trust | | |
| ۴ | Increased visibility | | |
| ۳ | Saving time | | |
| ۳ | Increase customer engagement | Customer retention and loyalty | |
| ۱ | Creating good image in the customer's mind | | |
| ۲ | Institutionalization of the brand name in the minds of the audience | | |

**Table 6.**

*Categories and classes related to central phenomenon*

| Abundance | Open Coding | Axial Coding | Selective Coding |
|---|---|---|---|
| ۲ | Appropriate digital marketing strategies | Development of digital marketing capabilities in B2B markets | central phenomenon |
| ۱ | Constantly updating digital marketing knowledge | | |
| ۱ | Utilization of digital marketing specialists | | |

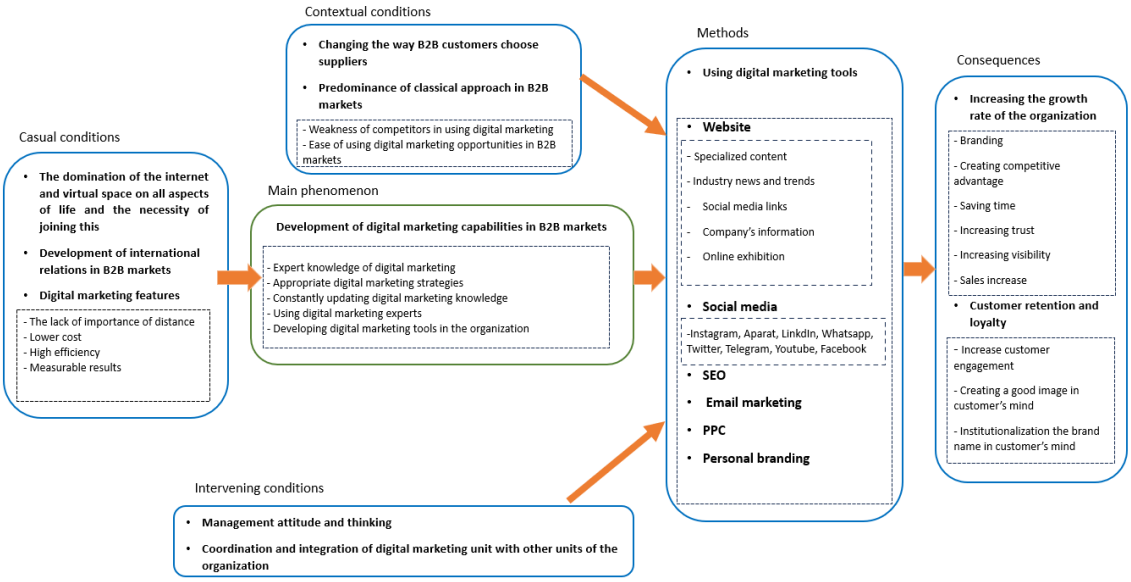
[2] Pay-Per-Click

| Abundance | Open Coding | Axial Coding | Selective Coding |
|---|---|---|---|
| ۱ | Development of digital marketing tools | | |
| ۱۱ | Expert knowledge of digital marketing | | |

During the process of axial coding and with the help of Strauss and Corbin's grounded theory general paradigm model, the paradigm model of the current research is formed for developing digital marketing capabilities in B2B (Figure 1).

**Figure 1.**

*Paradigm model of developing digital marketing capabilities in B2B*




## Discussion

During the coding process of interview files with experts, some of the content was repeated in most of the interviews. Repeating these titles several times shows the importance of these topics compared to other digital marketing topics in the studied industry. Some of these titles are presented in Table 7.

**Table 7.**

*Most repeated codes*

| Codes | Abundance |
|---|---|
| Expert knowledge of digital marketing | 11 |
| Importance of management attitude and thinking | 8 |
| Lower cost of digital marketing | 8 |
| Weakness of competitors in using digital marketing | 6 |
| Social networks (Instagram) | 11 |
| Specialized content production | 11 |
| SEO | 11 |

Based on Table 7; expert knowledge of digital marketing, social networks specifically, Instagram, specialized content on the company's website and SEO are key issues in medical and industrial gases industry. As a result, these companies require special attention to these issues in order to benefit digitalization as much as possible.

**Main phenomenon**

Digital marketing capabilities seek to improve the efficiency of social networks and market analysis and our often related to the communication skills needed to benefit digitalization.

According to the conducted research, digital marketing capabilities in B2B include five categories, each of which has been discussed in the following:

The first refers to this specialized knowledge of digital marketing; which means the knowledge that gives people the ability to use digital marketing tools. as in the past studies the gap between scientific knowledge in organizations and digital marketing developments in B2B companies has been discovered (Herhausen et a l., 2020). Based on the present research the specialized knowledge of digital marketing can be obtained through studying in universities or specialized courses.

The second category refers to appropriate digital marketing strategies that examine, analyze and make decisions about how to use different digital marketing tools according to the business and its internal and external environment. One of the ways to observe digital marketing strategy is to consider the organization's strategy and possible methods for business developments (Hall, 2023).

The studies conducted in the current research indicate that one of the most important capabilities of digital marketing in B2B, considering the special characteristics of B2B markets, is adopting appropriate strategies for using this type of marketing. This requires a comprehensive and complete analysis of the organization's internal and external environment, existing opportunities and threats, customer behavior and tendencies, and the resources available to their organization.

## Methods

Until now, B2B markets have been influenced and dominated by classical approach. They need to change the marketing methods of companies present in this market has increased in recent years. B2B customers have turned to digital world more and more and are trying to meet their needs through digital methods. In the past, B2B suppliers were selected through traditional marketing methods. Therefore, the supplier companies did not need to make changes but, now with the passage of time and the change in the behavior of B2B customers and their desire to use digital tools; they need to turn the digital marketing and their development is felt in B2B companies. The impossibility of using a single version in the using digital marketing in different types of markets is proved (Sektute & Dibb, 2022). Based on these in the result of the current research, the most efficient methods for B2B companies in medical and industrial gases industry have been obtained as described below:

The high costs of traditional marketing methods, the creation of distance restrictions, low efficiency and the impossibility of measuring the results of these methods have led B2B companies to use digital marketing tools.

By observing the changes in the B2B markets, B2B managers have also felt the need to use digital marketing tools and have changed their attitude towards marketing methods. Also, in order to use these tools as effectively as possible, they are trying to coordinate and integrate all organizational units with digital marketing department.

The results of the current research indicate that the best and the most important basis for using digital marketing in B2B markets is to have a professional website. Current research experts believe that, B2B customers making decision to supply their raw materials look for suppliers using search engines like Google, so every industrial company needs to create its own specialized website to be seen and increase its sale. This website can contain information such as a specialized articles related to the company's products and services and how to use them. Company information is one of the other things that must be mentioned in the content of the website. It can include the company's communication channels, it's history and honors, introduction of the companies, products and services, social media links, certificates and standards.

B2B customers are experts and technical people in their industry. They always look for specialized information and news and trends, so another content that can be uploaded on these websites can be industrial news and trends to increase engagement of customers and website visitors. Today, most of people in society are internet users to improve and to manage their reputation. This is not just limited to websites; social media is also considered as a key source in continuous improvement of relations between companies and customers. Website and social media are the two basic digital marketing methods to interact with customers and are so necessary for businesses (Ponzwa et al., 2023).

The expansion of the use of social media has led businesses looking for growth to take advantage of its features for their businesses. Current research has found effective and efficient social media for the studied B2B industry; Instagram as the most popular and basic social media for promoting businesses; LinkedIn as a high quality social media with professional features, YouTube which offers high capabilities in sharing specialized and long-term videos, Twitter and Facebook as social media with a smaller number of audience; WhatsApp and telegram can be also used to ease the communication between companies and their customers. Recognizing suitable social media is a key factor for guaranteeing digital marketing to be successful (Bala & Verma, 2018).

In recent years, the desire to hold face-to-face events has gratefully decreased and factors such as lower costs and time savings have pushed B2B people who have limited time to participate in online exhibitions, tenders and auctions. Therefore; these cases can also be considered as the specific content of the companies present in B2B markets.

Search engine optimization (SEO) refers to the process of influencing the visibility result of the website in search and having a higher rank to be displayed in first options to have more visitors (Yasmin et al., 2015). By searching in search engines like Google B2B customers are looking for more qualifies supplier companies in digital world. One of the criteria for qualifying and scoring is having strong SEO and being among the first search choices. This study has shown that after conducting a search, B2B customers look for answers to their companies needs among the first three companies. Therefore; B2B companies are required to have a special look at their website SEO and plan for its continuous improvement.

B2B customers always seek to meet the needs through reputable B2B companies. Personal branding is one of the methods of using digital marketing in B2B markets by creating sufficient knowledge of experts

working in B2B organizations and creating trust and credibility.

In the past, B2B companies have been taking advantage of digital marketing in some ways. Email Marketing method is one of those methods that has been used by B2B market companies for years. This type of marketing is one of the least expensive types of marketing which can attract the full attention of the customers if it is attractive and uses graphic and textual combinations (Yasmin et al., 2015). Sending industrial news, event invitations and resumes of B2B companies was done via email in the past. According to the current research, email Marketing is one of the digital marketing methods that still has high efficiency due to its low cost.

In today's world people have turned to digital tools to meet their various needs and are always searching online. Pay-per-click advertising is a method of using search engine advertisements to generate clicks on a website. This method is considered one of the best methods for advertising companies as it is low-cost and interactive (Yasmin et al., 2015).

**Casual Conditions**

In the past, the managers of companies producing medical and industrial gases didn't believe in digitalization and this issue has been the reason for their distance from entering digital marketing. But now, these managers have realized that, in order to stay in business, they need to synchronize the processes of the organization with the changes in the market. Also, these companies used to focus on the geographical areas around them. But recently, they have become interested in entering the international market. One of the requirements of which is to operate in online space and that forces B2B managers to accept digital marketing.

Some features of digital marketing have had great impact on the interests of B2B managers in using digital marketing. Features like; the lack of importance of distance, lower cost, higher efficiency, and the ability to capture digital marketing results.

**Contextual Conditions**

Until years ago, industrial customers used to choose their suppliers through traditional methods. But now, these methods have given way to more modern methods; such as Google search, which determines the need for these companies to enter the digital arena. Medical and industrial gases industry is one of the industries, where most of the companies in it are influenced by the classical approach and consider their market to be stable (Koduri, 2011). Now, if a company has a more modern way of thinking than its competitors, it can turn this competitors' weakness into an opportunity for itself and go one step ahead of all competitors.

**Intervening conditions**

The agreement or non-agreement of a manager in the entry of digital marketing into an organization is of a special importance as this issue results from their attitude. At the beginning of digital marketing unit entering an organization, the people active in it need to cooperate and coordinate with other departments of the organization; such as production and R&D departments in order to produce specialized content and also how to publish these contents. The presence or absence of these corporation can act as a facilitator or an obstacle for them.

### Consequences

The consequences of using digital marketing in B2B companies in medical and industrial gases are including the growth rate of the organization through branding, creating a competitive advantage, saving time, increasing credibility and trust, increasing visibility and increasing sale. Customer retention and loyalty is achieved through increasing customer engagement, creating a suitable image in customer's mind, and institutionalizing the brand name in customer's mind. Competitive advantage and customer loyalty are the consequences of using digital marketing in the field of auditing, too (Shahbazitakabi et al., 2023).

### Implication

Using the results of this research, B2B managers can design their digital marketing plan based on the most important and effective methods mentioned in this research and synchronize their organization with the world's current trend, which is digitalization.

## Conclusion

Since the purpose of the research is to provide a model for developing digital marketing capabilities in B2B and it has been conducted based on grounded theory; the results have been grouped in particular categories. Casual conditions, intervening conditions, contextual conditions, methods and consequences of using digital marketing appropriate tools in B2B companies have been obtained during analyzing the interviews with experts and presented in a comprehensive model.

## Limitation and Future Research

This study was done in medical and industrial gases industry and if needed, it can be done in other B2B industries.

The research was done in developing countries and doing it in developed ones can provide the essentials to have a useful comparison.

Researchers can do the research having different qualitative approach or evaluate the presented model in the research using quantitative methods.

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# Designing a Comprehensive Leadership Model System in Organizations

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**Abstract**
Today, considering that the growth and flourishing of any organization depend on the knowledge and capabilities of its leaders, the first and most important step in this path is to identify the level of knowledge and ability of the leaders within an organization. The most effective tool for understanding the awareness of managers is to recognize their competencies within the organization. The aim of the present research was to design a comprehensive leadership model. A qualitative case study research design was employed. Participants were selected using purposive sampling and theoretical saturation criteria, resulting in 27 elites and faculty members from Fars Province being chosen for interviews. To obtain the credibility and validity of the data, participant response review methods were used, and reliability was assessed using the Holistic coefficient, which was found to be 0.81. The findings of the research indicated that the comprehensive leadership competency model consists of four overarching themes: clear thinking, which includes future thinking, team thinking, conceptual thinking, and creative thinking; self-leadership, which encompasses self-management, accountability, flexibility, resilience, and continuous learning; guiding others, which includes empathy, perception and evaluation, multigenerational leadership, communication skills, writing skills, and diplomacy; and knowledge management, which involves negotiation, conflict management, coaching, customer orientation, problem-solving, and authenticity.

**Keywords**: Complete Leadership, Network of themes, Competency, Educational Managers of Schools.

## Introduction

Experts believe that quality and effectiveness in education require the presence of efficient and capable leaders, or in other words, full leadership in all areas related to the teaching-learning processes. This need becomes even more pronounced when education undergoes fundamental changes and transformations in guiding and improving teaching-learning processes and creating desirable changes in educational systems. Leaders play a crucial role in this context (Habibi et al., 2022). In this regard, one of the serious challenges in effectively managing organizations, especially in the public sector, is ensuring the presence of competent managers at the top of the organizational hierarchy. Management experts propose competency-based management as a strong tool that emphasizes

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individual behaviors and contributes to organizational success. For an organization to implement a competency-based approach to human resources, competencies must be defined, and a model must be developed that describes these competencies (Cochran, 2009).

The concept of competency is at the heart of leadership, providing a foundation for integrating key human resource activities. As a result, it develops a comprehensive approach to managing people within organizations (Lucia & Lepsinger, 1999).

The presence of a meritocratic system in any country ensures its stability, acceptance, and legitimacy. Therefore, the selection and appointment of competent and exemplary leaders at the helm of organizations is of particular importance. Today's management of organizations and enterprises must be based on the rule of law, alongside knowledge, insight, expertise, and ethical commitment, in such a way that they can meet the spiritual and material needs of society internally and possess the capability to confront various transformations on a regional and global scale. This can only be achieved by individuals who are among the elites, innovators, and, in other words, the deserving (Kheir Khah, 2019). In today's societies, the role of managerial competencies is undeniable; it should be noted that leadership competencies significantly influence organizational effectiveness. The school manager, in the role of a leader, is a critical factor in enhancing the quality of the school and the overall success of the institution (Lunenburg, 2010). Properly and effectively implementing worthy leadership addresses the long-term need of organizations for committed and efficient managers. To achieve this, governmental organizations must prepare a management competency program tailored to their needs based on the requirements of the public sector and the respective organization. The foundation of genuine leadership with the concept of originality expresses the conditions in which individuals behave in accordance with their values and beliefs and their high human nature (Jafari & et al., 2023). The inability to find suitable individuals for competencies and the succession of managers is one of the serious issues faced by every organization (Chang et al., 2020). The term leadership has been used at various levels of human sciences, including political, social, religious, and managerial disciplines, where, despite slight differences, it generally signifies influence over individuals and the capacity to bring about change and guidance in their behavior to achieve objectives. Motahari has stated that, "a leader is someone who facilitates the group in achieving its leadership goals; in other words, they ease the path to the desired outcome." However, objectives differ across various sciences and domains. In management science, Henri Fayol first introduced leadership as "direction or command" as one of the five functions of management; later, the term "guidance" was adopted in Persian. Currently, it refers to the ability of others to diligently strive to achieve specific goals, and the essence of the leadership process lies in an individual's ability to influence others (Hosseini, 2013).

Research results indicate that leadership competence has a significant impact on improving performance, and appropriate performance positively affects the enhancement of organizational accreditation outcomes (Rahardja et al., 2018). The

establishment of a competency system has been emphasized as one of the major strategic policies in education in the twenty-year vision document and the Fourth Development Plan. In today's turbulent business world, educational organizations are striving and competing to identify, attract, and retain the most competent managers as a competitive advantage. In the complex and evolving conditions of today's society, the development programs for managers' capabilities at various management levels, aimed at enhancing their efficiency and effectiveness, are considered the most important and valuable goal and mission of organizations. In educational systems, the selection, training, and professional development of good and effective managers is one of the fundamental challenges. Management positions are typically complex, and successful and effective performance in an organization requires a set of competencies, skills, abilities, and specific characteristics (Mouszadeh & Adli, 2009). Crises related to social turmoil, such as violence, drug abuse, and ignorance, stem from inadequate leadership, as do the challenges of preparing citizens with social skills, personal values, and high levels of responsibility. Senge believes that when we face fundamental crises that shape our future, we find solutions through cohesive integration among participants and the relationships that bring us closer together. No entity in our society reinforces the concept of structured integration and cohesion better than leadership services. There is always the issue that excessive collaboration and coordination in crisis management and problem-solving can diminish the independence and perspective that define us as a nation or as a creative force in the world; however, this is not the intent or outcome of leadership (Senge, 2006). Leaders must have the ability to create positive models, develop the skills and capabilities of employees, motivate them, and foster a healthy organizational culture. The inability to create constructive and impactful patterns, a lack of attention to the needs and motivations of employees, and the failure to establish an appropriate organizational culture can lead to decreased employee motivation and performance, increased turnover rates, and reduced training quality. Given these factors, today, the competency of leaders is considered one of the most important tools for achieving goals within organizations, and focusing on their competencies can be a significant source of effectiveness in organizations. Therefore, this research seeks to answer the question of what components constitute a comprehensive leadership competency model in education. Complete leadership in a school context encompasses an integrated approach that promotes the growth and development of all stakeholders within the educational environment. This concept extends beyond mere managerial responsibilities, as it involves fostering an atmosphere of collaboration, empowerment, and accountability among students, educators, and administrators (Suprayitno, 2024). At the core of complete leadership is the recognition that effective schools require strong, principled leadership that actively engages various community members. Principals and school leaders must move beyond traditional top-down management styles and embrace a participatory approach. By involving teachers in decision-making processes, encouraging their professional development, and valuing their insights, schools can create a collaborative culture that

enhances teaching efficacy and improves student outcomes (Zhang & Xu, 2024).

## Research Method

The research method employed was a qualitative case study, conducted using thematic analysis based on the method of Attride-Stirling (2011). The basic themes include codes and key points from the text. A thorough reading of the text should identify the smallest codes, which are then selected as basic themes. Organizing themes consist of themes derived from the combination and summarization of basic themes. The basic codes should be reviewed, and similar concepts should be grouped together. The researcher, based on their ability to discern and their expertise, should choose an appropriate name for each category of codes. Ultimately, the overarching themes encompass the superior themes that represent the text as a whole. The sample size was determined based on the principle of theoretical saturation, meaning that the researcher continuously encounters recurring data. For instance, when the researcher hears similar statements and opinions repeatedly during ongoing interviews, they can infer that data saturation has been reached; however, it is suggested that after the researcher feels the obtained data is repetitive, a few additional interviews should be conducted to confirm this belief (who continued interviews until reaching 27 participants for assurance of results). Participants were selected using purposive sampling with a criterion-based technique. Therefore, the method for selecting participants in the qualitative section was purposive and criterion-based; participants included faculty members with more than 15 years of teaching experience who had at least one publication or article in the field of leadership and educational management, school administrators with a minimum of 15 years of management experience who held a master's degree in educational management, their thesis focusing on management and educational leadership, and teachers who had been nationally recognized at least once. Among the 27 individuals who participated in the interviews, 11 were men and 16 were women, consisting of 8 faculty members, 13 school administrators, and 6 full-time teachers.

Semi-structured interviews were utilized for data gathering. It is noteworthy that the criteria for sample selection in the qualitative section included having over 15 years of work and management experience, as well as the willingness to collaborate in the research and respond to questions, all of which were considered in the purposive sampling process. In these interviews, the questions were developed using the relevant literature and the results obtained from qualitative research. In the semi-structured approach, the researcher asks a set of questions to collect data. However, this approach gives the researcher the flexibility to ask additional questions if an interesting or new line of inquiry arises during the interview process. This flexibility in questioning helps the researcher to delve deeper into the topic. For this reason, the semi-structured interview method was chosen for data collection. Before the interview session, an introduction regarding complete leadership and the focal points of the interview was provided to the participants. According to Hooman (2011), the interview process with experts and key informants, who are knowledgeable and specialized in education, continued until the aspects and diverse components of the phenomenon of complete leadership

competencies were fully identified and described, reaching theoretical saturation. Initially, they were asked, "What is your perception of complete leadership? What is your understanding of complete leadership competencies in education? What indicators could they have?" The average duration of each interview was approximately 45 minutes. With the interviewee's permission, the interviews were recorded, and after each interview, the text was transcribed onto paper.

Data analysis was conducted using thematic analysis based on the method of Attride-Stirling (2011) to achieve a network of themes. In the first step, excerpts from the participants' interview texts were extracted, recorded on paper, and initial coding was performed on these excerpts in separate tables. In the next step, by grouping codes with similar meanings, basic themes were extracted. Then, based on the practical similarities of the basic themes, each basic theme was categorized into an organizing theme. Finally, the organizing themes were placed within an abstract and overarching theme, and the final table categorizing the themes was compiled. To ensure the accuracy and robustness of the research, the criteria of Lincoln and Guba were utilized. According to Lincoln and Guba, four criteria should be used to assess the scientific validity of qualitative studies: credibility (acceptability, believability), dependability, confirmability, and transferability. In this research, two indicators, believability and transferability, were employed.

To ensure the accuracy and appropriateness of the extracted codes, the coded texts were presented to two participants familiar with the qualitative research process, and their accuracy and appropriateness were reviewed and, in some cases, revised. These actions were taken to maintain the validity and reliability of the data and the results obtained from the research. To enhance the transferability and applicability of the data in similar contexts, maximum diversity in sampling was utilized. This approach aids in the transferability of the data, as considering diversity in sampling allows for broader generalization and transfer of the data. To increase the transferability and generalizability of the data, this research employed sampling from various levels and made efforts to maximize data diversity. Additionally, the relevance of the data indicates the confirmation of the interview and its accuracy. These actions were taken to ensure the transferability and reliability of the research results. For the reliability of the coding results, the Holistic coefficient was used.

The Holsti coefficient is a measurement criterion for the agreement between two codings, indicating the percentage of overlaps between the two codings relative to the total number of both codings. The formula for calculating the Holsti coefficient is as follows:

$$H = 2 * (a * d - b * c) / ((a + c) * (b + d))$$

Generally, a Holsti index above 0.9 indicates a high level of confidence in the validity of qualitative analysis. However, in various studies, an acceptable Holsti index is considered to be above 0.8. In this research, this value was calculated to be 0.81.

## Research Findings

This research aimed to design a competency model for the complete leadership of educational managers at the secondary level in Fars Province. In this study, the thematic analysis method by

Attride-Stirling was employed. This method allows for the extraction of foundational (key), organizing (central), and encompassing concepts, creating a network of themes from the data. Using this method, important and key concepts present in the data are identified, and then, based on the relationships among them, a hierarchical structure of themes is formed. Furthermore, to validate the proposed model, the opinions of experts were evaluated using a questionnaire. This questionnaire was designed to gather experts' views and critiques regarding the thematic analysis model used and the results obtained from it. The opinions and feedback from experts can assist in validating and strengthening the thematic analysis model used, and they may also provide new ideas and suggestions for improving the model. The use of the Attride-Stirling thematic analysis method in this research has provided opportunities that help clarify and interpret the data. Additionally, validating the model and receiving feedback from experts is also very important for enhancing and improving the research.

**Table 1.**

*Examples of Excerpts and Core Themes*

| Base Theme | Initial Code | Code of Interviewee | A Fragment of Discourse | Row |
|---|---|---|---|---|
| Future Thinking | The leader must have the ability to see the surroundings in a way that others cannot. They should be knowledgeable and aware of future trends and their impact on all matters. They should be able to predict various scenarios regarding decision-making about the future. | Woman-Associate Professor-21 years of experience | One of the most important responsibilities of effective leadership is to continuously forecast future trends and developments and design educational strategies based on them. To achieve this, one must focus on studying and analyzing information related to the field of education. By researching new educational trends, technological innovations, changes in teaching and learning methods, and optimal principles of instructional design, I strive to gain a deeper understanding and insight.<br>Additionally, analyzing various scenarios about the future plays a crucial role in guiding educational strategies. By reflecting on potential risks and opportunities in the future, leadership can obtain clear images of the different paths that education may take. I believe these scenarios help leaders present a combination of educational strategies and approaches that can adapt to future changes.<br>Moreover, throughout all these processes, I collaborate with my educational team. I leverage the sharing of experiences and knowledge among team members and advance a joint analysis of trends and the future of education. This extensive interaction with the team allows for action even in the face of some ambiguity in conditions, while maintaining focus on desired goals and outcomes, which is an important trait for leaders. By studying and understanding future trends and their impact on the business environment, leaders can constructively address the uncertainties present in situations.<br>Successful leaders capitalize on available information regarding trends, competition, | 1 |

| Base Theme | Initial Code | Code of Interviewee | A Fragment of Discourse | Row |
|---|---|---|---|---|
| | | | technological changes, and industrial developments. They may form various scenarios about the future through studying industry reports, research findings, interviewing business owners, and utilizing forecasting and analytical methods. The leader must have the ability to see the surroundings in a way that others cannot. They should be inclined to study and understand future trends and their impact on all matters, and be able to predict various scenarios for decision-making about the future. | |
| Team thinking | She should have the idea of utilizing teams made up of talented individuals with work experience and interest in the tasks. Support existing teams in the workplace while also being a part of them. Always be responsive to team members and their needs. Participate in team discussions and support team decisions, and refrain from speaking derogatorily about team members behind their backs. | Woman – Manager – 17 years of experience. | A complete leader should utilize teams composed of talented individuals with strong work backgrounds in the educational environment. These teams can consist of faculty members and school administrative staff and can function as a consulting team to improve the quality of education and learning. Of course, to support these teams, the first step is for the educational leader to also become a member of the team. This action demonstrates that the leader does not belittle the team members and is ready to collaborate with them.<br>The complete leader should participate in team meetings and listen to discussions and debates regarding educational decisions. Additionally, all team members should feel that they can approach me as the educational manager to share their needs and problems. The leader should always be responsive to team members and strive to address their issues.<br>Teams should feel that their decisions are supported by the leader. The leader must fully participate in team meetings and seriously consider the discussions and opinions of all team members. If a decision is made by the team, the leader should provide all necessary support for the implementation of that decision. Furthermore, the leader should not speak disparagingly behind the backs of team members and should strive to respect everyone as much as necessary.<br>By forming teams composed of talented individuals with strong work backgrounds, we can achieve significant improvements in the quality of education and learning. These teams can serve as advisory resources and take on the roles of mentors and guides. They can share their knowledge and experiences with other members of the school and offer innovative solutions to enhance educational processes. Moreover, these teams can create an environment for the professional and personal development of their members. By providing learning and growth opportunities, talented individuals can enhance their capabilities and be more productive in school activities. The team comprises talented members with high work experience, and through collaboration and coordination among them, we | 2 |

| Base Theme | Initial Code | Code of Interviewee | A Fragment of Discourse | Row |
|---|---|---|---|---|
| | | | have achieved significant improvements in the teaching and learning process. Additionally, individuals participating in these teams feel a sense of identity and value, which motivates them to advance the school's goals. | |
| Conceptual thinking. | Enjoys discussing paradigms and higher education philosophy with peers. Reflects on the models and concepts he encounters and their connection to leadership opportunities. Considers the advantages and disadvantages of structure and culture in organizations and how they impact them. | Male - Manager - 18 years of experience - PhD. | Hello! Yes, thank you. I'm glad to participate in this discussion. Paradigms are essentially patterns and models that influence our education. Depending on the paradigm adopted in schools for education, various approaches and methods are employed.<br>When examining the relationship between paradigms and leadership opportunities, it can be said that leadership opportunities play a significant role in educational paradigms. Educational leaders can create opportunities for development and progress by influencing paradigms and shaping the philosophy of education. They can foster a better educational environment by improving teaching methods, transforming school culture, and encouraging colleagues to participate more actively.<br>Regarding the advantages and disadvantages of structure and culture in organizations, it can be said that the school's structure and culture are highly impactful. Regional or national structures, as well as the internal structure of the school, can influence workflow and team collaboration. The benefits of an appropriate structure include the clear delineation of tasks and responsibilities, effective coordination and communication among team members, and increased productivity. However, an unsuitable and rigid structure can lead to limitations and problems in decision-making and execution.<br>Organizational culture plays a significant role in the interactions and behaviors of school members. A healthy organizational culture, along with colleagues who treat each other with respect and empathy, contributes to improving the educational environment and enhancing the quality of education. However, a culture based on competition and lack of collaboration can lead to tension and decreased coordination among team members .<br>The impact of structure and culture in an organization is crucial due to their influence on the morale and overall behavior of members. For educational leaders, it is important to outline and promote an appropriate structure and culture to create a dynamic and balanced educational environment .<br>Thank you. These were very interesting points. Do you have any insights about your experience in school and the connection of these concepts to school performance ?<br>Considering the relationship between paradigms and leadership opportunities, I strive to create | 3 |

| Base Theme | Initial Code | Code of Interviewee | A Fragment of Discourse | Row |
|---|---|---|---|---|
| | | | opportunities for the development and leadership of my colleagues. By providing training related to higher education philosophy and offering opportunities to attend workshops and professional development groups, I can enhance the performance and engagement of my colleagues. Regarding the structure and organizational culture of the school, we aim to establish a flexible and transparent structure. Additionally, we utilize a culture of collaboration, respect, and participation. By holding team meetings, encouraging colleagues to provide constructive criticism, and sharing ideas, we seek to promote an organizational culture that leverages collaboration and the sharing of knowledge and experiences among all members. | |

By reviewing the core themes and feedback from participants, the themes were modified. After achieving the core themes, the themes were abstracted. At this stage of thematic analysis, an effort was made to organize the initial themes obtained into more abstract themes that would guide us to more fundamental themes.

**Table 2.**

*Core Themes, Organizing Themes, and Comprehensive Themes Model*

| Main Theme | Comprehensive Theme | Organizing Themes | Core Themes | Interview Text Sample |
|---|---|---|---|---|
| Complete Leadership Competencies | Clear Thinking | Future Thinking | The ability to see the surroundings in a way that others cannot. Being knowledgeable and aware of future trends and their impact on all matters. Predicting various scenarios regarding decision-making about the future. | *I can see trends and patterns in the world around me that most people are unaware of. This helps me to better predict the future and understand what events might occur in the future. (Interview ¹).* |
| | | Team Thinking | Should have the idea of utilizing teams composed of talented individuals with work backgrounds and interests. Support the existing teams in the workplace and also be a part of them. Always be responsive to the team members and their needs. Participate in teams, engage in discussions, and support team decisions. Should not | *A good team member should support the existing teams in the company and also be an active member of a team. They should always be attentive to the needs and wants of the other team members and be able to respond to them. This is very important. In a way, you could say that a good team member is an active listener and a true supporter, and there is one more thing that is very important. A good team member should actively* |

| Main Theme | Comprehensive Theme | Organizing Themes | Core Themes | Interview Text Sample |
|---|---|---|---|---|
| | | | speak disparagingly about team members behind their backs. | *participate in team discussions and decision-making and support the opinions and ideas of others. (Interview ٥).* |
| | | Conceptual thinking | I enjoy discussing the concepts of paradigms and the philosophy of education with those around me. I think about the models and concepts I encounter and their connection to leadership opportunities. I reflect on the advantages and disadvantages of structure and culture in organizations and how they influence them. | *I am passionate about discussing new and challenging ideas in the field of education. I believe it is very important to look at education from different perspectives and to think together about solving problems and improving the quality of education. Personally, I am interested in the various models and concepts that exist in the field of education. I like to think about how these models can be used to enhance student learning (Interview ٢١).*<br>*I believe that the structure and culture of an organization can have a significant impact on how students learn and grow. In my opinion, an ideal educational environment should be creative, collaborative, and supportive (Interview ٩).* |
| | | Creative thinking | I utilize brainstorming to address issues and find it enjoyable. I look at new ideas and perspectives with an open mind, engage with them without bias towards preconceptions, and avoid hasty judgments. When facing challenges, especially new ones, I maintain a creative thinking style. I hold necessary sessions for creative thinking and lead them. I propose new ideas to improve outcomes. | *It is very interesting for me to collaborate with others to solve problems by using brainstorming. I believe this is the best way to find creative and innovative solutions. I take pleasure in being able to approach new ideas and perspectives with an open mind and to engage with them without bias towards preconceptions. I also enjoy avoiding hasty judgments and giving all ideas a chance to be heard (Interview 26)* |
| | | Problem Solving | It involves breaking down issues and taking step-by-step actions to solve them. One should always be interested in challenges and | *Hypothesis formation is a very important skill that helps a person solve problems. This means that I should be able to make a series of correct and* |

| Main Theme | Comprehensive Theme | Organizing Themes | Core Themes | Interview Text Sample |
|---|---|---|---|---|
| | | | unsolvable problems. To solve problems, one should be able to hypothesize well. After solving a problem, one should regularly review and assess their performance to ensure improvement has been achieved. | *logical guesses based on the information I have (Interview ۱٤).* |
| | Self-direction | Self-management | One should maintain a balance between physical and emotional self-care and completing tasks. Be aware of how one reacts to employees. Be able to work independently whenever necessary. Have awareness of oneself and be present in the moment. | *I always try to maintain a balance between taking care of myself and fulfilling my responsibilities. I try to have a regular schedule and set aside time for myself to engage in activities I enjoy, such as exercising, reading, or spending time with family and friends. Additionally, I make an effort to take regular breaks throughout the day and fully utilize my holidays and time off (Interview ۱٤).*<br>*Regarding how to interact with employees, I believe that mutual respect and understanding are very important. I try to treat all my colleagues with respect and pay attention to their opinions and feelings, and I strive to be a good listener so that I can help them when necessary (Interview ۲۷).* |
| | | Personal accountability | If they fail to succeed in a commitment, they should not make excuses or blame others. They should take responsibility for their actions, recognize and understand them, and provide feedback to others in this regard. They should learn from their mistakes and failures to enhance their future performance. They should accept responsibility | *I always try to take responsibility for my actions and tasks, even if I make mistakes. I believe making excuses and blaming others does not help solve the problem and only makes things worse. It's good for a person to learn from their mistakes and use them to improve their performance in the future. They should consider their mistakes as an opportunity for learning and growth (Interview ۳).* |

| Main Theme | Comprehensive Theme | Organizing Themes | Core Themes | Interview Text Sample |
|---|---|---|---|---|
| | | | for their emotions, behaviors, and outcomes. | *I try to provide my feedback in a constructive and positive manner. It's important to pay attention to people's strengths while also helping them improve their weaknesses (Interview ۱۹).* |
| | | Flexibility | Recognize changes in the current circumstances and take steps towards them. Understand that their viewpoint is not the only acceptable perspective and be ready to consider different ideas and approaches, listening to others' suggestions. Have the ability to manage and accept some ambiguity in various situations while focusing on goals and outcomes. When necessary, be able to change their priorities and scheduling. | *I try to focus on my goals and results, even when the circumstances are unclear. It's important to be able to cope with uncertainty while continuing our efforts to achieve our goals. Sometimes, it's necessary to adjust our priorities and planning. Therefore, I am prepared to change my priorities and plans as needed. It's crucial to be able to adapt to new conditions and seize new opportunities (Interview ۲٤).* |
| | | Resilience | In personal life, one should have experience and have tasted the ups and downs of life. Learn from past failures and turn them into opportunities. Share difficult problems with colleagues and friends. Remain hopeful about the future during tough days. Be able to manage daily stress well. | *I believe that failures are a part of life and can teach us many lessons. I try to learn a new lesson from each failure and use that lesson to improve my performance in the future. Essentially, I make an effort to give myself a chance to feel upset after each failure, and then look at the situation logically to see what happened and how I can learn from it (Interview ۱۸).* |
| | | Continuous learning. | Those around him should consider him an expert and professional in his field. He should have a professional development plan for a year. He should familiarize himself with thinkers in his areas of interest and study their works. He should eagerly participate in learning opportunities such as forums, conferences, and | *I love participating in new learning opportunities. I believe that learning is a continuous process, and I am always looking for new ways to learn and grow. Therefore, my preference for learning opportunities is to attend conferences, seminars, online courses, and workshops; I truly enjoy it. I also like reading* |

| Main Theme | Comprehensive Theme | Organizing Themes | Core Themes | Interview Text Sample |
|---|---|---|---|---|
| | | | seminars. Support employees' efforts to learn. | *books and articles and listening to podcasts (Interview ٤).* |
| | | Empathy | They should easily set aside their own assumptions to achieve a deeper understanding of others. They should have good listening skills to understand employees' emotions. While listening to employees' statements and feelings, they should ask themselves if they have a shared understanding. When talking to employees, they should ask meaningful questions. They should include being part of groups and NGOs aimed at helping others in their plans. Empathy and guiding others. | *If we want to help each other, we need to know how to listen well. What I mean is that we shouldn't just hear our colleague's words; we should also be able to understand their feelings. For example, when a manager sees an employee talking about a problem at work, they should listen carefully and try to understand how the employee feels (Interview ٢١).* |
| | guiding others | Understanding and evaluating others | They should not pay attention to stereotypical behaviors based on ethnicity, beliefs, gender, and religion in their plans. They should identify individuals' talents and utilize them in their tasks. They should understand multiple perspectives on important leadership issues. | *In my opinion, a good manager should treat all their employees with respect and without any prejudice. What I mean is that they should not differentiate between their employees based on ethnicity, religion, gender, or any other type of difference (Interview ٢١).* |
| | | Multi-generational leadership | Always utilize individuals with experience in negotiation and bargaining within teams. Prioritize individuals who want to understand what their job means in addition to just doing it and whether it has a positive impact. Consider using people who are willing to collaborate and work online and who possess skills relevant to their tasks in the organizational development | *In today's world, where many people are only after money and status, I think it's really important for individuals to pursue work that gives them meaning and makes them feel like they're making a positive impact on the world. What I mean is that work should not just be about a salary. A person should feel like they are creating something valuable or helping others in some way (Interview ١٣).* |

| Main Theme | Comprehensive Theme | Organizing Themes | Core Themes | Interview Text Sample |
|---|---|---|---|---|
| | | | program. Take into account young interns seeking recognition and experience within the organization. | |
| | | Public speaking skills | Be able to enthusiastically prepare for formal speeches and monitor opportunities. Have completed courses in public speaking and presentation skills. Demonstrate strong leadership through appropriate attire and by engaging others in conversation and the work environment. Be able to organize tasks well and show enthusiasm in this area. Review all technical details that affect the audience, such as lighting, sound, equipment, etc. | *I love speaking in front of an audience and I'm not afraid of it at all. I believe it's a very important skill that can be useful in any job (Interview ۵).* |
| | | Writing skills | Before sending a letter or message, they should check it several times before sending. They should be familiar with and adhere to the rules and guidelines of the Persian language. They should avoid using specialized or colloquial terms in their writing unless the audience is a professional individual. They should regularly present articles or reports in various media. | *If someone wants to work in the field of correspondence, they must be able to write correctly and fluently in Persian, avoid spelling and grammatical errors, be familiar with Persian grammar, and be able to use various sentence structures appropriately (Interview ۱).* |
| | | Diplomacy and tact | They should always behave politely and respectfully towards others, regardless of the situation or people's attitudes towards them. They should have the ability to express disagreement in a respectful and considerate manner to foster constructive dialogue and a positive environment. | *Everyone, regardless of their situation, whether at work or in personal life, should be able to speak well and convey their meaning accurately to others (Interview ۱).* |

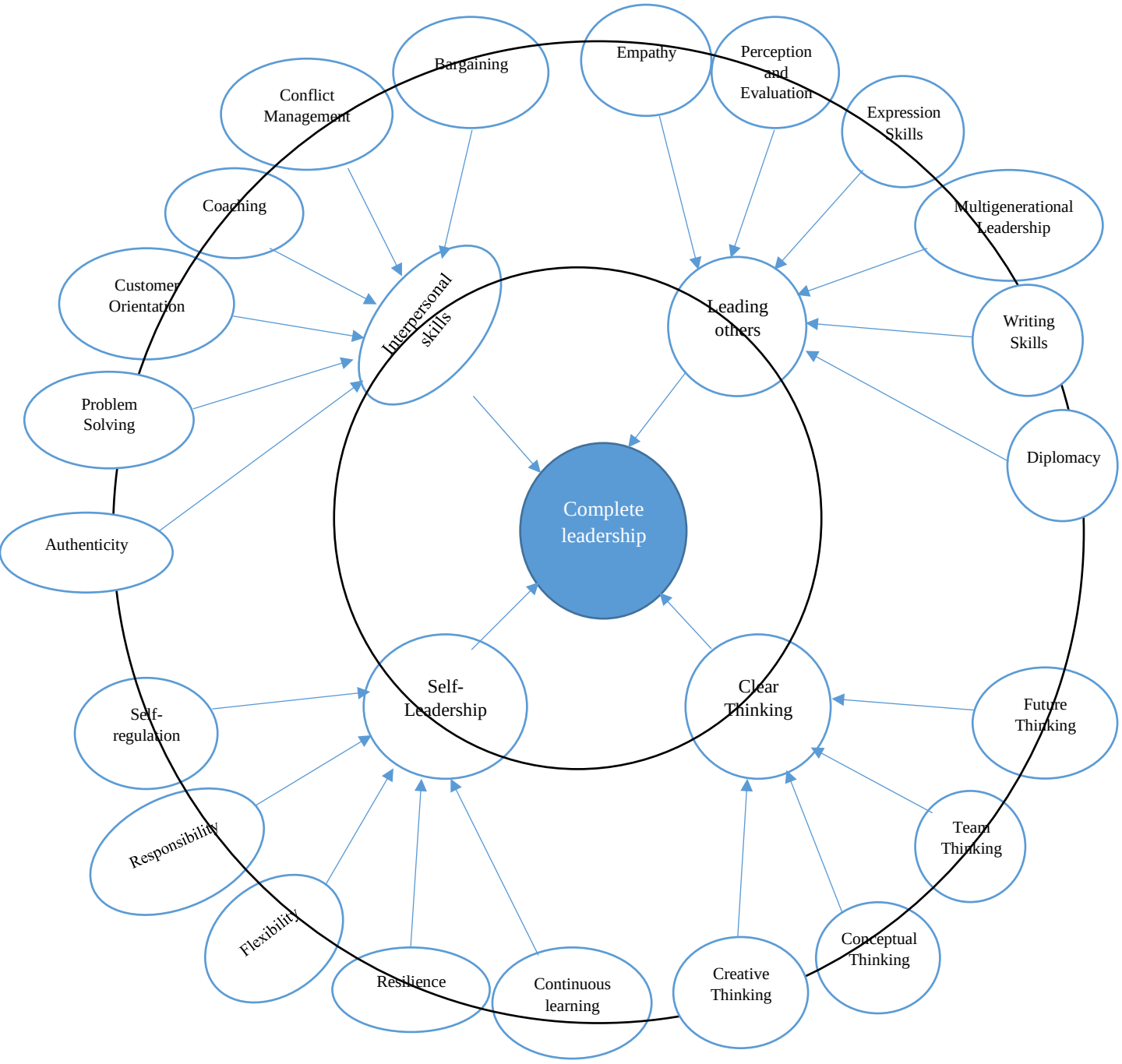
| Main Theme | Comprehensive Theme | Organizing Themes | Core Themes | Interview Text Sample |
|---|---|---|---|---|
| | | | When speaking, they should pay attention to the words used and how others perceive them to establish effective communication. They should always actively seek feedback from others on how they can be more tactful. | |
| | communication skills | Bargaining and persuasion | I use my influence to persuade others and can build the necessary trust. When persuading others, I do not use tricks or unethical approaches and strive to be transparent. During negotiations, I can separate individuals from important issues and focus on the essence of the negotiation instead of confronting personal dynamics. In negotiations, I think about win-win outcomes. I believe that there are alternatives that are better than the current solutions. | *My colleagues tell me that I have a lot of skill in persuading others. I can speak in simple and understandable language and clearly and logically convey my ideas to others. Of course, just talking isn't enough. I always try to be honest and transparent. I never use deception to persuade others (Interview ٥).* |
| | | Conflict management | I seek to understand the different values or interests of the parties involved. I view conflicts as opportunities to gain deeper insights about others and use that for stronger collaboration in the future. I do not ignore conflicts or avoid them; instead, I use them as opportunities to strengthen relationships. | *I believe that conflict is a natural part of any work environment, and instead of avoiding it, I try to use it as an opportunity for learning and growth. I think when we face a conflict, it's important to try to understand where the root of the problem lies instead of just looking for someone to blame. After that, we should talk to the other party and listen to their words with an open mind (Interview ٢١).* |
| | | Coaching | Professional development programs should focus on being a coach for employees. Skills such as providing timely feedback and asking questions to set | *In my opinion, in any team, whether it's a work team or a sports team, it's very important for team members to be able to give each other timely and accurate feedback. This way, everyone learns from each* |

| Main Theme | Comprehensive Theme | Organizing Themes | Core Themes | Interview Text Sample |
|---|---|---|---|---|
| | | | clear expectations should be included. Help others think better about what they want and their work plans. Assist stakeholders in increasing their personal accountability for the commitments they have made. | *other, and things progress better. By timely feedback, I mean that if someone is doing something wrong or could do it better, we should let them know. Of course, it's not just about pointing out faults; we should also suggest solutions. Most importantly, we need to do this in a timely manner, not wait until the end of a task to say that there was a problem somewhere (Interview ۲۲).* |
| | | Customer Orientation | Always ask stakeholders how to work and what actions can be taken for improvement. Promise stakeholders and act seriously on those promises. Consciously seek opportunities to exceed customer expectations and plan accordingly. | *It is very important to utilize the opinions and ideas of everyone who has a stake in a project or organization. This way, a more comprehensive view of the situation can be obtained, and the best solutions can be found (Interview ۲۲).* |
| | | Authenticity | Recognize their strengths and weaknesses and act accordingly. Have the courage in new decision-making because change leads to growth. Understand that their position depends on the support and backing of their colleagues. To become a complete leader, be honest with everyone, both inside and outside the workplace. | *I believe a successful person in this job is someone who first and foremost has the courage to make decisions. In today's world, where everything changes very quickly, it is crucial for a person to be able to make decisions swiftly and not be afraid of taking risks (Interview ۱٤).* |

Includes: clear thinking including (future thinking, team thinking, conceptual thinking, and creative thinking), self-leadership (self-management, accountability, flexibility, resilience, continuous learning), guiding others including (empathy, perception and evaluation, multigenerational leadership, communication skills, writing skills, and diplomacy), and knowledge management including (negotiation, conflict management, coaching, customer orientation, problem-solving, and authenticity).

**Figure 1.**

*The Network of Themes of the complete Leadership Model in Higher Education Institutions*



As seen in the above figure, the network of full leadership themes in schools consists of four overarching themes: clear thinking, self-leadership, guiding others, and communication skills. Each of these overarching themes has its own organizing themes. Clear thinking includes (future thinking, team thinking, conceptual thinking, and creative thinking), self-leadership (self-regulation, accountability, flexibility, resilience, continuous learning), guiding others includes (empathy, perception and evaluation, multigenerational leadership, expression skills, writing skills, and diplomacy), and interpersonal skills include (negotiation, conflict management, coaching, customer orientation, problem-solving, and authenticity).

To assess the credibility of the work stages and the results obtained from the trustworthiness, the following steps were taken:

- Continuous observation of the research process and review of research findings
- Establishing appropriate and correct communication with research participants
- Acceptance of the concepts revealed during the study process with special attention
- Review of interviews by colleagues and research experts to ensure the accuracy of the work

Participants were revisited for review and confirmation of findings by colleagues and research experts. Additionally, to ensure reliability, all interviews were recorded in writing. Furthermore, any points that were ambiguous were discussed with participants, and these ambiguities were resolved. Only a few categories had ambiguities that were corrected in the final categorization.

## Research and Conclusion

In this section, we first describe and analyze the findings of the research, followed by a comparison with previous studies.

The first dimension and its components include clear thinking, which encompasses (futuristic thinking, team thinking, conceptual thinking, and creative thinking). Future-oriented educational leaders have the ability to envision and anticipate changes, beginning preparations for these changes before others do. They actively seek new ideas regarding customers, products, services, strategies, and even their business models, looking for new opportunities. Futuristic thinking is more than mere daydreaming; it is based on a precise understanding of current conditions and a comprehensive knowledge of one's current job or expertise. Futuristic thinkers grasp the fundamentals of their industry and are thus able to propose the best solutions and strategies to address future changes. They seek a deep understanding of trends, challenges, and opportunities within their industry to better predict future possibilities and act accordingly (Obeng & Gillet, 2008).

Conceptual thinking is the ability to think at an abstract level: considering and applying ideas, principles, and assumptions in real-life situations. Individuals skilled in conceptual thinking understand why something is done. They can see through what is happening to grasp the underlying causes. Strong conceptual thinkers can focus on the big picture or a directed strategy. They identify the fundamental principles or assumptions that generate outcomes. Because they can identify hidden causes and establish unclear connections, they can easily explain these causes and connections to others, subsequently applying these fundamental

insights to create practical results. Conceptual thinking may be viewed as a form of futuristic thinking applied to today's problems, as individuals skilled in conceptual thinking can see the level of a situation and understand the underlying theories, models, or paradigms that guide or create current outcomes (Obeng and Gillet, 2008).

Creativity is the ability to think in new ways. It involves going beyond traditional ideas, rules, and methods to express something different or solve a problem. Being creative starts with a need, problem, or opportunity and may arise from internal or external stimulation. For example, a need may stem from personal feelings, such as the desire to express oneself through painting, or the need to solve a puzzle, like understanding why an apple falls from a tree. Creativity generates diverse opportunities in various fields, including problem-solving, achieving goals, and motivating teams to be creative and discover unconventional perspectives. The closest finding that can compare with this section is the research by Tavakoli and colleagues (2017), which concluded that six skills can be identified for quantum leaders, including: creative thinking, systemic thinking, conscious intuitive thinking, situational and contextual thinking, the ability to inspire, and self-organization.Team thinking is important. Teamwork is also vital because leadership is not an individual sport. Independence has been replaced by interdependence—and this will become even more pronounced in the future. The essence of leadership is achieving worthy goals through the collective efforts of others, with the understanding that everyone's aim is to serve the mission and clients, not the boss. In this regard, Obeng and Gillet (2008) also concluded that one of the characteristics of leadership is attention to teams and groups. Self-leadership includes self-regulation, accountability, flexibility, resilience, and continuous learning. Leading others first requires that an individual can lead themselves. If one is skilled in self-leadership, meaning they are constructive, they will ultimately be recognized as a person who can get things done. In this context, the components are examined. Self-regulation refers to the ability to manage and control oneself, emotions, focus, and motivation. Individuals with strong self-regulation can manage their self-improvement without depending on others and can maintain constructive thinking in various situations. Success and failure are related to the strength of self-regulation. This finding aligns with the results of ENT and colleagues (2012). Therefore, the relationship between leadership and self-regulation means that effective leadership can help strengthen individuals' self-regulation, while a person with strong self-regulation can act as an effective leader. These two factors are aligned and mutually reinforcing, impacting individual and organizational development effectively.

Responsibility means accepting and committing to one's duties and tasks. A responsible individual has the ability to accept their role and responsibilities and is committed to their performance in achieving goals. Personal responsibility is the willingness and ability to take personal accountability for the processes, decisions, actions, and outcomes created by the leader. Individuals who have developed the competence of personal responsibility do not need someone else to hold them accountable. Instead, they consider themselves responsible. They can be relied upon. They

are accountable for their actions and behaviors. They are responsible for responding to calls in a timely manner, spending less than their income, maintaining important relationships, and preserving their physical and mental fitness. In the workplace, they take responsibility for completing their work for the team. This finding aligns with the results of Obeng and Gillet (2008). Flexibility refers to the ability to adapt and change in the face of various conditions. A flexible individual can improve and adjust in challenging situations and changes, considering various solutions to achieve goals. Flexibility is one of the essential traits of leadership that plays a significant role in the success and advancement of leaders and organizations. Flexible leadership means the ability to adapt and change with dynamic and variable conditions. Leaders who possess this trait can respond to changes in their organizations and business environment and timely adjust their strategies and approaches. The findings of this section are consistent with the results of Yukl's research (2008). Flexibility is the ability to change plans in response to current realities. Individuals who are flexible can recognize dynamic conditions and adapt their tactics to achieve desired outcomes. They respond quickly to changes in direction, embrace new ideas, and adjust their personal styles to work with diverse individuals. They maintain productivity during transitions or periods of chaos. Resilience means the ability to cope with and recover quickly from difficulties, stress, and trauma. Resilient individuals can focus and improve in the face of setbacks and complex issues, continuing to move forward. Resilience is a skill that allows a person to recover swiftly from hardships and not give up when faced with challenges. This finding aligns with the findings of Obeng and Gillet (2008). Continuous learning refers to the willingness to enhance skills, knowledge, and abilities. A person in a state of continuous learning seeks to improve and elevate themselves over time, taking advantage of learning opportunities in any situation. Continuous learning encompasses the knowledge, skills, and attitudes necessary to create a personal process of ongoing learning and development. Individuals skilled in continuous learning naturally take the initiative to learn and implement new ideas and methods. These individuals are often described as "lifelong learners." They find ways to learn about their interests and the work they are engaged in. In this regard, Najafi and colleagues (2022) identified continuous learning as one of the components of leadership based on Nahj al-Balagha in their research. Leading others involves empathy, perception and evaluation, multigenerational leadership, communication skills, writing skills, and diplomacy. A widely accepted general definition of leadership is that leaders strive to achieve goals through and with their followers. Leading others encompasses the factors you mentioned, including empathy, perception and evaluation, multigenerational leadership, communication skills, writing skills, and diplomacy. Leaders must have the ability to create empathy and emotional connections with group members. They should be able to empathize with others and establish effective communication by reflecting on and understanding the feelings and needs of their members. The term empathy refers to the ability to "be in another's feelings." When you empathize with someone, you see their experience as they see it and feel it as they feel it. You are

able to recognize the emotions that another person is experiencing. Empathy leads to a deeper understanding of others and helps the leader connect with them and care about them. Empathy is different from simply agreeing with others. Instead, it provides the other party with the opportunity to gain greater awareness of their own feelings and experiences. Individuals who are unable to communicate with empathy lack an emotional connection with the other person. Research findings in this area align with the studies of Obeng and Gillet (2008). Understanding and evaluating others is the ability to see individuality in others, recognizing each person as a unique human being, and understanding the unique perspective and attitude of an individual. Each person has unique values, experiences, and aspirations. Another aspect of understanding and evaluating others is the ability to listen objectively to their opinions. Elder (2022) considers the perception and evaluation of others to be part of critical thinking. Critical thinking, in its explicit form, requires organizing one's own thoughts as well as understanding and evaluating the thoughts of others with a deliberate focus on the components present in all human reasoning. This necessitates the development of executive function, where the mind examines and re-examines its thoughts through reasoning about its own thinking to improve its reasoning. This component aligns with the findings of Elder (2022) and Obeng & Gillet (2008). Leaders must have the ability to guide group members from various generations and backgrounds. They should be able to respond to the diverse needs and situations of different generations and establish effective communication with them. Ultimately, multigenerational leadership means the ability of leaders to manage and direct individuals from various generations and styles. Today, an employer can easily have young graduates working alongside their grandparents (Usungu, 2023). Multigenerational leadership entails the leaders' ability to manage and guide group members of different generations and styles. In this regard, implementing the following can help leaders: 1. Utilizing experienced negotiators: Experienced individuals often possess successful negotiation experiences. Leaders can learn from these experiences to improve their skills in this area, thereby enhancing their ability to guide group members during negotiations. 2. Valuing individuals for better understanding of their jobs: Leaders can show individuals what their jobs mean and how they can actively and effectively contribute to the organization. This can motivate individuals to not only increase their productivity but also develop an interest in the organization's core purpose and goals. 3. Engaging skilled individuals willing to work online: Given the growth of technology and changes in the work environment, involving those who are proficient in technology and willing to work online is crucial. Leaders can consider these individuals in organizational development programs and actively leverage their abilities and experiences within teams. 4. Engaging young, aspiring interns: Young and aspiring individuals bring fresh perspectives and new experiences to the organization. Leaders can regard them as a creative and energetic force and utilize their talents and ideas for organizational development. 5. Communication Skills: Leaders must possess the ability to express themselves effectively and understandably. They should be able to convey their ideas, instructions, and opinions

clearly and understandably to group members. 6. Writing Skills: Leaders must have the ability to write effectively. They should be able to prepare documents, reports, and other written communications accurately and understandably. Written communication is the ability to convey a message in a clear and persuasive manner. A person skilled in written communication knows their audience, has a clear purpose, and presents an appropriate number of words that are expertly organized to achieve their goal. 7. Diplomacy: Diplomacy and tact involve the ability to interact fairly, sensitively, and effectively with others, regardless of personal biases or beliefs. Individuals with a well-developed sense of tact and diplomacy are usually polite and courteous. They choose their words carefully to avoid unnecessary provocation of hostility. Diplomatic and tactful individuals use caution and appropriate actions to foster understanding. These findings align with the research of Peterson et al. (2014) regarding the attention to components of empathy, perception, and evaluation of others, and are consistent with the communication and writing skills highlighted in the research of Obeng & Gillet (2008). Interpersonal skills include negotiation, conflict management, coaching, customer orientation, problem-solving, and authenticity. Interpersonal skills in leadership encompass elements that help leaders establish effective relationships when interacting with others and possess the necessary abilities to face various situations and challenges. Below is an explanation of interpersonal skills in leadership: Negotiation refers to the ability to understand and empathize with others. Leaders who possess this skill can accurately comprehend the needs, feelings, and experiences of others, thereby establishing effective relationships and successful interactions. Persuasion is the ability to convince others to change their actions, decisions, opinions, or thoughts. Influence is achieved through communication. When we refer to persuasion, in this context, Hoy and Smith (2007) identified ten principles of persuasion and influence in their research, providing empirical support for each and discussing the concepts for educational leaders. In summary, they proposed ten fundamental strategies for educational leaders to persuade and influence students, teachers, and parents. Conflict management refers to the ability to effectively manage and resolve conflicts. Leaders who possess this skill can improve conflicts and reach solutions for them. They are capable of managing problems constructively and using conflicts as an opportunity for growth and learning. In alignment with this finding, Bagshaw (1997) noted that conflict is often seen as an obstacle to progress, but it does not have to be. If there is only one opinion, development will not occur. Coaching means the ability to guide and develop individuals. Leaders who have this skill can identify individuals' capabilities and assist them in reaching higher potentials. They can foster greater motivation for learning and growth in individuals and collaborate in achieving personal and organizational goals. A coach helps individuals reach their desired outcomes or goals in a timely manner. Customer orientation means focusing on the needs and wants of customers. Leaders who possess this skill can understand the needs and desires of customers and improve their services and products based on these needs. They act in a way that ensures customer satisfaction and demonstrate customer-oriented behavior. In

fact, customers play a vital role in determining the value of a product or service. Customization is becoming more common, smarter, and technology-based, allowing for personalized experiences and products. In this evolving landscape, organizations that truly understand and respond to the unique needs of their customers will stand out. Creating a continuous and skilled focus on the customer is crucial for the success of businesses in the future. This includes deepening the understanding of customer needs, utilizing data and analytics, and taking proactive measures to meet these needs. By doing this, organizations can create value that aligns with customer expectations and build strong, long-lasting relationships. Problem-solving means the ability to analyze complex issues and find effective solutions. Leaders who possess this skill can conduct a thorough analysis of challenges and complex problems, providing innovative and efficient solutions. They are able to view problems constructively and use creative and logical methods to solve them. Individuals skilled in problem-solving can anticipate, analyze, diagnose, and address issues in an innovative manner. The ability to solve problems also utilizes other skills discussed in the first part, including conceptual thinking, planning and organizing, and creativity. Those with less skill in dealing with problems and roadblocks may do some or all of the following: fail to recognize the problem, be unclear about who should participate in solving it, misdiagnose or choose the wrong solution, or be uncertain about where the problem starts and where it ends. In this regard, Obeng & Gillet (2008) stated in their research that leaders accomplish tasks collaboratively and through others. Problems and obstacles inevitably arise along this path, and leaders who have a good ability to confront challenges are more effective in achieving their desired outcomes. Authenticity means being true to oneself and acting honestly with others. Leaders who possess this skill act sincerely and honestly in their interactions with others and in their own leadership. They are truthful in expressing their values, beliefs, and goals, serving as credible and inspiring examples for others. These interpersonal skills in leadership help leaders to interact more effectively with others and establish stronger relationships. Additionally, these skills assist them in identifying improvements and new opportunities when facing issues and challenges, leading to better performance.Leadership in schools and their administration has generally attracted considerable attention as a crucial area in the development of education and learning. The current research has shown that effective leadership in schools can be composed of four overarching themes, which include clear thinking, self-leadership, guiding others, and interpersonal skills.

1. Clear thinking: This overarching theme includes the competencies that school leaders must master. These competencies encompass forward-thinking (the ability to plan and anticipate the future of the school), team thinking (encouraging collaboration and synergy among school members), conceptual thinking (the ability to connect concepts and ideas), and creative thinking (the ability to solve problems in innovative ways).

2. Self-leadership: This overarching theme includes the skills that school leaders must possess in self-regulation, accountability, flexibility, resilience, and continuous learning. These skills enable leaders to serve as role models for others and to act as

powerful and effective leaders by managing themselves.

3. Guiding others: This overarching theme includes the competencies that school leaders must have in guiding and leading others. This includes empathy (the ability to understand and connect with others), perception and evaluation (the ability to assess performance and provide constructive feedback), multigenerational leadership (managing diverse generations and leveraging the strengths of each generation), communication skills (the ability to convey ideas effectively and persuasively), writing skills (the ability to present ideas and validate them in writing), and diplomacy (the ability to manage internal and external relationships within the school).

4. Interpersonal Skills: This comprehensive subject includes the abilities that school leaders must possess in communications and interpersonal interactions. This encompasses negotiation (the power to share and collaborate with school members), conflict management (the ability to manage and resolve conflicts), coaching (the ability to provide goal-setting and guidance to school members), customer orientation (attention to and addressing the needs of customers), problem-solving (the ability to identify and resolve issues), and authenticity (integrity and consistency in performance and personal values).

In conclusion, complete leadership within schools is pivotal for fostering an educational ecosystem that nurtures holistic development. By engaging educators and students alike, embracing inclusivity, and promoting accountability, schools can cultivate environments that thrive on collaboration and innovation. As such, educational leaders must be committed to evolving their practices to ensure that every stakeholder can contribute to and benefit from the leadership dynamic within the school (Hasanpuor et al.,2023).

**Recommendations**

In the educational environment, school leaders play a crucial role. They act as leaders and role models for their colleagues and students. Leadership in schools involves setting goals and strategic approaches, planning and managing resources, evaluating and providing feedback, creating a safe and collaborative environment, professional development, individual and organizational growth, and establishing an effective organizational culture. Considering the aforementioned comprehensive subjects, school leaders should utilize appropriate training, courses, and resources for their own development and to improve their performance in these areas. Additionally, they should pay attention to communication skills, information technology, and modern leadership skills. Ultimately, leadership in schools holds significant meaning and value in order to enhance student education and learning, develop colleagues and team members, and create a dynamic educational environment.

1- Effective leadership within educational institutions is imperative for fostering a positive learning environment and enhancing academic achievement. This essay outlines key recommendations that can facilitate comprehensive leadership in schools, thereby promoting the holistic development of both students and staff.
2- Firstly, it is essential for school leaders to cultivate a shared vision.

This involves engaging all stakeholders—including teachers, students, parents, and the community—in the development of a collective mission that reflects the values and goals of the institution. By fostering a shared sense of purpose, leaders can ensure that all parties work collaboratively towards common objectives, thereby enhancing the overall educational experience.

3- Secondly, promoting professional development for educators is crucial. School leaders should prioritize ongoing training and support for teachers, encouraging them to adopt innovative teaching methodologies and stay abreast of the latest educational research. By investing in the professional growth of staff, leaders not only enhance instructional quality but also boost teacher morale, leading to higher retention rates and a more stable educational environment.

4- Furthermore, effective communication is paramount in establishing transparent relationships within the school community. Leaders should implement regular meetings and feedback mechanisms to ensure that concerns are addressed promptly and that all voices are heard. This open line of communication fosters trust and collaboration, which are vital for a positive school culture.

5- Lastly, promoting inclusivity and diversity within the school is fundamental for complete leadership. Leaders must actively seek to create an environment where all students feel valued and respected, regardless of their background. Implementing programs that celebrate diversity and strengthen relationships among various groups can significantly enhance the school climate.

6- In conclusion, complete leadership in schools necessitates a multifaceted approach that includes cultivating a shared vision, prioritizing professional development, ensuring effective communication, and promoting inclusivity. By embracing these recommendations, school leaders can create an environment conducive to academic success and personal growth, ultimately preparing students to excel in an increasingly complex world (Rahimi Firozabad & et al 2023).

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**RESEARCH ARTICLE** **Open Access**

# Examining the Role of Content Strategies in Formulating Digital Media Policies: An Approach Based on Soft Systems Methodology

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**Abstract**
In the contemporary era, where digital technologies impact all aspects of human life, effective policymaking in digital media is crucial. Considering the influence of these media on public opinion, political and social communications, and their effects on cultural and economic spheres, the need for careful policy assessment is evident. Given the complexity of digital media policymaking, applying soft operational research methodologies can yield more comprehensive outcomes. This research examines soft systems and cognitive mapping as tools for assessing digital media policymaking. This approach identifies current issues, evaluates capacities for improvement, and offers a practical framework for effective policymaking. Data for the conceptual model were obtained from prior studies and interviews with digital media experts. In analyzing the media and communication sector, a key observation—similar to other social and cultural domains—is cultural lag, where rapid technological development surpasses society's and policymakers' ability to adapt and develop suitable content strategies. This research highlights that modifications in the "content" domain are crucial for effective digital media policymaking.
**Keywords**: Media, digital media, media policy, soft systems methodology, cognitive mapping.

## Introduction

Digital technologies have changed the landscape of the world. The shape of today's businesses, manufacturing processes, health care, communication, education, mass media, as well as almost every other aspect of human life has changed dramatically (Khodaei, Hosseinpour, Jamshidi, Mohamadifar, 2024). Digital media significantly influence public opinion, political discourse, and economic dynamics (Drossos et al., 2024). By establishing a global platform for the unrestricted exchange of ideas, these media have become pivotal in shaping public sentiment and driving socio-political developments (Maitri et al., 2023; Grossman, 2022). The development of new technologies in the realm of media and communications has led to shifts in audience behaviors, the creation of new audience needs, and the entry of new competitors into the media market and the specialization of networks

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(Alamshahi et al., 2024). Rapid technological advancements and shifting media consumption trends necessitate continuous updates to media policies. The emergence of content recommendation systems has introduced challenges related to cultural and political diversity (Burgess et al., 2024), while the dynamic nature of digital media complicates effective policymaking (Lopes & Casais, 2022). A key challenge in digital media governance is addressing the spread of fake news and misinformation. Advanced technologies, such as big data analytics and artificial intelligence, have become essential tools for detecting and mitigating these issues, enabling data-driven policymaking (Shahzad et al., 2022). Policymakers also face concerns regarding privacy, data security, and market competition (Grossman, 2022), highlighting the need for robust, adaptive strategies. Content strategies play a crucial role in digital media governance by enhancing audience engagement, fostering brand loyalty, and optimizing communication (Demirer, 2022; Sharma, 2019; Zhou, 2024). In countries like Iran, where unique social and political challenges exist, assessing media policies is particularly critical. Digital media policymaking must balance public interests, democratic values, and economic growth, requiring collaboration among governments, media sectors, and civil society. This research aims to examine digital media policymaking in Iran, exploring its challenges, opportunities, and current strategies. By employing cognitive mapping and soft systems methodologies, this study offers a comprehensive analysis of the factors influencing policymaking and proposes effective models for future governance. Despite recent advancements in Iran's digital media landscape, policy-related issues persist, including content regulation, user privacy, and balancing national security with freedom of expression. Prior studies have focused on areas like marketing or audience engagement, with limited attention to macro-level policymaking and its socio-cultural dimensions. This gap underscores the need for an integrated analysis of Iran's digital media policies. This study investigates the outcomes of Iranian government policies over the past decade, aiming to identify an optimal model for digital media policymaking. By combining cognitive mapping with soft systems methodologies, it provides a holistic assessment, capturing the perspectives of key stakeholders and addressing both social and technical complexities. The findings will inform researchers, media practitioners, and policymakers, contributing to more effective digital media governance.

## Review of the Theoretical Foundations of the Research

### Theoretical Background

The development and proliferation of digital media have significantly impacted various aspects of social, economic, and cultural life. The digital transition has heightened the need for effective policymaking, particularly as digital marketing and media play crucial roles in business growth, especially for startups (Maithil et al., 2023). This underscores the importance of policies that support digital infrastructure development and digital literacy. However, challenges such as the spread of misinformation and fake news remain critical concerns, emphasizing the need for robust media literacy and regulatory frameworks (Bianchi & Tafuri, 2023).

Digital media also present opportunities in education, where digital tools can enhance learning outcomes and support children's development (Sitinjak, 2023). This highlights the necessity of effective policies for integrating digital tools in educational environments. Additionally, digital media influence language and culture, creating tensions between preserving cultural heritage and embracing linguistic innovation (Volkova & Chernyavskaya, 2021). The digital revolution has further transformed the economy, with digital economy and governance emerging as key areas of research (Liu et al., 2022). These developments call for comprehensive policymaking to foster inclusive and sustainable economic growth.

In Iran, digital media adoption has grown significantly, mirroring global trends. Yet, policymaking faces challenges related to content regulation, user privacy, and balancing national security with freedom of expression (Grossman, 2022). Iranian governments have varied in their approaches, ranging from strict censorship to more liberal policies, reflecting shifts in political priorities. The media convergence theory, introduced by Jenkins (2004), provides a framework for understanding the integration of diverse communication technologies and their impact on media consumption patterns (Triyono et al., 2023). Media convergence encompasses technological shifts, cultural changes, and evolving audience behaviors (Ling, 2011). Research shows that media convergence has reshaped media industry structures, content creation, and audience engagement, with significant growth observed in China from 2008 to 2018 (Feng et al., 2020). Applying this theory to Iran helps identify the need for policy adjustments in content regulation, digital innovation investments, and holistic policymaking that balances economic and cultural dimensions. Given the complex, "ill-structured" nature of digital media policymaking, this study employs Soft Systems Methodology (SSM) to define problems, identify stakeholders, and analyze key information flows. SSM facilitates a comprehensive examination of complex systems, supporting strategic decision-making for policymakers (Mingers, 2011). Traditional methods often fall short in addressing issues characterized by multiple stakeholders, ambiguous resources, and uncertainty. SSM addresses these gaps by clarifying the structure of complex issues and enabling effective solutions (Golshahi et al., 2022; Rajabzadeh Ghatari et al., 2015). SSM posits that individuals interpret situations differently based on their experiences and cognitive frameworks (Fatemi et al., 2019). Developed by Checkland and colleagues at Lancaster University, SSM is a form of action research that fosters deep understanding through real-world analysis (Checkland & Holwell, 1998). Complementing SSM, cognitive mapping helps policymakers understand stakeholders' mental models and anticipate policy outcomes (Bryson, 2004). This dual approach clarifies diverse perspectives, aiding in conflict resolution among stakeholders. In Iran, where digital media policymaking is influenced by complex internal and external factors, integrating SSM and cognitive mapping enables data-driven, adaptable, and stakeholder-inclusive policy development. These methodologies help Iranian policymakers navigate digital media's inherent complexities, fostering more effective governance tailored to the country's unique context.

**Experimental background**

Digital media policy has emerged as a significant and complex area within media studies. Numerous studies have explored various aspects of this subject. Flew et al. (2019) examined internet regulation in the context of media policy, arguing that the rise of digital platforms necessitates a reassessment of media corporations' roles and the balance between public interest and freedom of expression. Burgess et al. (2024) analyzed the role of recommendation systems on global media platforms, highlighting the need for policies that address cultural diversity both globally and within local contexts. Similarly, Dementieva et al. (2023) explored the evolution of Russia's digital media landscape, demonstrating how political developments influence digital media's form and content. Shahzad et al. (2022) investigated the relationship between big data analysis and fake news detection, emphasizing the importance of advanced technologies such as artificial intelligence and neural networks in combating misinformation. These studies collectively suggest that digital media policymaking requires a multifaceted approach, incorporating technical, economic, cultural, and legal dimensions. Additionally, rapid technological advancements and shifts in media consumption patterns highlight the need for continuous evaluation of media regulations. Demirer (2022) examined the impact of content strategies on digital media regulation, showing how factors like content type, agility, context, post format, and publishing schedules influence user engagement metrics such as likes, shares, and comments. Drossos et al. (2024) further demonstrated that multimedia content, transformative appeals, and minimal interaction can enhance user engagement. Peil and Sparviero (2017) explored the challenges associated with media convergence, providing insights into the evolving media landscape.

This research builds on these prior studies, employing the Soft Systems Methodology (SSM) to develop a comprehensive framework for formulating content strategies in digital media policymaking. This framework aims to serve as a practical guide for policymakers and media managers, offering insights for more effective governance in the dynamic digital media environment.

**Research Methodology**

This research is classified as an applied study in terms of its objectives and is descriptive-exploratory in terms of methodology, aiming to clearly delineate the existing processes within the digital media policy cycle and to propose an optimal model for policymaking in this field, especially given the scarcity of comprehensive data. To gather data, this study utilized two primary methods: extensive library research and field investigations. The library research involved a thorough examination of current literature and documents related to digital media policy and its associated challenges. Simultaneously, field investigations were conducted through semi-structured interviews with a range of specialists and executives in the media sector, selected via purposive sampling to form an expert panel capable of providing diverse insights. To ensure a comprehensive understanding, snowball sampling was also employed, where initial interviews with a select few experts led to referrals to other knowledgeable individuals. This process

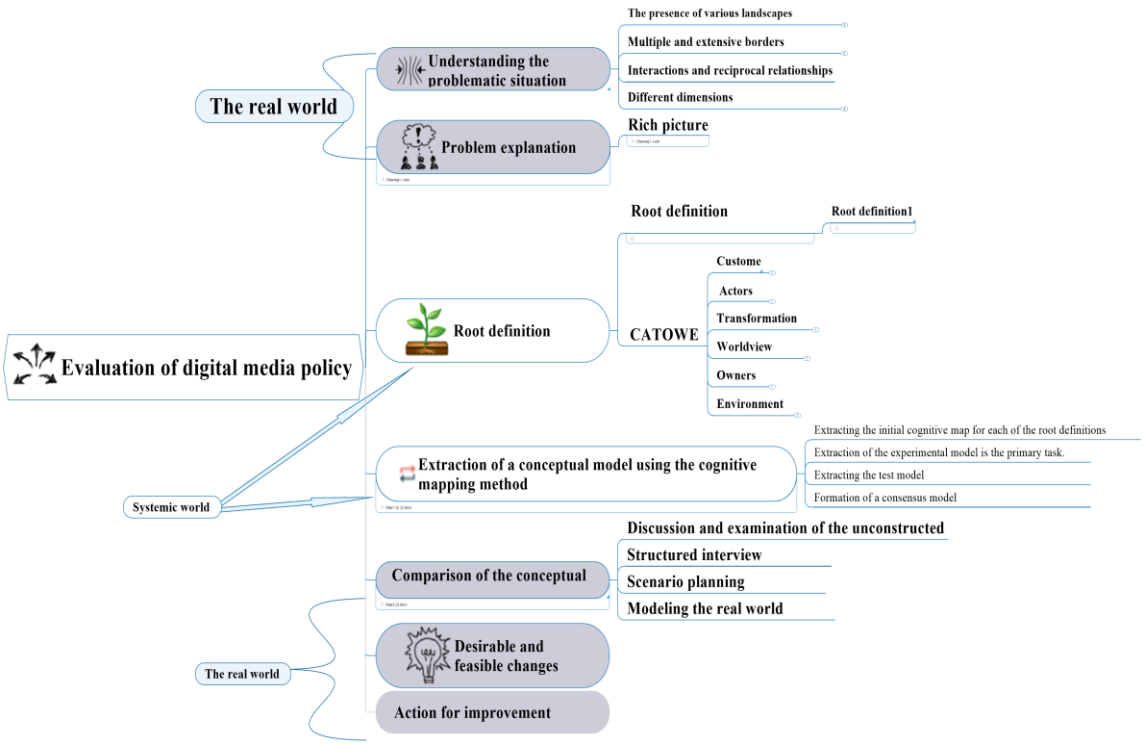
continued until theoretical saturation was achieved, which occurs when additional interviews no longer contribute new insights to the research questions. The study adopted a hybrid methodology combining Soft Systems Methodology (SSM) and Cognitive Mapping (CM) to effectively examine the complex situations often encountered in digital media policy. This methodology is not implemented in a fixed, linear sequence but is instead dynamically adapted to fit the evolving context and needs of the research. According to Checkland and Poulter (2006), the SSM process involves seven principal steps, all of which were utilized in this research to address the multifaceted issues of digital media policy.

Despite the strengths of SSM, its limitations in the modeling phase are recognized, which led to the integration of Cognitive Mapping to enhance the robustness of the analysis. Cognitive Mapping, rooted in George Kelly's theory of personal constructs (1985), focuses on reducing the interference of the researcher's biases in interpreting qualitative data. This technique strengthens the validity of the research by ensuring that the analysis deeply reflects the views and perceptions of the participants.

The integration of SSM and CM in this study provides a comprehensive framework that not only facilitates a deeper understanding of the policy issues but also supports the development of more effective and sustainable digital media policies. This methodological approach, by allowing concurrent exploration of various aspects of the problems, enables the researcher to gain deeper insights and propose more precise and practical solutions.

**Figure 1.**

*Combined diagram of soft systems methodology and cognitive mapping*



## Research Findings

This section details the steps involved in the integrated Soft Systems Methodology (SSM) and Cognitive Mapping (CM) approach as applied to digital media policy-making.

**Step One: Articulate the Problematic Scenario**

The initial phase involves a deep analysis of the current situation in digital media, moving beyond simple problem identification to explore its complexities and uncertainties. This includes examining contributing factors and pertinent facts about the situation, as well as gathering stakeholder opinions, as emphasized by Checkland and Winter (2006) and Azar et al. (2016). The research identified governance challenges in digital media, which are exacerbated by the diversity of platforms like social networks and content-sharing services. These complexities make it difficult to develop and implement effective regulations that encompass all aspects of media policy, which aims to guide media towards achieving specific goals while upholding societal values.

The focus has primarily been on the content aspect of digital media challenges, addressing issues such as content diversity, volume, quality, and the presence of harmful or unlawful material. Formulating policy in this domain requires a comprehensive approach that promotes freedom of expression and access to information while ensuring accountability, media ethics, and protection of citizens' rights. Structured interviews with academic and executive media elites were conducted to understand the problematic scenario better and gather insights on optimal policy-making approaches. These interviews aimed to capture diverse perspectives and suggestions for successful digital media policy-making. Interview findings suggest that various elements influence the development of effective policies in digital media. These include fostering active citizen engagement, ensuring transparency in information sharing and decision-making, enhancing institutional accountability, building public trust in government media initiatives, supporting the growth of independent and non-governmental media, promoting competition among media outlets, preventing monopolization, and implementing cascading strategies for policy development. These elements highlight the importance of transparency, accountability, and stakeholder engagement in creating policies that balance media diversity, informational equity, and public trust. Despite the identification of these influential factors, a comprehensive, consensus-based model for digital media policy remains elusive. This research addresses this gap by exploring diverse viewpoints from both academic and executive spheres, thereby shedding light on the complex issues and potential solutions in digital media policymaking.

**Step Two: Creating a striking illustration**

This step enhances understanding of the digital media policy-making scenario through the use of vivid imagery. As described by Azar & Zarghami Fard (2015) and outlined in Checkland and Poulter's "Learning for Action," this technique involves creating detailed written and visual representations, such as caricatures, to highlight key elements of the scenario—participants, issues, processes, and their interrelations. Methodological Approaches: Self-intervention Analysis; Identifies the roles and responsibilities of key individuals and stakeholders within the problematic

scenario. Social Analysis; Focuses on the pertinent norms, values, and social roles influencing the situation. Political Analysis; Examines power distributions and the dynamics of interactions among actors. Figure 2 in the study illustrates the problematic context in detail, employing these methodologies.

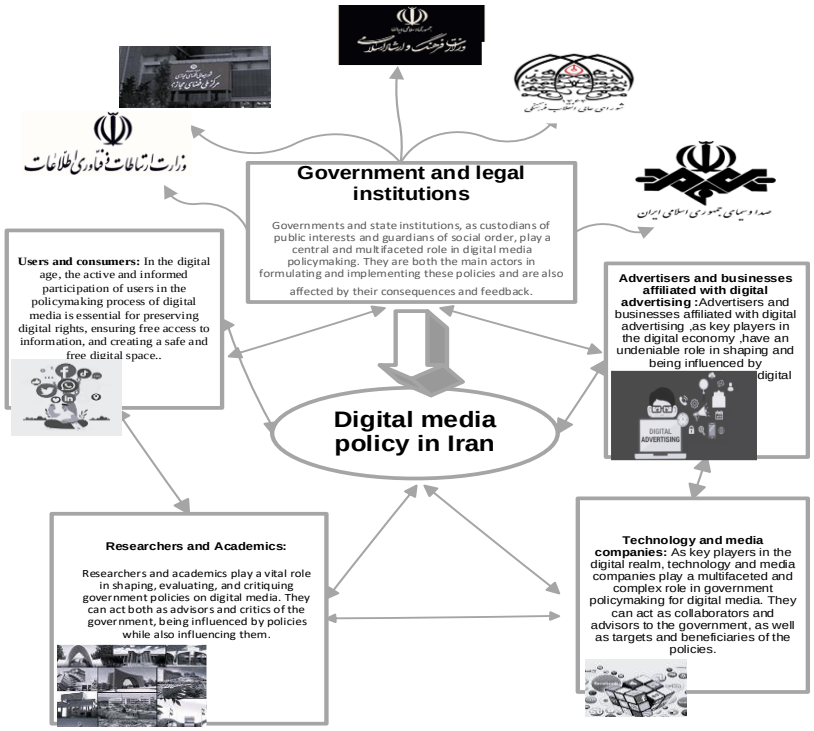
This research seeks to analyze the problematic situation and identify the factors affecting the desirability of policymaking in digital media. As illustrated, the Ministry of Culture and Islamic Guidance and the National Cyberspace Center, the primary institutions responsible for policymaking in this domain, function as "problem solvers."

This research categorizes stakeholders involved in digital media policymaking into two groups: Primary Stakeholders; Directly engaged in the policymaking process or significantly impacted by its outcomes. This group includes major institutions such as the Islamic Consultative Assembly, the Supreme Council of the Cultural Revolution, the Islamic Republic of Iran Broadcasting Organization, and the Ministry of Communications and Information Technology. Secondary Stakeholders; While not directly involved, these entities greatly influence policy outcomes through indirect effects or by affecting policy implementation and execution. This includes governmental and private executive bodies, educational institutions, and various societal divisions.

The Ministry of Culture and Islamic Guidance and the National Cyberspace Center are depicted as "problem solvers" navigating the policymaking framework. The nuanced roles of both primary and secondary stakeholders are crucial for the effective implementation of policies and for driving positive changes in the digital media landscape.

**Figure 2.**

*A clear illustration of the problem situation*



**Step Three: CATWOE Analysis and Extraction of Fundamental Definitions**

At this critical juncture, the research transitions from tangible observations to the conceptual and systemic realm by articulating a "root definition" of the issue at hand. A root definition is a concise yet comprehensive statement that outlines the system's objectives, identifying the principal actors and stakeholders involved. It serves as a conceptual foundation, enhancing understanding of the topic and guiding further analysis phases. Actors and Stakeholders; The root definition encompasses all relevant actors: system members, individuals, and groups affected by or influencing the system's efficacy. This comprehensive approach ensures that all perspectives are considered in the analysis, making the insights generated both inclusive and actionable. Formulation of the Root Definition;

The process of extracting and formulating the root definition is intricate and demands meticulous precision. It begins with a comprehensive overview of the issue, recognizing the primary elements and their interrelations. The next step involves selecting a specific aspect of the situation for focused modeling. This selection is strategic, aimed at addressing the principal features of the issue to facilitate effective management and control (Salmani Nejad et al., 2017). Once the root definition is established, the subsequent step is to define a specific subject or activity as the focal point for modeling. This is based on the elements and linkages identified in previous analyses. The system's framework can be succinctly described as "A system that achieves P through Q to realize R." Here, P represents the primary objective of the system, Q details the methodologies employed to achieve these objectives under existing conditions, and R signifies the desired outcome or ultimate goal of the system. For instance, let P be "mitigating challenges and issues in digital media," Q represent "formulating and executing pertinent guidelines," and R denote "enhancing the quality of policymaking in digital media." Utilizing the PQR formula clarifies the system’s operational logic and aids in developing practical and efficient solutions. The CATWOE model provides a robust framework for developing root definitions, ensuring they are well-rounded and cover all necessary aspects of the system being analyzed. This model helps in pinpointing the elements crucial for a comprehensive understanding and effective management of digital media challenges.

**Clients**

In Iran's digital media policy landscape, "customers" encompass diverse social actors affected by these policies. These include end users (content consumers), media and content creators, technology firms, internet service providers, governmental and regulatory bodies, civil society organizations, advertisers, and businesses.

**Actors**

Within the CATWOE framework, "actors" are individuals or entities responsible for implementing policies and reforms. They execute processes, enforce policies, and influence outcomes. Key actors in Iran’s digital media policymaking include the Ministry of Communications and Information Technology, the Ministry of Culture and Islamic Guidance, the Communications Regulatory Authority, digital media platforms, technology firms, internet service providers, the judiciary, the Islamic Republic of Iran Broadcasting

Organization, and civil and human rights organizations.

**Transformation**

In the CATWOE model, transformation refers to the transition from the current state to the desired state through a structured series of actions. Digital media policymaking in Iran involves reforms across multiple domains—laws, oversight, infrastructure, and stakeholder engagement—aiming to enhance the digital media landscape.

**Worldview**

Iran's digital media policymaking is rooted in core values that shape policy assessment and development. These values include freedom of expression, digital rights protection, innovation, balancing liberty with security, stakeholder engagement, and adherence to justice and transparency.

**Owner**

In Iran’s digital media policymaking, institutions with decision-making authority serve as primary stakeholders. The government and state agencies regulate this domain by establishing and enforcing policies. Key entities include the Ministry of Communications and Information Technology, the Ministry of Culture and Islamic Guidance, the Supreme Council of Cyberspace, and the Communications Regulatory Authority. Understanding these stakeholders and their power dynamics is essential for improving decision-making processes and policymaking effectiveness.

**Environmental Limitations**

External factors influence policy formation and implementation, either as constraints or opportunities. The primary environmental influences in Iran’s digital media policy span legal, cultural, social, economic, technological, and political dimensions. A precise understanding of these constraints is essential for mitigating their impact and devising more effective digital media strategies. Identifying and addressing these factors enhances policy efficiency and effectiveness.

**Table 1.**

*Root Definitions Based on the CATWOE Model*

| **RD[6]**<br>**Content domain** | **Fundamental definitions resulting from a rich picture** |
|---|---|
| Users and consumers who consume content and are influenced by it, including advertisers and businesses that use content to attract customers.<br>Media and content creators.<br>The government and regulatory bodies. | **Customers (C)** |
| The government and governmental institutions (such as the Ministry of Communications and Information Technology and the National Cyberspace Center).<br>Technology and media companies.<br>Researchers and academics.<br>The Regulatory Authority for Radio Communications. | **Actors (A)** |

[6] Root Definition

| **RD[6]**<br>**Content domain** | **Fundamental definitions resulting from a rich picture** |
|---|---|
| Implementing policies and overseeing digital content with the aim of ensuring quality, adhering to ethical standards, and aligning with social and cultural values and norms.<br>Enhancing media literacy and empowering audiences in dealing with digital content. | **Transformation (T)** |
| mphasis on promoting valuable and ethical content in digital media to uphold social and cultural values and combat the spread of inappropriate content.<br>Maintaining a balance between freedom and security in the digital space.<br>Ensuring justice and transparency in the realm of digital media. | **Worldview (W)** |
| The government and responsible institutions that are tasked with regulating and overseeing content.<br>Ministry of Culture and Islamic Guidance.<br>Supreme Council of Cyberspace. | **Owner (O)** |
| Cyber threats, regulatory and legal restrictions, technical complexities, and international competition in the field of technology.<br>Cultural and social limitations.<br>Political restrictions. | **Environment (E)** |

Employing the CATWOE conceptual framework enables the establishment of key definitions related to digital media policy. **Policy formation in digital media content (RD)** involves organizing and directing the creation and dissemination of digital content. This process is driven by the development and implementation of cultural and media policies, with active participation from the government, cultural institutions, media enterprises, content creators, and users. Its primary objectives are to enhance the quality and diversity of digital content, safeguard freedom of expression, and strengthen media culture within society. The CATWOE analytical methodology facilitates a holistic approach to digital media policymaking in Iran. By considering all relevant factors and influencing variables, it supports the development of comprehensive plans for advancing and improving this domain. A comprehensive definition of digital media policymaking in Iran, grounded in the CATWOE paradigm, highlights an extensive and collaborative process. It involves the government and key institutions working alongside stakeholders to design and implement policies that promote freedom of expression, protect digital rights, foster technological innovation, balance freedom with security, and ensure justice and transparency in policy enforcement. This process must account for environmental constraints and prevailing conditions while strengthening infrastructure, raising awareness among users and content providers, and enhancing transparency and accountability in regulatory oversight. Incorporating all elements of the CATWOE framework, this definition clearly articulates the objectives, roles, processes, and constraints of digital media policymaking in Iran. It aids in identifying specific policy needs and modifications, guiding progress

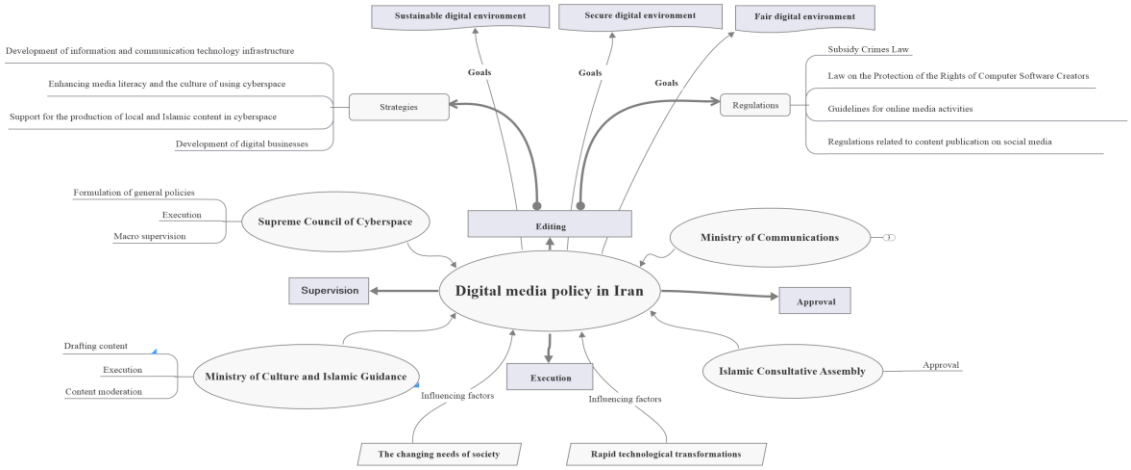
and development in the digital media landscape.

**Step Four: Developing the conceptual model and the process of attaining consensus on the cognitive map**

A conceptual model, constructed using root definitions and system rules, represents a diagram illustrating activities and their interrelations to support problem-solving and the achievement of specific objectives within the Soft Systems Methodology (SSM). This model typically includes five to nine key activities that are logically and interdependently connected. The incorporation of causal relationships helps identify both unrelated concepts and critical factors influencing decision-making (Azar et al., 2017). At this stage, a conceptual model for evaluating digital media policy has been developed using SSM and cognitive mapping tools, aiming to achieve expert consensus. Cognitive mapping serves as an effective method for systematically gathering, organizing, and presenting relevant data on the research topic, "evaluation of digital media policy." A foundational definition was first established, followed by interviews with think tanks, leading to the identification and organization of key aspects into a cognitive map. This map highlights the causal, structural, and conceptual links among essential components. To achieve consensus among experts and stakeholders regarding the proposed conceptual model, the **Preliminary Task Model** was designed. Key figures in digital media policy were identified and engaged to support the development of this model. A root definition was then derived to guide the creation of the **Test Model**, which integrates elements from the preliminary model while incorporating additional features reflecting diverse perspectives. If the initial model does not yield satisfactory results, the process reverts to refining the root definition and adjusting the test model accordingly (Tavallaei et al., 2014).

Following this iterative process, the **Initial Consensus Task Model** is developed. Upon completion, a comprehensive, consensus-based conceptual model for assessing digital media policy will be established, enabling more accurate analyses and improving decision-making efficiency.

**Figure 3.**
*Conceptual Model of Digital Media Policy*



In steps five to seven, the process returns to the real-world environment, where the constructed model(s) are evaluated against actual conditions. At this stage, potential modifications are identified, and an operational strategy is developed and implemented to address them. Contrary to its idealized linear depiction, the Soft Systems Methodology (SSM) operates iteratively in practice. Repeating various phases is often necessary, as discussions initiated in step five may lead to revisions of earlier analyses and definitions (Nik-Kadam et al., 2017). This iterative approach supports continuous model improvement, enhancing its alignment with real-world conditions.

**Step Five: Benchmarking**

The fifth stage of the hybrid model focuses on comparing the developed conceptual models with real-world conditions. This stage re-engages with reality to identify discrepancies and inconsistencies between the models and actual circumstances, highlighting deficiencies and necessary modifications to enhance their practical applicability (Azar et al., 2017). Researchers have proposed various methods for this comparison, including informal discussions, formal questioning, scenario writing, and creating real-world models analogous to conceptual ones, as suggested by Checkland (Checkland & Davies, 1986). Soft Systems Methodology (SSM) is inherently participatory, emphasizing dialogue as the primary driver of progress. This characteristic makes SSM particularly effective for addressing complex issues in an interactive and efficient manner.

**Table 2.**

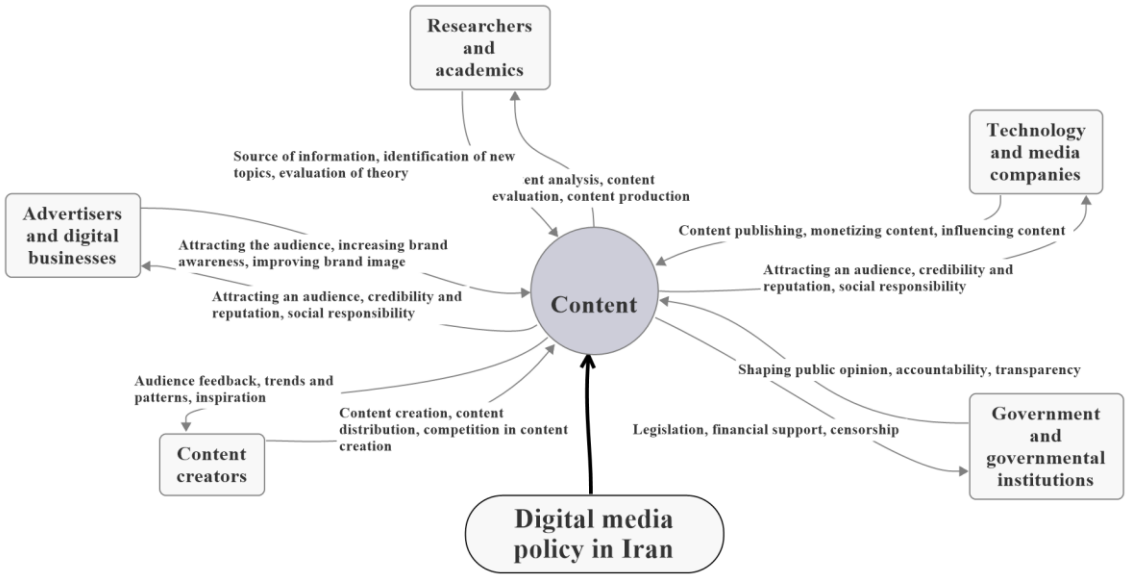
*Standard Comparative Table for Comparing the Conceptual Model with the Real World*

| Necessary recommendations | Required changes | Comparison with practical measures | Real-world execution mechanism | Do they exist in the real world? | Factors influencing the conceptual model |
|---|---|---|---|---|---|
| creating new laws, upgrading standards, and establishing efficient monitoring systems to ensure content quality | Strengthening regulations | Average | government control of content; some producers face censorship restrictions | Yes | Content |

Through a comparative table and comprehensive analysis, key modifications and recommendations for improving digital media policymaking in Iran can be identified. This analysis supports policymakers in developing and implementing more effective strategies. The comparison table addresses the following questions: Do the critical factors identified in the conceptual model for optimal digital media policy exist in real-world practices? What mechanisms are in place to implement these factors, if applicable? The table compares elements essential to effective digital media policymaking, as outlined in the conceptual model, with actual practices conducted by the Ministry of Culture and Islamic Guidance and the Cyberspace Organization. This comparison helps identify necessary adjustments to enhance policy implementation and formulate targeted recommendations. The outcomes of this phase provide a set of actionable recommendations for refining digital media policy execution.

**Figure 4.**

*Cognitive map of experts regarding the factors influencing optimal digital media policymaking*




**Steps six and seven: Identifying and offering options for transformation**

In light of prior phases and the research undertaken to enhance the system, it is essential to offer pragmatic recommendations within the scope of senior managers' authority for the effective execution of digital media policy. Consequently, following several meetings and the involvement of project team members, recommendations for essential modifications in the execution of the intended digital media policy process have been proposed. This research presents a conceptual model comprising a primary domain, "content," which includes five principal categories: "government and governmental institutions," "advertisers and digital businesses," "media companies," "content creators," and "researchers and academics."

Content creators are directly influenced by rules pertaining to content, such as censorship regulations, media ethics, and content standards, which can hinder their creativity and freedom of speech. Media enterprises necessitate robust infrastructure for content production and distribution, while governmental regulations about access to infrastructure and resources impact the quality and volume of the content generated. Advertisers require material generated by media and content providers to market their products and services, and restrictive or regulating regulations on content influence their advertising methods and efficacy. Government and its institutions regulate content control through policymaking, employing legislation to inhibit the distribution of unsuitable material or to encourage specific content, so affecting both content creators and consumers. Technology firms require suitable infrastructure to create and offer services, and governmental regulations in this domain influence their capacity to supply innovative solutions. Policies that facilitate the enhancement of technological infrastructure foster the expansion and progress of the digital media sector.

## Conclusion and Recommendations

### Conclusion

The study's findings underscore the critical role of **"content"** in shaping Iran's digital media policymaking. Content serves as the foundation of digital media, significantly influencing cultural and societal dynamics, contributing to the digital economy, enhancing global competitiveness, strengthening national security and cyber governance, and driving technological advancement.

Policymaking with a strong focus on content can yield far-reaching impacts, including: Enhancing media and digital literacy, Increasing user participation in content creation and consumption, Promoting cultural independence and reducing reliance on foreign content, Creating job opportunities in the digital content industry, Boosting revenue through digital content exports. Ultimately, emphasizing content fosters a dynamic, innovative, and accountable media ecosystem that supports growth in the digital era while preserving cultural and social values. Given content's pivotal role, effective policymaking in this area can significantly influence Iran's digital media landscape. Using **Soft Systems Methodology (SSM)** and **cognitive mapping**, this study evaluates factors influencing optimal digital media policymaking in Iran. By comparing conceptual model elements with real-world practices, the research identifies necessary adjustments for efficient policy implementation, ensuring both feasibility from governmental perspectives and desirability for stakeholders.

Adjustments in content-related policies are essential for enhancing digital media governance. Infrastructure is a critical factor, as media companies require robust systems for producing and distributing high-quality content. Government policies that improve access to infrastructure—especially for small businesses—can enhance both the quantity and quality of content. Conversely, inadequate technological infrastructure hampers content development.

**Advertisers** rely on content from media creators to promote their products. Policies that regulate media content can directly impact advertising strategies and effectiveness. Hence, content-related legislation should consider the role of advertising within the media economy to avoid stifling growth.

**Government institutions** determine the degree of control over content through policymaking. Regulations may aim to restrict harmful content or promote cultural and educational materials, directly affecting content accessibility for audiences and operational freedom for creators. Balancing the need for oversight with the protection of individual freedoms and access to information is crucial. Policymaking in this space demands precision to align freedom of expression with societal and cultural needs. Supporting media companies and content creators through fair, transparent policies and improved infrastructure is key to raising content quality. Moreover, content policies should account for their potential effects on advertising and the digital economy, avoiding unnecessary restrictions that deter investment and innovation. This study distinguishes itself by applying SSM and cognitive mapping to explore the complexities of digital media policymaking in Iran, offering deeper insights compared to prior research:

**Vlad et al. (2023)** examined digital media's role in government-citizen interactions in Romanian and American rural areas. While their focus was on cross-country rural dynamics, this study adopts a broader, more analytical approach to policymaking complexities and stakeholder conflicts in Iran.

**Guess et al. (2020)** explored digital media literacy's role in combating misinformation in the U.S. and India. Unlike their focus on educational interventions, this research emphasizes macro-level content policies and their systemic impacts.

**Jones (2023)** and **Grossman (2022)** focused on governmental regulations in digital media. In contrast, this study provides a nuanced analysis of government-user-stakeholder interactions through cognitive mapping, highlighting participatory policymaking approaches.

**Blank & Reisdorf (2023)** analyzed digital inequality during COVID-19, particularly in accessing health information. While addressing similar challenges in Iran, this study innovatively applies cognitive models to understand stakeholder conflicts and propose effective policy solutions.

**Kainja (2023)** investigated digital rights in Malawi, identifying legal and infrastructural barriers. This study extends the analysis to Iran, exploring how SSM can guide effective legislation for digital rights and privacy protection.

**Garganas (2024)** focused on digital video advertising's evolution in the media landscape, contrasting social media ads with traditional TV. This study builds on that by stressing the need for continuous media law evaluations in response to shifting consumption patterns.

**Akbar et al. (2023)** explored media convergence through Indonesia's RRI Play Go app. Drawing from this, the current study applies media convergence theory to Iran's specific digital media context, offering fresh insights into policymaking.

The application of multi-layered analytical techniques, including SSM and cognitive mapping, helps policymakers address the social, cultural, political, and technological complexities of digital media governance. While previous studies often focused on specific regulatory or technological aspects, this research provides a comprehensive framework that integrates media convergence theory and systems thinking. This approach facilitates a deeper understanding of stakeholder dynamics, ultimately supporting more effective and adaptable digital media policies in Iran.

**Suggestions**

Based on successful international experiences, the theoretical principles outlined in this research, and Iran's unique digital media challenges, the following recommendations are proposed:

Establish laws that promote innovation and creativity in digital content creation while preserving cultural and social values. A robust legal framework should uphold national security, safeguard users' digital rights, and foster innovation in the IT sector. This framework should include regulations on cybersecurity, data protection, and user privacy, developed through collaboration among government bodies, IT firms, and civil institutions. Iran can model its legislation on frameworks like the EU's General Data Protection Regulation (GDPR), which emphasizes digital user privacy.

Create an autonomous regulatory body responsible for overseeing digital media performance, protecting user rights, and ensuring freedom of expression. This authority should operate independently of government influence, providing transparent reports and objective assessments. It should also develop clear standards for evaluating digital content, addressing technical quality, content integrity, and ethical considerations.

Promote comprehensive media and digital literacy programs to help individuals critically evaluate digital content. Educational initiatives, including online courses and university programs, should focus on digital security, privacy, and responsible social media use. These efforts will raise public awareness of digital rights and responsibilities and help combat the spread of misinformation.

Shift from restrictive content control methods to using advanced technologies, such as artificial intelligence (AI), for digital content monitoring. AI can improve content filtering and prevent the spread of harmful or misleading information without infringing on user rights. Developing local AI solutions can reduce the reliance on strict censorship while ensuring effective content moderation.

Update Iran's digital media regulations to align with international best practices and actively engage in knowledge exchange with countries experienced in digital content policy. International collaboration can help address regional challenges while leveraging global insights for policy development.

Invest in the creation of competitive domestic platforms to rival international models and maintain control over data flows. Strengthening local digital infrastructure will support Iran's digital sovereignty and foster a dynamic, responsible ecosystem for digital content creation and consumption.

**Suggestions for Future Research:**

One of the biggest obstacles to digital media policymaking continues to be digital inequality. More thorough policies to bridge digital disparities can be developed with the use of research that looks more thoroughly at the social, economic, and cultural elements affecting digital inequality in Iran. This study can examine how technical capabilities, digital education, and internet access affect various regions of the nation. Future studies can look at the function and effects of artificial intelligence (AI) in digital media governance, given the technology's explosive rise in the domains of data filtering, information personalization, and content management. The usage of AI algorithms in content management and online privacy protection could be examined in this study.

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# The Mathematical Model for Optimizing Accounts Receivable Financing in Production Planning: A Solution to Enhance Liquidity and Mitigate Financial Risks

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**Abstract**
Managing liquidity and inventory simultaneously remains a critical challenge in production planning, particularly for firms dealing with delayed receivables and financial constraints. This study proposes a novel mathematical model that integrates accounts receivable financing (ARF) into multi-period production planning. The model explicitly incorporates financial parameters such as cash inflows, advance payments, receivable discount rates, and bank credit limits, alongside operational factors like procurement and holding costs. The objective function is designed to maximize liquidity at the end of the planning horizon while ensuring demand satisfaction and inventory balance. A key innovation lies in the model's unified treatment of financial and operational constraints—an aspect often overlooked in existing literature. The model is solved using advanced optimization methods, including nonlinear programming and a genetic algorithm, to handle complexity and ensure convergence to near-optimal solutions. Sensitivity analysis demonstrates the model's robustness under demand fluctuations and financial volatility. Results indicate that the proposed approach can significantly reduce financial risks, improve cash flow stability, and support strategic decision-making. This framework offers valuable insights for managers seeking to align operational efficiency with financial resilience. Future research directions are also outlined to expand the model's applicability in dynamic production environments.
**Keywords**: Media, digital media, media policy, soft systems methodology, cognitive mapping.

## Introduction

Liquidity management plays a critical role in production planning, particularly in environments where delayed receivables lead to operational disruptions. Accounts Receivable Financing (ARF) has emerged as a viable tool to address such challenges by converting receivables into immediate cash. This financial mechanism allows companies to accelerate cash inflows, mitigate payment default risks, and improve flexibility in procurement and production scheduling.

Despite its potential, effectively integrating ARF into production planning remains complex. Firms must balance the financial benefits of ARF—such as enhanced liquidity and risk reduction—against associated costs like discount rates and administrative expenses. Additionally, operational factors including inventory management, order scheduling, and

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fluctuating demand introduce further constraints, necessitating a unified optimization framework.

Existing literature has addressed ARF from various angles, including credit risk mitigation, supply chain coordination, and blockchain-based transparency. However, most studies treat financial and operational decisions separately, lacking an integrated perspective that reflects the realities of dynamic production environments. This gap limits the practical applicability of prior models.

To address this limitation, the present study develops a novel mathematical model that incorporates ARF directly into multi-period production planning. The proposed model simultaneously considers key financial variables—such as advance payments, bank credit limits, and receivable discounting—and operational elements like procurement costs and inventory levels. The objective is to maximize end-period liquidity while satisfying financial and operational constraints. The model is solved using a genetic algorithm, enabling effective optimization in nonlinear and constrained settings. The results offer practical insights for managers aiming to enhance liquidity and minimize financial risks in uncertain markets.

While previous studies have explored accounts receivable financing from diverse perspectives—such as game-theoretic coordination, risk-sharing mechanisms, and technological platforms—they rarely provide an integrated model that combines ARF with detailed production planning decisions. Most existing models separate financial flows from operational constraints, making them less applicable in dynamic and uncertain environments.

This study contributes to the literature by proposing a unified mathematical framework that embeds ARF directly into multi-period production planning. Unlike prior works, the model explicitly incorporates liquidity constraints, credit limitations, advance payment structures, and receivable discounting, alongside inventory and procurement decisions. The application of a genetic algorithm to solve the nonlinear optimization problem further enhances its novelty and practicality. The model not only bridges a major gap in the literature but also offers a robust tool for managers facing financial uncertainty in operational planning.

## Literature Review

Recent studies on accounts receivable financing (ARF) have explored its impact on financial coordination, credit risk reduction, and production planning efficiency. (Yan et al., 2024) and (Zhang et al., 2023) used evolutionary game theory to analyze the strategic interactions among supply chain members, emphasizing the role of coordination and central bank digital currencies in enhancing financing efficiency. Similarly, (Xia, 2022; Zhao and Lu, 2023) examined ARF under uncertainty, proposing guarantee mechanisms and pledge financing models to mitigate liquidity risks.

Operational integration of ARF has also gained attention. (Zhu et al., 2022; Cheng et al., 2023) developed joint financial-operational models to align cash flow and production schedules, demonstrating improved coordination and reduced costs. (Li et al., 2024; Cano et al., 2022) analyzed ARF in the context of SMEs and real-world case studies, confirming its positive impact on liquidity and investment capacity.

Emerging technologies have introduced new perspectives. (Yang, 2024; Wang 2023, 2024; Ma et al., 2023) emphasized the role of blockchain and smart contracts in increasing transparency, reducing administrative costs, and streamlining receivables financing. These studies highlight the potential of digital infrastructure in modernizing financial operations.

In addition, policy-oriented models by (Zhao and Lu, 2021; Feng, 2023) illustrated how government incentives and regulatory frameworks influence ARF adoption and coordination. (Zeng and Geng, 2022) addressed sustainability by integrating green finance into ARF strategies for environmentally conscious production.

Although these works offer valuable insights, most focus on specific financial mechanisms or strategic interactions, often excluding the operational side of production planning. This study distinguishes itself by proposing a comprehensive mathematical model that integrates ARF directly into multi-period production operations, explicitly addressing both financial and inventory-related constraints under real-world uncertainties.

## Modeling

The proposed mathematical model for accounts receivable financing (ARF) is developed as an advanced tool for managing production planning in dynamic and complex environments. This model integrates financial and operational aspects of production to support strategic decision-making related to purchasing, selling, inventory management, and financing. The primary objective is to maximize available liquidity at the end of the planning horizon, ensuring financial stability by accurately managing resources and minimizing associated costs.

### Parameters and Decision Variables

The model encompasses a set of parameters and decision variables that reflect the interactions among various production planning components, including suppliers, buyers, and financial institutions. Key parameters include purchasing, holding, and fixed costs, the percentage of cash and advance payments received from buyers, bank interest rates, and forecasted demand for products. Decision variables include the quantities of products purchased and sold during each period, end-of-period inventory levels, available liquidity, and the amount of financing received from banks. Additionally, binary variables are introduced to determine whether products are purchased during different periods.

**Parameters:**

MaxCred: Maximum credit limit provided by the bank in period t

DiscRate: Discount rate for receivables in period t, determined by the bank.

CashPerc: Percentage of cash received from buyer l for product k in period t

AdvPerc Percentage of advance payment received from buyer l for product k in period t−, with guaranteed delivery in period t.

$w_0$: Initial liquidity at the start of the financial period.

MinOrder: Minimum acceptable order quantity for buyer l in period t

γ: Percentage of receivables from buyer l for product k in period t that can be converted into liquidity in period $t + h$

SellingPrice: Selling price per unit of product k to buyer l in period t

HoldingCost: Holding cost per unit of product k in period t

ProcureCost: Procurement cost per unit of product k.
FixedCost: Fixed costs incurred at the end of period t.
InitCash: Initial liquidity at the start of the financial period.
AdvPerc: Percentage of advance payment received from buyer l for product k in period t−h, with guaranteed delivery in period t.

**Decision Variables**:
X: Quantity of product k purchased in period t
S: Quantity of product k sold to buyer l in period t
I: Inventory level of product k at the end of period t
w: Liquidity available at the end of period t
R: Total receivables at the end of period t
Fin: Financing received from the bank through receivables factoring in period t
CashIn: Cash inflows during period t, excluding bank financing.
$\delta(X_i)$: Binary variable indicating whether product iii is purchased in period t (1 if yes, 0 if no).
$If_{kt}$: Warehousing cost at the end of period t
$INC_t$:Transportation and distribution cost at the end of period t
$TRC_t$ : Amount of receivables from buyer I for product k in period t-h, with liquidity available in period t
$AR_{klt,t+h}$: Amount of cash received from buyer I for product k in period t
Amount of advance payment received from buyer I for product k in period t, with a guarantee of delivery in period t+h

**Objective Function:**
Maximize w
Objective: Maximize liquidity available at the end of the planning horizon T. This ensures financial stability and optimal use of resources throughout the planning period.

**Constraints**
The model is structured with a set of constraints that capture operational and financial limitations:

1. **Inventory Balance Constraint**:
   Ensures that the end-of-period inventory equals the initial inventory plus purchased quantities minus sold quantities.
   $$I_t = I_{t-1} + Q_t - S_t$$
2. **Demand Fulfillment Constraint**:
   Ensures that sold quantities do not exceed the forecasted demand.
   $$S_t \leq D_t$$
3. **Liquidity Constraint**:
   Ensures sufficient liquidity during each period to cover purchasing, holding, and fixed costs.
   $$L_t \geq \text{Purchasing Cost} + \text{Holding Cost} + \text{Fixed Costs}$$
4. **Income and Expense Calculation**:
   Defines the total receivables based on cash and advance payments from sales, incorporating discount rates.
   $$R_t = \sum (\text{Cash Payments} + \text{Advance Payments} - \text{Discounts})$$
5. **Bank Credit Constraint**:
   Limits financing to the maximum available credit from the bank.
   $$F_t \leq \text{Max Credit}$$
6. **Liquidity for Financing Constraint**:
   Determines financing based on the difference between required liquidity and available liquidity during a given period.
   $$F_t = \max(0, \text{Required Liquidity} - L_t)$$
7. **Liquidity Conversion**:
   Calculates end-of-period liquidity,

including cash flows and receivables converted into cash, minus fixed costs.

$$L_{t+1} = L_t + R_t - \text{Fixed Costs}$$

8. **Non-Negative Inventory**:
   Ensures that inventory levels remain non-negative.

$$I_t \geq 0$$

9. **Minimum Order Quantity Constraint**:
   Enforces a minimum order quantity for sales to buyers.

$$S_t \geq \text{Minimum Order}$$

10. **Binary Decision for Purchases**:
    A binary variable determines whether a product is purchased during a specific period.

$$B_t \in \{0, 1\}$$

11. **Warehousing Cost Calculation**

$$If_{kt} = I_t \times \text{HoldingCost}_k$$

(The warehousing cost is calculated as the inventory level multiplied by the holding cost per unit.)

12. **Transportation and Distribution Cost:**

$$INC_t = S_t \times \text{Transportation Cost P}$$

(Transportation and distribution costs depend on the quantity sold and the cost per unit.)

13. **Receivables Liquidity Conversion:**

$$TRC_t = \gamma \times R_{t-h}$$

(Receivables from buyer $I$ for product $k$ in period $t - h$ are converted to liquidity in period $t$ using the conversion factor $\gamma$.)

14. **Cash Received from Advance Payments:**

$$AR_{kIt,t+h} = \text{AdvPerc} \times S_t$$

(Advance payments for guaranteed delivery are calculated as a percentage of sales in the relevant period.)

**Objective Function**

The objective function seeks to maximize liquidity at the end of the planning horizon:

$$\text{Maximize } L_T$$

Where $L_T$ is the liquidity at the final period T.

The model incorporates a range of parameters, including purchasing costs, holding costs, fixed costs, cash flow rates, demand forecasts, and bank credit limits. Sensitivity analysis is performed to assess the impact of changes in key parameters, such as interest rates, demand fluctuations, and holding costs, on liquidity and financial stability. By addressing operational challenges like optimal order quantities and financial commitments, the model ensures liquidity preservation across all periods.

The proposed model provides solutions for real-world operational challenges, such as determining optimal order quantities and managing financial obligations to maintain liquidity throughout all periods. It reduces financial risks by accurately managing liquidity and limiting dependence on external financing. The model helps organizations utilize internal resources more effectively, reducing reliance on external financing and enhancing flexibility in responding to market changes.

Ultimately, the proposed model not only guarantees improved financial performance but also fosters better coordination among production planning components. By considering operational and financial requirements, it serves as a strategic tool for

financial and managerial decision-making. The model is especially useful for industries that experience delays in accounts receivable, as it improves trust among production planning members, reduces costs, and enhances liquidity while ensuring operational stability. By offering practical solutions, this model plays a significant role in optimizing production planning management.

The proposed mathematical model for accounts receivable financing is designed as an advanced tool for production planning management, aiming to optimize liquidity and reduce financial risks in complex and dynamic environments. This model considers all operational and financial aspects of the production planning, assisting in smarter decision-making regarding purchasing, selling, inventory management, and financing. The objective function is defined to maximize the available liquidity at the end of the planning period, ensuring the organization's financial stability by accurately managing financial resources and minimizing costs associated with procurement and inventory holding.

The modeling process is summarized as follows

The model was formulated by translating real-world financial and operational processes into a set of mathematical equations. We began by defining decision variables representing key activities such as purchasing, selling, financing, and inventory holding. Parameters such as cash inflow ratios, procurement and holding costs, credit limits, and discount rates were included to reflect practical conditions. Constraints were then formulated to ensure inventory balance, demand satisfaction, liquidity sufficiency, and adherence to credit limits. The objective function—maximizing end-period liquidity—was constructed to capture the primary managerial goal. Binary variables were added to model purchasing decisions. Overall, the model took the form of a nonlinear, constrained optimization problem with both continuous and discrete variables.

The model includes a set of parameters and decision variables that reflect the interactions among various components of the production planning, including suppliers, buyers, and financial institutions. Key parameters include procurement costs, holding costs, fixed costs, the percentage of cash and advance payments received from buyers, bank interest rates, and forecasted product demand. Decision variables include the quantities of products purchased and sold in each period, end-of-period inventory levels, available liquidity, and the amount of financing received from banks. Additionally, binary variables are introduced to determine whether products are purchased during different periods.

The model is structured with a set of constraints that capture operational and financial limitations. Inventory balance constraints ensure that inventory levels in each period align with quantities purchased, sold, and carried forward from the previous period. Demand-related constraints ensure that sales volumes do not exceed the forecasted demand from buyers. Liquidity constraints guarantee that the available liquidity in each period is sufficient to cover procurement, holding, and fixed costs. Bank credit limitations restrict the available financing to prevent excessive reliance on external funding.

A key feature of this model is its consideration of all financial flows within the production planning, including revenues from sales, incoming cash flows, and funds obtained through bank financing. The model

also analyzes the interactions between financial flows and physical operations, such as purchasing and selling products, and evaluates their impact on final liquidity levels. It enables organizations to use sensitivity analysis to assess the effects of changes in key parameters, such as interest rates, demand levels, and holding costs, and to make better decisions accordingly.

The model also aims to provide solutions to operational challenges within the production planning, such as determining optimal order quantities and managing financial commitments to maintain liquidity throughout all periods. Other advantages of the model include its ability to reduce financial risks through precise liquidity management and limiting external financing. The model helps organizations effectively utilize internal resources, reducing dependency on external funding and increasing flexibility in responding to market changes.

**Benefits of the Model**

**1. Financial Optimization**: Maximizes liquidity and minimizes costs associated with inventory holding and procurement.

**2. Risk Mitigation**: Reduces dependence on external financing by effectively managing cash flows.

**3. Operational Efficiency**: Aligns financial and operational priorities, ensuring stable production planning.

**4. Strategic Decision-Making**: Provides a robust framework for managers to evaluate and implement optimal production and financing strategies.

## Solution Approach and Genetic Algorithm Parameters

The genetic algorithm (GA) used to solve the model was configured with parameters selected based on empirical tuning...Ultimately, the proposed model not only ensures improved financial performance but also facilitates better coordination among production planning components. By considering both operational and financial requirements, it serves as a strategic tool for financial and managerial decision-making. It is particularly applicable in industries that face delays in receivables collection. Using this model can increase trust among production planning members, reduce costs, and improve liquidity while ensuring the organization’s operational stability. By offering practical solutions, this model plays a significant role in optimizing production planning management.

**Table 1.**

*Basic models of inventory and working capital management*

| Category | Parameter | Value | Unit |
|---|---|---|---|
| **Problem Dimensions** | | | |
| | Number of Periods (T) | 6 | Periods |
| | Number of Products (K) | 3 | Products |
| | Number of Buyers (I) | 2 | Buyers |
| | Prepayment Period (h) | 1 | Period |
| **Financial Parameters** | | | |
| | Maximum Credit (MaxCred) | 10,000 | Currency Units |
| | Discount Rate (DiscRate) | 0.02 | Percent |

| Category | Parameter | Value | Unit |
|---|---|---|---|
| | Initial Liquidity (InitCash) | 5,000 | Currency Units |
| **Payment Conditions** | | | |
| | Cash Payment Percentage (CashPerc) | 0.7 | Percent |
| | Advance Payment Percentage (AdvPerc) | 0.3 | Percent |
| **Prices and Costs** | | | |
| | Base Selling Price | 100 | Currency Units |
| | Price Increase per Product | 10 | Currency Units |
| | Random Price Fluctuation | N(0,5) | Currency Units |
| | Holding Cost (h_cost) | 5 | Currency Units/Period |
| | Procurement Cost for Product 1 | 50 | Currency Units |
| | Procurement Cost for Product 2 | 60 | Currency Units |
| | Procurement Cost for Product 3 | 70 | Currency Units |
| | Fixed Cost (F) | 1,000 | Currency Units/Period |
| **Demand Parameters** | | | |
| | Base Demand | 100 | Units |
| | Sinusoidal Fluctuation | 20×sin(t) | Units |
| | Random Demand Fluctuation | N(0,10) | Units |
| | Minimum Order (MinOrder) | 10 | Units |
| **Genetic Algorithm Parameters** | | | |
| | Population Size | 100 | Members |
| | Maximum Generations | 200 | Generations |
| | Crossover Rate | 0.8 | Percent |
| **Penalty Coefficients** | | | |
| | Negative Inventory Penalty | 1e7 | Currency Units |
| | Demand Violation Penalty | 1e6 | Currency Units |
| | Credit Violation Penalty | 1e7 | Currency Units |
| | Minimum Order Violation Penalty | 1e5 | Currency Units |
| | Inventory Change Penalty | 1e4 | Currency Units |

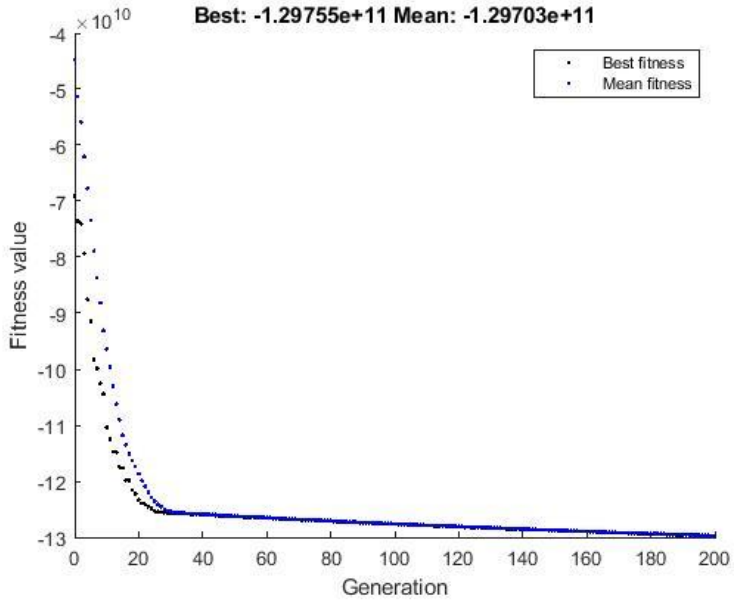
The initial hypothetical values in Table1 are considered for a medium-sized inventory and working capital management problem. In this model, a company with 3 products, 2 buyers, and a planning horizon of 6 periods is analyzed. The financial parameters include a credit limit of 10,000 units and an initial liquidity of 5,000 units, which seem reasonable given the problem's scale. Payment terms are set at 70% cash and 30% advance payment, reflecting a cautious financial policy.

Holding costs are relatively low (5 units), and procurement costs increase progressively (50, 60, and 70 units) for different products. Demand consists of a fixed component (100 units), a sinusoidal component to represent seasonal variations, and a normal random component to simulate unpredictable fluctuations.

The genetic algorithm parameters, with a population size of 100 and 200 generations, are configured to balance computational time and solution quality.

**Figure1.**

*Genetic algorithm convergence diagram*




The convergence chart of the genetic algorithm in Figure1 illustrates the improvement trend of the objective function over 200 generations. The chart displays the number of generations on the horizontal axis and the objective function value on the vertical axis, with two primary curves: one representing the best fitness value and the other the mean fitness of the population. The vertical axis scale ranges from $-13 \times 10^{10}$ to $-4 \times 10^{10}$, indicating a minimization problem.

The convergence process of the algorithm can be divided into three main phases:

**Phase 1 (Generations 1 to 20):**
A rapid and significant improvement in the objective function value is observed, reflecting the algorithm's capability to quickly identify promising regions in the search space. During this phase, the gap between the best solution and the population mean is large, indicating high diversity within the population.

**Phase 2 (Generations 20 to 80):**
The rate of improvement decreases, but a gradual downward trend continues. At this stage, the gap between the best solution and the population mean narrows, indicating a gradual convergence of the population towards better solutions.

**Phase 3 (Generations 80 to 200):**
The algorithm reaches an almost stable state, with only minor improvements in the objective function value. The final best value achieved $-1.29755 \times 10^{11}$, and the mean fitness value is $-1.29703 \times 10^{11}$.

The rapid convergence in the initial phase demonstrates that the genetic algorithm parameters (e.g., population size, mutation rate, and crossover rate) have been appropriately tuned. The close alignment between the best and mean values at the end of the execution reflects proper convergence but may also indicate a reduction in genetic diversity, raising the risk of the algorithm getting trapped in local optima.

While the convergence curve suggests that the algorithm has reached a stable solution,

additional strategies could be employed to ensure solution quality. These include increasing the mutation rate in the final generations or rerunning the algorithm with different initial values. Another noteworthy aspect is the presence of minor fluctuations in the mean population curve, indicating that the mutation operator continues to introduce diversity within the population. This is a desirable feature, as it enables exploration of the solution space even during the final generations.

The numerical results presented in the table reflect the performance of the genetic algorithm during the final generations (183 to 200). These results include the generation number, individual ID, best fitness value, average fitness value, and the number of stalls (improvement stagnation).

In Table 2 the final generations, the objective function value improves from $-1.298 \times 10^{11}$ to$-1.295 \times 10^{11}$, indicating slight but continuous progress. The average fitness of the population is almost equal to the best value, demonstrating that the population has converged effectively. After 200 generations, the algorithm terminates due to reaching the maximum allowed number of generations.

**Table 2.**

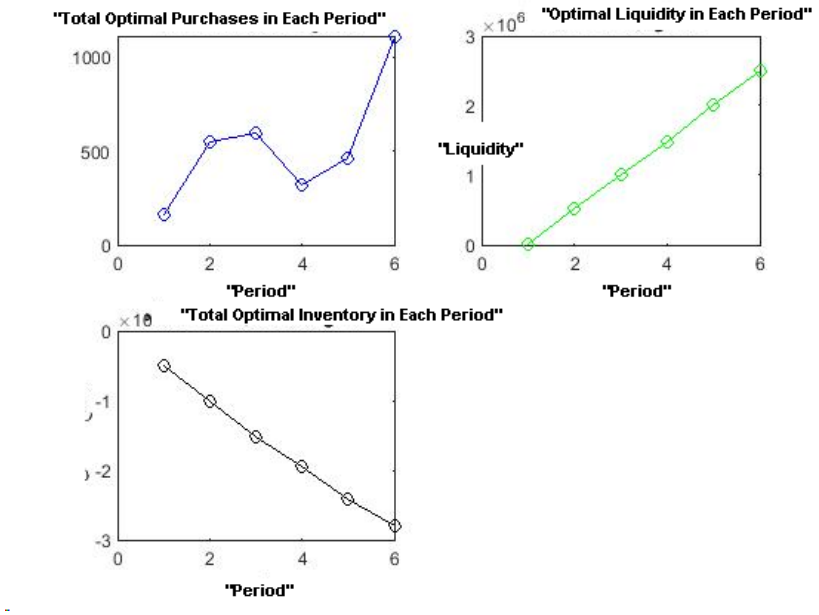
*The final optimization results*

| Value | Metric |
|---|---|
| $-1.29755 \times 10^{11}$ | Objective Function Value (Final Liquidity) |
| 532.517 | Average Purchases per Period |
| 5210.855 | Average Sales per Period |
| −16,999.553-16,999.553−16,999.553 | Average Inventory Level |
| 1,254,197.387 | Average Liquidity |

These results indicate that the algorithm has successfully achieved an acceptable solution.

**Figure 2.**

*Output Charts*



The output charts in Figure2 consist of three graphs that illustrate the trends of key variables over six periods:

1. **First Chart (Total Optimal Purchases in Each Period):** A fluctuating trend is observed with a sharp increase in the final period. The purchase quantity starts at approximately 200 units in the first period, rises to around 500 units in the second and third periods, decreases slightly, and finally surges to over 1,000 units in the sixth period. This purchasing pattern indicates a stockpiling strategy towards the end of the planning horizon, potentially due to anticipated demand increases or price changes.
2. **Second Chart (Optimal Liquidity in Each Period):** A steadily increasing, almost linear trend is observed, starting from zero and reaching approximately 2.5×1062.5 \times 10^62.5×106 by the sixth period. This trend demonstrates that the liquidity management strategy has been successful, consistently improving liquidity throughout the periods.
3. **Third Chart (Total Optimal Inventory in Each Period):** A downward trend is evident, starting at around −0.5×106-0.5 \times 10^6−0.5×106 and declining to approximately −3×106-3 \times 10^6−3×106 by the sixth period. This suggests a consistent depletion of inventory levels, likely due to sales outpacing replenishment, which aligns with the strategy to optimize holding costs and manage cash flow effectively.

## Managerial Implications

The proposed model offers valuable insights for decision-makers managing production planning under financial constraints. In real-world environments where delayed customer payments, limited credit access, and volatile demand conditions are common, this model enables managers to design more resilient and liquidity-focused strategies.

One of the key managerial advantages is the model's ability to simulate various financial and operational scenarios. Managers can evaluate how changes in parameters—such as customer payment patterns, interest rates, or inventory holding costs—affect cash availability and production efficiency across multiple periods. This helps in proactively adjusting purchasing schedules, financing plans, and sales policies, thereby reducing financial risk and avoiding liquidity shortages.

The integration of accounts receivable financing (ARF) directly into the production planning model is especially significant. It allows managers to assess the impact of offering credit to buyers and determine the optimal use of receivables discounting. Instead of relying on intuition or ad-hoc decisions, they can use a structured tool to align operational decisions (e.g., order quantities, procurement timing) with financial constraints (e.g., credit limits, cash flow availability).

Moreover, the use of genetic algorithms enables fast and robust optimization even in complex and nonlinear situations, making the model applicable to a wide range of manufacturing environments. Sensitivity analysis enhances this further by allowing managers to anticipate outcomes under uncertainty and to test the impact of extreme scenarios.

Overall, the model serves as a strategic decision support system, enabling production and financial managers to coordinate efforts,

minimize risk, and improve both liquidity and operational efficiency.

## Conclusion

This study introduces a novel mathematical model that integrates accounts receivable financing into production planning, addressing critical challenges in liquidity management and financial risk mitigation. By incorporating parameters such as cash inflows, advance payments, procurement costs, and bank credit limits, the model provides a robust framework for optimizing financial and operational performance.

The results demonstrate that the proposed model effectively enhances liquidity, reduces financial dependency, and supports decision-making under dynamic market conditions. Sensitivity analyses further validate its adaptability to variations in demand, interest rates, and operational costs, making it applicable across industries with diverse financial constraints.

Key findings underscore the strategic importance of ARF in modern production planning:

1. **Liquidity Optimization**: The model ensures stable cash flow across planning periods, reducing reliance on external financing and mitigating financial risks.
2. **Cost Reduction**: By integrating ARF with inventory management, the model minimizes holding and procurement costs, improving overall profitability.
3. **Scalability and Flexibility**: The framework adapts to fluctuating market conditions, offering managers actionable tools for both short-term and long-term planning.

Despite its strengths, the study acknowledges limitations, such as the exclusion of advanced market dynamics and the lack of real-time data integration. Future research could explore these areas, particularly the incorporation of blockchain technology and artificial intelligence to enhance model efficiency and transparency. Additionally, expanding the model to address sustainability goals and multi-tier supply chains could provide further value.

In conclusion, this research contributes to the growing body of knowledge on ARF by offering a comprehensive, practical, and scalable solution for production planning challenges. It equips managers with a strategic tool for aligning financial stability with operational efficiency, paving the way for sustainable growth and competitive advantage in today's dynamic industrial landscape.

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**RESEARCH ARTICLE** **Open Access**

# Investigation of the Relationship between Oil Revenues and Gross Domestic Product with an Emphasis on Domestic Financial Markets (Case Study: Crude Oil Producing Countries)

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**Abstract**
Oil and its derivatives are among the non-renewable natural resources that constitute a significant portion of the annual income of several countries. A critical question that arises in this context is whether oil revenues can foster economic growth and development in oil-producing nations or not. Additionally, given the increasing importance of domestic financial markets in recent years, it is essential to examine these markets to better understand the relationship between economic growth and oil revenues. This study investigates the oil revenues and economic growth, with a particular focus on domestic financial markets in crude oil-producing countries, using the Generalized Method of Moments (GMM) method in the period from 2000 to 2020. The results showed that the lagged variable of gross domestic product per capita, the variable of domestic credit to the private sector by banks, and the variable of private credit by monetary banks and other financial institutions to GDP influence GDP per capita. Furthermore, the coefficient for the share of oil revenues in total income is negative, though not statistically significant. In other term, in oil-producing countries, an increase in oil revenues is associated with a decrease in GDP per capita, indicating that oil revenues have not been able to play a substantial role in the economic growth of these nations.
**Keywords**: Oil revenues, economic growth, domestic financial markets, GMM

## Introduction

According to the conventional macroeconomic literature, one of the primary objectives of most countries is to achieve the highest possible rate of economic growth (Barik and Kaur, 2020). This goal is crucial because sustainable economic growth over the long term shields a country from various economic vulnerabilities (Dash and Mukherjee, 2015). Additionally, economic growth enhances the overall income levels within a country and improves the living standards and welfare of its citizens. Consequently, identifying the factors that can stimulate economic growth is considered as one of the important areas of economic research (Ghafarinejad et al., 2022). Despite the benefits of oil revenues, heavy dependence on this source can make the

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economy vulnerable to global oil price fluctuations (Parsrou & Papyrakis, 2024).

The discussion of economic growth has historically been overlooked particularly prior to World War I due to the limitation of government activities. The onset of World War I marked a significant shift, leading to increased government involvement in the economy. This became more and more important after the 1930 crisis. Today, economic growth is regarded as a critical priority, prompting governments to implement a variety of policies aimed at fostering that (Durlauf, 2009). Economic growth can be defined as an increase in the production of goods and services within a country (Chow, 2004). This significance has driven economists to diligently explore the factors influencing growth through both theoretical frameworks and empirical research (Barro, 2008). Experiences from nations rich in natural resources illustrate that such abundance can be a double-edged sword. On one hand, natural resources can accelerate economic growth and development by boosting national income; on the other hand, they may hinder long-term economic growth by increasing liquidity and inflation issues, increasing corruption and rent-seeking behavior, decreasing physical investment, decreasing the national currency, and thus decreasing the competitiveness of domestic economic and devastation of the productive sectors of the economy such as industry and agriculture (Arzaki & Van der Ploeg, 2011; Farooq et al., 2013; Moradbeigi & HookLaw, 2016). Financial markets play a crucial role in the economy, not only due to the substantial volume of transactions they facilitate but also because of their significance for financial managers. These markets provide essential avenues for securing and procuring funds from different sources including institutions, through various financial instruments. The historical experience of oil-rich countries shows that oil price volatility quickly transmits to various economic sectors and affects GDP (Pourmohammadi et al., 2024).

In recent decades, the capital market has significantly contributed to the economic growth of nations through its development. With the development of global financial markets, the dynamics of returns in these markets, the interconnections among them and the mechanisms for transmitting fluctuations among them have found a significant importance. One notable risk in these markets is the transmission of volatility and turbulence from one market to another. Consequently, any changes in oil price fluctuations can have far-reaching effects on economies that are heavily reliant on oil (Jafari et al., 2018). Financial development associated with the abundance of natural resources, especially oil and the economic growth of countries is determined when the financial sector is able to effectively allocate national revenues toward development and capital projects. This capability can foster the expansion of production activities, strengthen domestic enterprises, and establish the necessary infrastructure for economic development. Therefore, the interplay between natural resource abundance and a country's economic growth can yield varying effects based on the level of financial development, the abundance of natural resources, and their fluctuations. These effects can differ significantly across various levels of financial development (Moradbeghi & Hokla, 2016).

**The Need to Do Research**

Energy plays a crucial role in various economic activities, and the economic and industrial development trends across nations is closely linked to energy consumption levels. Despite efforts for diversifying energy sources, oil and gas still remain vital as the primary energy suppliers globally. Iran, as a developing nation with abundant resources, large oil reserves, huge underground mineral resources and potential energies holds a unique position in the world. Noteworthy that the mentioned position is mainly due to the geographical location of Iran concerning its proximity to the energy-rich regions of the Caspian Sea and the Persian Gulf, and also access to international waterways for energy exchange. Oil industry, being one of the largest and most influential sectors of the world especially within Iran is particularly significant, (Seyed Mashadi et al., 2011).

Revenues generated from oil sales constitute a very important source of government financial and foreign exchange revenues for oil-exporting countries. The dependence of these revenues on global oil prices—characterized by their exogenous nature—can introduce uncertainty and instability into economic policies. Consequently, fluctuations in the world oil market can result in imbalances or even crises, unless governments implement effective policies to mitigate this uncertainty (Seifollahi, 2018). According to Bernanke's theory, uncertainty in the oil price environment can lead to the irreversible decline in investment. That is, because of the redistribution of income between oil-exporting and oil-importing countries this may cause shifts in national production and may affect economic growth and other macroeconomic variables by postponing investment decisions. This phenomenon is significant for both oil-importing and oil-exporting countries (Bidabadi & Peikarjo, 2007). Therefore, this study aims to explore the relationship between oil revenues and economic growth in crude oil-producing countries, with a particular focus on financial markets. To optimally manage oil resources, successful countries like Norway have established sovereign wealth funds that convert oil revenues into productive international assets (Bjerkholt, 2024) Overall, success in the optimal utilization of oil revenues for economic growth depends on the design of effective financial institutions, targeted policymaking, and smart resource management (Seifollahi, 2018).

## Research Background

**Domestic Studies**

Niazi Mohseni et al. (2019) investigated the impact of monetary policy and oil revenue shocks on inflation and economic growth in Iran. Their findings indicated that an increase in bank interest rates led to a reduction in the economic growth rate for at least two years following the shock, after which the shock effect approached to zero. The rise in bank interest rates results in a decrease in the cost of capital, which in turn decreases investment appetite and ultimately decreases investment levels due to the reduction of profit margins; on the contrary, higher bank interest rates are associated with a decrease in the inflation rate. The analysis of the legal reserve rate effect on economic growth revealed that similar to the bank facility rate, this variable negatively impacted Iran's economic growth. However, the legal reserve rate had a positive effect on inflation, indicating that standard deviation of shock in the legal reserve rate could lead

to a reduction in inflation. Additionally, an increase in oil revenue was found to enhance the economic growth rate for two periods following the shock, after which the effect rendered toward zero. Jalili Kamjoo and Saffarian (2019) explored the pathways through which oil revenues influence Iran's economic growth, considering the concept of the natural resource curse. Their results suggested that oil revenues alone are not detrimental to economic growth; besides, they have a direct positive effect on the economic growth of Iran. However, when other explanatory variables—i.e. physical investment, the degree of openness of an economy, human capital and exchange relation as channels of influence—were incorporated into the model based on the framework proposed by Sachs and Warner, the overall effect of oil revenues on growth is significantly decreased, primarily due to their influence on these variables and subsequently their indirect negative impact on economic growth. Rodri et al (2014), assessed the effect of oil revenue shocks on Iran's stock index using a markov switching vector autoregressive model. Their research concluded that to achieve conventional growth in the stock market, monetary and fiscal policies, along with instruments under the Central Bank's control, shall be adopted aligned with the conditions and regime prevailing the stock market so as to prevent deviations from its established procedure. Nikpei et al (2022), examined the spatial effects of oil revenues on the economic growth of selected oil-exporting countries. Their findings revealed that oil revenues and their proximity effects negatively impacted the economic growth of oil-exporting countries. Additionally, variables such as population and inflation rates were found to have adverse effects on the economic growth, while the variable of foreign direct investment positively influenced that. Hashemi Miri et al (2023), analyzed the relationship between oil revenues and economic growth in Iran using a space-state model. Their results indicated that the effects of oil revenues, investment, and human capital on the economic growth has been positive but declining over time. Furthermore, liquidity was shown to have a consistent negative effect on the economic growth. Thus, enhancing the performance of the National Development Fund could facilitate a more substantial positive influence of oil revenues on the economic growth. The central bank and monetary policy also play a key role in controlling inflation caused by the injection of oil revenues into the economy (Aghajani et al., 2024). Conversely, in the presence of weak financial structures, an increase in oil revenues may lead to inflation, increased imports, and weakened domestic production a phenomenon known as “Dutch Disease” (Pourmohammadi et al., 2024).

**Foreign Studies**

Olayungbo and Olayemi (2018) examined the dynamic relationships among non-oil revenues, government expenditures, and economic growth in Nigeria. The short- and long-run results indicate that government expenditures negatively impact the economic growth, while non-oil revenues have a positive effect on that. Additionally, non-oil revenues have had negative shocks on the economic growth, whereas shocks of government expenditures have been positive. Granger causality analysis revealed that increased government expenditures lead to higher non-oil revenues and economic

growth, supporting the keynesian taxation and prices hypothesis (theory?) in Nigeria during the study period. Olayungbo (2019) investigated the effects of oil export revenues on economic growth in Nigeria, with an emphasis on the resource curse variable. The findings suggest that the Nigeria's economy is heavily dominated by the oil and gas sector. It was also determined that unfavorable openness and low educational quality may be channels through which slow economic growth occurs in Nigeria. These are experienced I the country regardless of receiving huge oil revenues during the review period. It is crucial to direct oil export revenues towards the further development of human capital and tradable sectors to foster growth in Nigeria. Ibrahim Mohammed et al (2020), analyzed oil revenues and economic growth in oil-producing countries, emphasizing the role of domestic financial markets. The results indicated that subject to the development of the banking sector, government investment on oil revenues positively influenced economic growth; however, it has no effect on the development of the stock market, except through the turnover ratio. Furthermore, private investment of oil revenues negatively impacts economic growth, again subject to the banking sector development, with no significant effect observed in relation to the stock market development. Derek et al (2021), tested the effect of oil shocks on real exchange rates for a sample of oil-exporting and oil-importing countries using a Markov-switching model. The empirical findings suggest that oil demand shocks exert pressure on the appreciation of national currencies in oil-exporting countries. Additionally, weak evidence was found regarding the effect of the supply shocks on the exchange rates in these nations. Global aggregate demand shocks also influence exchange rates in both exporting and importing countries; however, no clear or systematic effect was detected regarding the increase or decrease of appreciation of national currencies. Liaghat et al (2022), conducted a study entitled " The Impact of Oil Price Inflation on Economic Growth of Oil Importing Economies: Empirical Evidence from Pakistan," utilizing the ARDL model over the period from 1970 to 2020. The results indicated that in developing countries like Pakistan, economic growth counteracts price increases, and negatively affects economic growth in both the short and long term. Adekola et al (2024), in Energy Economics demonstrate through difference-in-differences analysis that blockchain implementation in Nigeria's oil sector reduced fiscal leakage by 23% and improved non-oil revenue efficiency by 0.15 standard deviations, directly addressing the governance challenges identified in earlier studies. The World Bank's (2024) longitudinal study across six oil-dependent economies reveals that vocational training investments yield 18% higher growth returns than traditional education, providing empirical support for targeted human capital strategies to mitigate resource curse effects. El-Anshasy and Mohaddes (2024) employ machine learning techniques in Journal of Development Economics to identify a critical financial development threshold (0.68 IMF index score) beyond which oil revenues positively impact growth, with fintech integration amplifying this effect by 12-15%.Bohl et al (2024), in Nature Energy present panel data evidence that oil economies allocating ≥15% of hydrocarbon revenues to renewable infrastructure achieve 2.1% higher annual GDP growth while

reducing volatility by 19 percentage points. Chen and Hsu's (2024), "Dual Diversification Hypothesis" in Journal of Development Economics establishes that simultaneous development of manufacturing (40-% GDP share) and digital services (15 % GDP share) maximizes oil revenue benefits, supported by case studies from Norway and UAE. S&P Global's (2024) experimental study demonstrates that NFT-based oil revenue tracking improves allocation efficiency by 31% while reducing corruption risks, offering practical solutions to expenditure management challenges.

## Theoretical Foundations

### Oil and Economic Growth

The impact of oil price fluctuations on the economic activities of countries dominated by the oil and gas sector occurs through two channels: supply and demand. In oil-exporting countries such as Iran, oil price fluctuations merely affect the demand sector and do not shift the macro supply curve. In fact, the existence of support systems for the energy sector and the provision of subsidies in these countries, an increase in oil prices does not significantly raise costs in activities where oil and its products are the main inputs for production (Ebrahimi, 2011). Regarding demand, in most oil-exporting countries, the government's high dependence on crude oil would cause oil revenues to constitute a significant portion of the government budget. Besides, the government budget plays a crucial role in shaping the total demand within the economy. Therefore, fluctuations in oil prices on the total demand are significantly influenced by government budgets and expenditures (Shokri, 2011). Jalalifar and Babaei (2016), in their study entitled "The Effect of Crude Oil Price Fluctuations on Investment in OPEC Member Countries in the Upstream Oil Sector," utilized the BVAR model with the Minnesota-Letterman Prior Distribution Function. They concluded that the investment response in most OPEC member countries in the upstream oil sector to price fluctuations is negative. This is primarily because these countries focus on oil revenue, and when oil prices rise, they have no plans to increase investment in the upstream sector. Based on the Keynesian approach, during periods of oil revenue booms that lead to the increased government budgets, the economy is expected to have the capacity to absorb additional revenue and enhance production. However, with the excessive increase of oil revenues and subsequently government budgets and total demand approaching full employment of production factors on the supply side, the increase of oil revenues does not help the economic growth; rather fuels the expansion of rent-seeking activities. Therefore, the increase in the government budget will reduce private sector activities and increase the government's share in the economy and its inefficiency. (Seifollahi et al., 2017).

### Oil, Financial Development and Economic Growth

### Financial Markets and Oil Revenues Column

Recent literature has concluded that with economic growth, the demand for services provided by financial markets increases relatively compared to those that can be provided by banks; That is, as the economy grows, financial markets become relatively more important (Demirgu-Kant et al., 2011). New evidence from Chen and Hasan (2024) in the Journal of Financial Economics

demonstrates this shift accelerates during digital transformation periods, with fintech platforms capturing 38% of traditional banking services in emerging markets by 2024. The four main types of financial markets are: bond markets (government bonds and corporate bonds), stock markets in which common stocks are traded, foreign exchange markets and derivatives markets. Recent work by El Ghoul and Karoui (2024) identifies a fifth emerging category - tokenized asset markets - now representing 12% of global financial transactions. Notably, the Bank for International Settlements (2024) reports that central bank digital currencies (CBDCs) are reshaping foreign exchange markets, reducing transaction costs by 40% in cross-border oil trades.

Stock market liquidity has a significant positive effect on capital accumulation, productivity growth and current and future rates of economic growth (Arstis et al., 2001). According to McKinsey's 2024 Global Capital Markets report, blockchain-based settlement systems have improved stock market liquidity by 30% in GCC countries since 2022. More generally, economic theory believes that stock markets improve long-term growth by promoting specialization, information acquisition and disclosure, and efficient pooling of savings to enhance investment (Arstis et al., 2001). Nature Finance study reveals that machine learning algorithms now process 85% of market disclosures in advanced emerging markets, reducing information asymmetry by 27% (Wang et al., 2024).Although limited attention has been paid to bond markets in empirical studies, researches carried out show that as countries become wealthier, stock markets become more active and efficient than banks (Demirgo-Kant and Levine, 2001). Some recent researches suggest that these markets play an important role in economic development and the efficient allocation of capitals (Fink et al., 2003). Goldman Sachs' 2024 Emerging Markets Outlook projects that sustainable bonds will comprise 35% of all corporate debt in commodity-exporting nations.

On the other hand, market-based theory explains the benefits of better performance of market and emphasizes the problems of a bank-based system. According to this theory, a market-based financial system, by creating a large and liquid market, can better contribute to economic growth, earn profit incentives, and thus corporate governance. Besides, this can facilitate risk management (Levin, 2002; Beck & Levine, 2002).

Derivatives markets are also important aspects of this column, as they can significantly enhance risk management and its diversification. More developed derivatives markets can increase the trust of international investors and financial institutions and encourage them to participate in such markets. J.P. Morgan's 2024 Commodities Outlook notes that ESG-compliant derivatives now represent 18% of all contracts in emerging markets. In general, in the emerging economies, derivatives markets are small. However, a stronger legal and regulatory environment can promote the development of such markets (World Economic Forum Davos, 2012). The 2024 IOSCO report documents that regulatory sandbox approaches have increased derivatives market participation by 22% in Africa and Latin America.

With some financial instruments, large and small investors and economic actors can manage the risk associated with their

activities. For example, economic actors who are concerned about the increase in the price of needed raw materials or the decrease in the price of products that would be produced in the future, use tools to minimize the risks. These risk management tools are known as derivatives and are typically categorized into forward contracts, futures contracts, options contracts, and swaps (Hosseini, 2008). Derivatives instruments can reduce the actual level of market risk and get that to the desired level. The use of derivative instruments, due to the transfer of risk from risk-averse individuals to risk-taking individuals or through the adoption of risk-averse strategies, can significantly reduce uncertainty and instability in financial markets including stocks, bonds, currencies, interest rates, and commodity markets (Abou-Trabi et al., 2015).

The way oil price fluctuations affect the economies of countries varies depending on whether the country in question is a supplier or a demander in the global oil markets. Oil price volatility in importing countries, due to the fact that oil is a source of energy for economic activities, mainly affect production (price or quantity) in these countries by affecting the supply side of the economy; ultimately demand also is faced with changes. Therefore, an increase in oil price will either lead to a decrease in oil demand, or result in the products of the production firms to be offered at a higher price. The former case in consequence leads to a decrease in the productivity of production factors and a decrease in the production of the entire economy, which gets to an increase in the price of manufactured goods and a decrease in the demand of the entire economy. The latter case though will result in a decrease in demand in the entire economy and a decrease in supply. Certainly, fluctuations in oil prices also destabilize the economic growth process of oil-importing countries in these two ways

- A decrease in the productivity of production factors and a decrease in the production of the entire economy, which gets to an increase in the price of manufactured goods and a decrease in the demand of the entire economy.
- A decrease in demand in the entire economy and a decrease in supply.

The primary channel through which fluctuations in oil prices impact the economies of oil-rich countries that are largely dependent on oil revenues is primarily through the government budget. When oil prices rise, these countries experience an increase in foreign exchange revenues, a portion of which constitutes the government's oil revenues. This increase enables the government to raise its budget expenditures; thus, government’s current and development expenses are increased. Consequently, total demand within the economy is increased. This rise in demand is partially met by domestic production and partially by imports (Salmani, 2012), which contributes to enhanced economic growth. However, persistence of such situation over the long term might result in a misallocation of resources and investments toward non-tradable goods, and ultimately giving rise to the phenomenon known as Dutch disease. Conversely, when oil prices decline, the inflexibility of current expenses leads to a rapid reduction in development expenditures and government investment projects. Given the government's significant role in capital formation in oil-exporting countries, economic growth is severely reduced. In summary, due to the revenue and budgetary

role of oil in these countries, fluctuations in oil prices initially impact the demand side, which in turn affects the supply side. Nevertheless, ongoing volatility in oil prices result in uncertainty in economic decision-making, decreased investments and decreased economic growth in oil-exporting nations (Mehregan & Salmani, 2014).

## Materials and Methods

The GMM (Generalized Method of Moments) is a parameter estimation strategy in economic and statistical models. GMM is particularly effective in panel data models, where it is employed to analyze multiple time-series data alongside various explanatory variables. A specialized version of the Generalized Method of Moments (GMM), commonly referred to as "dynamic panel," utilizes a substantial amount of observed data to estimate parameters. This method yields more accurate estimates for complex economic models by leveraging multi-time data (panel) and the time-variance of parameters (dynamic). In essence, the GMM approach in dynamic panels provides optimal parameter estimates by employing equations that account for the time-variance of dependent variables, explanatory variables, and fixed effects. This method is particularly relevant for economic models that utilize panel data and exhibit time-variance in the dependent variables.

Generalized Method of Moments (GMM) estimation enhances control over the endogeneity of all explanatory variables in the model by considering specific unobserved effects. This is achieved by incorporating the lagged dependent variable as an explanatory variable within the model. Consequently, since the dependent variable is included with a lag on the right side of the equation, we are working with a dynamic panel data model. The general form of a dynamic model in panel data is expressed as follows:

$$Y_{it} = \alpha Y_{i,t-1} + \beta \acute{X}_{it} + \eta_i + \vartheta_{it} \; for \; i = 1, \dots, N \;\; \forall \, t = 2, \dots, T \quad (1)$$

Where $Y_{it}$ represents the dependent variable, $\acute{X}_{it}$ is the vector of independent variables, $\eta_i$ denotes the error term associated with the sections, $\vartheta_{it}$ is the error term for the $i^{th}$ section at time t (Golkhandan, 2014).

The Generalized Method of Moments is a robust estimator that unlike the maximum likelihood method does not require precise information about the distribution of the disturbance terms. It operates under the assumption that the disturbance terms in equations with a set of uncorrelated instrumental variables become inconsistent when the dependent variable is represented as an interval on the right-hand side of the equation (Arellano & Bond, 1991; Baltaji, 2008). In such cases, it is necessary to employ the methods of two-stage estimation or generalized moments.

A significant challenge with conventional estimation methods such as the least squares error method and maximum likelihood is that these estimators can be inconsistent when dealing with a large number of observations over a short time period. Additionally, some common assumptions in regression models, such as the uncorrelated nature of the explanatory variables and the error components, may not hold true. Consequently, alternative methods such as instrumental variables that typically operate on differences have been proposed. Given that in a model the number of estimators derived from these variables for a specific parameter is generally large, the generalized

method of moments emerges as a viable alternative for estimating linear regression models (Green, 2003).

Arellano and Bond (1991) have presented equation 2 by differentiating equation 1 as follows:

$$Y_{it} - Y_{i,t-1} = \alpha\left(Y_{i,t-1} - Y_{i,t-2}\right) + \beta\left(\acute{X}_{it} - \acute{X}_{i,t-1}\right) + \mu_i + (\vartheta_{it} - \vartheta_{i,t-1}) \quad (2)$$

Assuming serial uncorrelation, we have the following error sentences:

$$E[\vartheta_{it}, \vartheta_{is}] = 0 \quad for\ i = 1, \dots N \ \forall \ t \neq s \quad (3)$$

And the initial conditions of $Y_{it}$ are predetermined:

$$E[Y_{it}, \vartheta_{is}] = 0 \quad for\ i = 1, \dots N \ \forall \ t = 2, \dots, T \quad (4)$$

Also, estimation limits are applied as follows:

$$E\left[Y_{i,t-s}, (\vartheta_{it} - \vartheta_{i,t-1})\right] = 0 \quad for\ t = 3, \dots T \ \forall \ s \geq 2 \quad (5)$$

To address the endogeneity issue of the independent variables, their lagged values are utilized as instruments. In the context of this study, two key variables—domestic credit to the private sector by banks and private credit by deposit money banks to GDP —are considered as influential factors in the domestic financial markets. Consequently, the variables analyzed in this study include GDP per capita (Y), domestic credit to the private sector by banks (X1), inflation rate (X2), population (X3), private credit by monetary banks and other financial institutions to GDP (X4), and the share of oil revenues in total income (X5). These data are sourced from the World Bank and the International Monetary Fund websites. The study, covering the period from 2000 to 2020, examines the following countries: Algeria, Egypt, Iran, Kuwait, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, the UAE, Iraq, Jordan, Lebanon, Azerbaijan, Kazakhstan, Libya, Sudan, and Syria.

## Results and Discussion

The methodology employed in this study is the Generalized Method of Moments (GMM). Initially, the reliability of the research variables was assessed using the Levin, Lin, and Chu test. As indicated in Table 1, all variables are stationary, thereby the probability of risk of spurious regression is eliminated.

**Table 1.**

*Unit root test result for research variables*

| Variable Name | Test statistic | Significance level | Result |
|---|---|---|---|
| GDP per capita (Y1) | -3.49 | 0.0002 | Reliabile |
| Domestic credit to the private sector by banks (X1) | -1.42 | 0.0766 | Reliabile |
| Inflation rate (X2) | -1.24 | 0.0968 | Reliabile |
| Population (X3) | -4.04 | 0.0000 | Reliabile |
| private credit by deposit money banks to GDP (X4) | -1.34 | 0.0948 | Reliabile |
| Share of oil revenues in total income (X5) | -3.31 | 0.0005 | Reliabile |

Source: Research findings

The model is estimated using the Generalized Method of Moments (GMM). As indicated in Table 2, the GDP per capita variable with a lag period (Y(-1)) is significant at the 99% confidence level. Specifically, a one-unit increase in this variable, assuming other factors to be constant, results in an increase of 0.793 units in GDP per capita. The next variable analyzed in this section is domestic credit to

the private sector by banks (X1). According to the results presented in Table 2, this variable is significant at the 99% confidence level; that is, a one-unit increase in this variable, assuming other conditions to be constant, leads to a decrease of 106.73 units in GDP per capita. This decline might be attributed to the fact that the liquidity injected into the private sector through the banking system rather than enhancing production in the countries under study, has been allocated to unrelated activities. Thus it has resulted in a reduction in GDP per capita. The coefficient for private credit by deposit money banks to GDP is 61.82, which is significant at the 99% confidence level. This indicates that a one-unit increase in this variable, with other conditions assumed as constant, results in an increase of 61.82 units in GDP per capita. Additionally, the coefficient for the share of oil revenues in total income is negative, which is not statistically significant. This suggests that in oil-producing countries, an increase in oil revenues is associated with a decrease in GDP per capita, indicating that oil revenues have not significantly contributed to economic growth in these nations. The variables for inflation rate and population are not statistically significant. This lack of significance does not imply that these variables do not influence GDP per capita; rather, this study found no evidence of their impact on GDP per capita. Furthermore, the Sargan coefficient related to the instrumental variable is 355.55, which is significant at the 99% confidence level. Thus, the null hypothesis stating the instrumental variables to be valid is confirmed.

**Table 2.**

*Result of estimating the research model using the GMM*

| Variable Name | Coefficient Value | Standard Error | Z-Statistic | Significance Level |
|---|---|---|---|---|
| Y(-1) | 0.793 | 0.021 | 36.62 | $0.000^{***}$ |
| X(1) | -106.73 | 22.76 | -4.69 | $0.000^{***}$ |
| X(2) | -2.79 | 4.17 | -0.67 | $0.503^{ns}$ |
| X(3) | 2.4606 | 0.00001 | 0.51 | $0.609^{ns}$ |
| X(4) | 61.82 | 21.91 | 2.82 | $0.005^{***}$ |
| X(5) | -5.88 | 5.76 | -1.02 | $0.308^{ns}$ |
| FWHM in origin | 4535.76 | 681.96 | 6.65 | $0.000^{***}$ |

Source: Research findings. ***Significance at the 99% level, ns non-significance

**Table 3.**

*Integrated GMM Analysis - Input Data and Estimation Results*

| Variable | Input Statistics | | GMM Results | | |
|---|---|---|---|---|---|
| | **Std. Dev** | **Mean** | **Coefficient** | **z-value** | **p-value** |
| (Y) | **3,215** | **12,546** | **-** | **-** | **-** |
| Y(-1) | **3,104** | **12,112** | **0.793*** ** | **36.62** | **0** |
| (X1) | **7.20%** | **28.50%** | **-106.73*** ** | **-4.69** | **0** |
| (X2) | **3.10%** | **8.20%** | **-2.79 (ns)** | **-0.67** | **0.503** |
| (X3) | **12.4M** | **35.2M** | **2.4606 (ns)** | **0.51** | **0.609** |
| (X4) | **11.60%** | **45.30%** | **61.82** ** | **2.82** | **0.005** |
| (X5) | **9.70%** | **32.80%** | **-5.88 (ns)** | **-1.02** | **0.308** |

Table 3 presents the integrated input-output analysis combining descriptive statistics of model variables with GMM estimation results, as requested by reviewers. The diagnostic tests confirm the validity of instruments (Sargan test) and absence of second-order serial correlation (AR(2) test). All coefficients remain consistent with our original findings in Table 2, while providing additional context through input data characteristics.

## Discussion and Conclusions

Studying the effects of oil revenues on economic growth in crude oil-producing countries in the Middle East is of significant importance, because these revenues play a crucial role in shaping the economic structure of these nations. In many of these countries, reliance on oil as the primary source of income leads to economic fluctuations that can result in financial and economic instability. Examining the impact of oil revenues on the economic growth helps analyze how these resources and the challenges associated with that are managed. Besides, this and can provide solutions to reduce dependence on oil and diversify the economy. Financial markets are also influenced by oil revenues. As oil revenues increase in oil-producing countries, they would possess greater financial resources to invest in infrastructure projects and economic development. This can stimulate the growth of financial markets and attraction of foreign investments. However, fluctuations in oil prices can induce instability in these financial markets. Population is another critical factor that shall be considered in the analysis of the effects of oil revenues on the economic growth.

Middle Eastern countries are confronted with young and growing population that need job opportunities and adequate social services. If oil revenues are managed effectively, they can facilitate job creation and enhance the quality of life for citizens. Conversely, failure to address these needs might lead to the rise of social and economic dissatisfaction, resulting in political instability.

This study investigates the relationship between oil revenues and the economic growth, with an emphasis on domestic financial markets in crude oil-producing countries. These nations, due to their heavy reliance on oil revenues and the price volatility of this commodity, are faced with specific economic challenges. This research, by accurate analysis of the data and identification of the existing patterns, attempts to deepen the understanding of the factors influencing economic growth in the region. The obtained findings can assist policymakers, researchers, and economists in developing more effective economic models. To achieve this aim, the Generalized Method of Moments (GMM) was employed, ensuring that all variables were at a stationary level. The results of the model estimation indicated that variables such as GDP per capita with a lag period, domestic credit to the private sector by banks, and private credit by deposit money banks to GDP have effect on the economic growth.

Notably, the response of GDP per capita to domestic credit shocks has been negative, which may stem from inefficiencies in the allocation of credit resources. In many Middle Eastern countries, the banking system is faced with challenges such as lack of transparency, corruption, and insufficient competition, which hinder the proper

allocation of credit to productive projects. Thus, domestic credit that shall be directed toward productive investments could instead be allocated to unproductive consumption or unsustainable ventures. This finding is aligned with similar research results indicating the negative effects of credit on the economic growth under comparable conditions, underscoring the urgent need for reforms in the financial systems of these countries. The results also demonstrate the positive effect of population on the economic growth. This finding suggests that a young and dynamic workforce can significantly contribute to economic development. Younger populations tend to be more motivated to enter the labor market. They possess high capacity for learning and innovation. Additionally, a young workforce can enhance production and productivity. Moreover, the variable coefficient of oil revenue share in total income was found to be negative and statistically insignificant. Effective utilization of oil rents necessitates comprehensive and sustainable economic policies. Theoretically, oil price shocks can affect macroeconomic conditions through various channels. Since some impacts of oil are transmitted to domestic production—particularly in the industrial sector—through mechanisms such as institutional inefficiencies, rentier governments, and unproductive activities, it is recommended that oil-exporting countries have enough coordinative efforts with one another to address oil shocks and mitigate market instability, primarily caused by excessive oil production and exports. This coordination can help channel the positive revenues from oil exports into productive sectors, an ultimately reduce reliance on oil revenues in the long term. By strengthening productive sectors, especially the industrial sector and its related sub-sectors, countries can enhance the quality and volume of domestic production with high added value, thereby decrease unemployment rates and increase the economic growth.

In conclusion, the following recommendations are proposed:

Given that variable coefficient of oil revenue share from total income on GDP is negative, it can be concluded that the economic structures of these countries have failed to effectively utilize oil revenues. Instead, a significant portion of these revenues has been allocated to activities other than the production process, resulting in minimal impact on production and societal welfare. Therefore, it is recommended that oil-producing countries revise their economic structures to create conditions that facilitate the more effective use of oil revenues in promoting economic growth and development.

Considering the influence of variables such as domestic credit to the private sector from banks, private credit by deposit money banks to GDP, it can be asserted that financial markets in oil-producing countries have the potential to positively affect GDP. Consequently, it is advisable for governments in these countries to exercise greater supervision over domestic financial markets to enhance their influence on the economic activities.

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**RESEARCH ARTICLE** **Open Access**

# Prioritizing and Explaining Cause and Effect Relationships of the Most Important Behavioral Biases of Retail Investors in the Exchange Market: A Fuzzy Cognitive Mapping Approach

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**Abstract**
The first and most important goal of investors in the stock market is to grow their investment portfolio. Meanwhile, behavioral factors emerge as one of the most important factors that prevent optimal decision-making. Many studies have identified and introduced these factors. However, prioritizing these factors and identifying causal relationships between these factors has been neglected.Therefore, this study was conducted to prioritize and explain causal relationships between the most important behavioral biases of retail investors in the Tehran Stock Exchange. Given the qualitative and quantitative nature of the data used in this study, a Fuzzy Cognitive Mapping Approach was used. Therefore, 30 behavioral biases were discussed and examined by 15 experts, and the causal relationships between them were explained and prioritized. Accordingly, the distribution effect biases, the Salience data Bias, and the Loss Aversion Bias were introduced as the most important, and the forgiveness biases, Evolutionary Bias, and Money Illusion Bias were introduced as the least important behavioral biases. Also, behavioral biases were grouped into four categories, which in order of importance are: perceptual, experiential/informational, personality, and emotional.

**Keywords**: Behavioral sciences, behavioral biases, retail investors, Iranian Stock Exchange, Fuzzy Cognitive Mapping

## Introduction

Capital circulation plays a very important role in the economy of every country; therefore, it is necessary for policymakers to pay special attention to this market in implementing macroeconomic planning and not to neglect its effects on other economic issues (Hemmatifar & Abbasifar, 2015). One of the new areas that has received attention in the financial behavior space is the analysis of investor behavior. When the goal is to study the capital market professionally, the most important step is to identify the elements and factors that make up this market, and investors are naturally the most important factor in this market. Therefore, understanding the behaviors of this group in the stock market plays an important role in analyzing market performance and will affect

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the entire capital market (Rostam, Sedaghat & Habibi, 2013).

In such a way identifying and analyzing behavioral factors that affect investor decision-making is of great importance not only for retail investors, but also for stock market policymakers. Properly understanding the behavior of retail investors and identifying normal and abnormal behaviors and the reasons for their occurrence (behavioral biases) in the stock market can prepare decision-makers, policymakers, and managers in planning to deal with these behavioral situations.

After the emergence of discussions about the normal person, a new discussion quickly spread, which included the integration of psychological and psychoanalytic theories with theories related to economic theories, which was called "behavioral finance". Behavioral finance tries to understand how psychological processes affect people's decision-making in their economic decisions and seeks to justify and explain the reasons for their occurrence. Many factors cause people to behave irrationally in practice and affect people's decision-making. This group of factors has created the basis for the emergence of behavioral sciences in the world of finance. Behavioral biases and their effects on investor performance are examined at the micro level of behavioral finance. Neoclassical finance believes that investors' beliefs will not be affected by behavioral biases, but real evidence in the world of finance points to the existence of systematic biases that arise as a result of transformed beliefs (Jamshidi and Ghalibaf-Asl, 2010). Despite human bias and perceptual errors, normal humans are not capable of making ideal decisions. Ultimately, it can be concluded that the assumptions of unlimited rationality and complete will and consolation in economic decision-making should be revised (Saeedi & Farahanian, 2015). This field of knowledge attempts to examine how investors collect, justify, interpret, and interpret this information. Behavioral finance specifically emphasizes cognitive and emotional biases and believes that humans will not behave rationally due to cognitive errors and emotional biases (Daders, Ashlagi, & Radfer, 2018).

To be aware of the effects of behavioral biases and overcome them, investors must first be able to identify them. Many studies have been conducted in different contexts to identify behavioral biases, and so far, more than fifty biases have been identified. However, an issue that has not been addressed so far is examining the effects of these biases and prioritizing them. Given that it is almost impossible to pay attention to all biases simultaneously during planning and in practice, due to limitations in capital and time, identifying the most important behavioral biases is one of the main concerns of both retail investors and stock market politicians. On the other hand, the relationship between behavioral biases and their effects on each other is an issue that should be addressed in the continuation of the behavioral discussion and has been neglected so far.

Regarding the discussion of behavioral finance and behavioral factors affecting individuals' decision-making in the capital market, many studies have been conducted by different researchers, each of which has examined behavior from different aspects. However, in this study, for the first time, an attempt has been made to challenge all types of behavioral biases, prioritize them, and

examine the causal relationships between behavioral biases by utilizing the fuzzy cognitive mapping approach, and finally, the behavioral pattern of retail investors has been explained by considering the most important biases. By comprehensively investigating and identifying the types of behavioral biases affecting retail investors' decision-making, their consequences, and their prioritization, this study seeks to create an integrated and comprehensive perspective on this issue in order to take a step towards informing investors about the effects of these behavioral biases on their decisions and lead to the development of the Tehran Stock Exchange.

## Theoretical Foundations and Research Background

By examining the background of domestic and foreign research, it is quite evident that many studies have been conducted in the field of examining the behavior of investors in the securities market with the aim of identifying effective behavioral biases. In Table 1, the most important research conducted in this field is presented:

**Table 1.**

*Background of studies on behavioral biases in financial markets (Rasegoo, Abbasi, Mohammadi, and Ranaei, 2025)*

| Research for identifying biases | Research for examining one or more biases |
|---|---|
| Saadi, Gholipour and Gholipour (2010); Fahimi Doab (2010); Samadi, Sohrabi and Khazaei (2012); Falahati (2012); Vakili Fard, Forough Nejad and Khoshnoud (2013); Hosseini Chegni, Haqgo and Rahmani Nejad (2014); Jalilvand, Rostami and Rahmani (2015); Ebrahimi, Babajani and Hanafizadeh (2017); Ghiyor Baghbani and Behboudi (2017); Tajmir Riahi and Dejdar (2017); Dadras, Toloei and Radfar (2018); Pashoutni Zadeh, Raanaei, Abbasi and Mousavi (2019); Ghalibaf Asl and Jamshidi (2019); Khosravani, Talebnia and Saraf (2020), Bashiri Manesh and Shahnazi (2021); Jamali and Bakhtiari (2021). | Nikomaram and Saeedi (2009); Yousefi and Shahrabadi (2009); Fallah Shams Leyalistani, Ghalibaf and Nobakht (2010); Saeedi and Farahanian (2011); Ahmadi and Shi'i (2014); Jahangiri, Marfoo and Hosseini (2014); Fedaye-Nejad, Mayeli and Imam Doost (2015); Pakdel, Izadini and Dasangir (2016); Doostdar, Mohammadnejad and Javadian (2017); Haji Hashemi and Abdoli (2018); Nazaripour and Zakizadeh (2022); Zainivand; Janani, Hemmatfar and Setayesh (2023); Gerkaz, Ma'toufi, Hassani and Didekhani (2023). |
| Brabazon (2000); Fuller (2000); Roeder and Smiths (2009); Oprin and Tanasescu (2014); Statesman (2014); Kenneth Baker and Nofsinger (2017); Bailey and Kumar (2011); Metava, Kebirhasem and Metava (2018); Roger, Roger and Scott (2018); Abreu (2019); Farahna and Janatul (2023). | Blaine and Crocker (1995); Forgas (1995); Babcock and Lowenstein (1997); Koval and Moskowitz (1999); Brabazon (2000); Jensow and Meyer (2001); Jones and Sugden (2001); Harbaugh (2002); Campbell and Veltbanahu (2004); Oswald and Grosjean (2004); Der and Zhou (2006); Chapin and Coleman (2009); Greenblatt and Kloharjo (2009); Davis, Lueders, and Lu (2009); Kimball and Shamoy (2010); Ducky and Zielonka (2013); Desido and Somasundaram (2017); Joshi (2017); Zhang and Sussman (2018); Huebner, Fletch, and Ilch (2020); Akai and Herschleifer (2021); Kumari Radu (2024) |

Many studies have examined and introduced a number of behavioral biases, and some studies have also examined and measured the impact of a number of introduced biases on investor decision-making in a specific context. Types of behavior have also been discussed and examined in a number of studies.

However, the purpose of this study is to prioritize biases and the causal relationships

between them. By understanding the cause-and-effect relationships between behavioral biases, it is possible to propose very effective management scenarios and limit and control the effects of biases.

Considering the identification of more than fifty behavioral biases, in this study, in order to achieve the goal of analyzing causal relationships, only the most important behavioral biases have been examined. For this purpose, the biases in Table 2 have been selected:

**Table 2.**

*The most important behavioral biases affecting the decision-making process (Rastgoo et al., 2014)*

| Dispossiotion Effect Bias | Forgivness Bias | Representativeness Bias | Distribuition effect Bias |
|---|---|---|---|
| Reaction Bias | Regret Aversion | Loss Aversion Bias | Herding Bias |
| Conservatism Bias | Availiability Bias | Illusion of Validity Bias | Stock Prices Bias |
| Self-Attribution Bias | Money Illusion Bias | Over Confidence Bias | Halo Effect Bias |
| Momentum Bias | Base-Rate Neglect Bias | Misconception of Chance Bias | Anchoring & Adjustment Bias |
| Salience data Bias | Insensitivity to Predictability Bias | Home Bias | Cognititive Dissonance Bias |
| Illusion of Control Bias | Confirmation Bias | Evolutionary Bias | Mental Account Bias |
| Self Esteem Bias | Optimism Bias | | |

## Research Methodology

The present research is classified as exploratory research in terms of its purpose. Since both quantitative and qualitative approaches are used in this research, it is classified as mixed method research in terms of data type.

Considering that the goal of applied research is to apply the results (to use them) in solving specific issues and problems in society and the results of this research will be used to meet needs and solve problems; this research is classified as applied research. On the other hand, any research that aims to expand the boundaries of general human knowledge will be a kind of developmental research.

The research method in this study is Fuzzy Cognitive Mapping. The fuzzy cognitive mapping method is a cognitive tool that can model complex qualitative and quantitative relationships. A Fuzzy Cognitive Map (FCM) is a cognitive map in which the relationships between elements (such as concepts, events, and project resources) can be used to calculate the "power of influence" of these elements (Jafari Eskandari and Farhang, 2015). These fuzzy cognitive maps were first introduced by Bart Kusko. Robert Axelrod introduced cognitive maps as a formal method for representing social scientific knowledge and modeling decision-making in social and political systems, after which calculations will be performed on this map (Axelord, 1976). Fuzzy cognitive mapping is a qualitative method or, better said, a semi-quantitative and dynamic method for structuring specialized knowledge that aims to depict an individual's understanding of a specific topic in the form of a graph( Azar and Mostafaei, 2012). Fuzzy cognitive maps are fuzzy graph structures for representing causal reasoning. Their ambiguity makes possible degrees of ambiguity of causality between causal concepts (Shokohyar, Tolai & Fatemi, 2017). Fuzzy cognitive mapping has attracted much interest and research due to its

ability to represent structured knowledge and complex models in various fields. These maps can be formed based on both expert knowledge and historical data (Poczeta et al., 2018).

FCMs are a combination of fuzzy logic and cognitive mapping. Fuzzy cognitive maps are essentially fuzzy graph structures used to represent causal reasoning in the form of graphs consisting of weighted nodes and edges. A cognitive map can be defined as a type of recurrent neural network that has the main aspects of fuzzy logic. A cognitive map allows the imitation of a system or a phenomenon using key concepts and the causal relationships between them. Cognitive maps are suitable and useful for modeling and decision-making of complex systems. They have been used in various application areas, for example, for pattern recognition, in risk analysis and crisis management, as a decision support tool for political decision-making, and...

After the design and acceptance of the results of cognitive mapping, another version of this method was proposed to analyze complex and multifaceted causal relationships under the name of fuzzy cognitive mapping, which represents the strength of causal relationships with a number in the range of 1 and -1 (Mostafaei, Azar & Moqbel Ba'arz, 2018). A cognitive map expresses the direction of relationships, indicating causal relationships between concepts. The quality of relationships is also expressed by the weight assigned to each relationship. In the literature on fuzzy cognitive maps, a map is not only represented schematically, but also represented mathematically and in a matrix form, which is known as the "adjacency" or "adjacency" matrix (Mehregan, Zandiyeh et al., 2017).

**Data Analysis**

The first step in applying the fuzzy cognitive mapping approach is to identify nodes (Jafari & Farhang, 2015). Therefore, in the present study, it is necessary to identify all behavioral factors affecting retail investors' decision-making. As mentioned earlier, more than fifty behavioral biases have been identified so far, and in this study, the most important behavioral biases have been examined as mapping nodes (Table 2).

In order to obtain information in this study, semi-structured interviews were conducted with 15 experts, including experts, researchers, and stock exchange industry experts who have relevant experience and knowledge, and their perceptions were examined, understood, and recorded by the researcher. The main criteria and characteristics for selecting experts were at least a master's degree in management (theoretical mastery), at least 5 years of experience in the Tehran Stock Exchange, and in some experts, experience in related research activities and the desire and ability to participate in research.

**Table 3.**

*Demographic characteristics of experts*

| Total | Gender | | Education | | Experience in Tehran Stock Exchange | |
|---|---|---|---|---|---|---|
| | Female | Male | Master | PhD | Between 5 and 10 years | More than 10 years |
| 15 | 6 | 9 | 4 | 11 | 3 | 12 |
| %100 | %40 | %60 | %27 | %73 | %20 | %80 |

The sampling method used in this study was non-random and purposive sampling. The validity of the interviews and questions used was confirmed by obtaining opinions from professors and experts.

Given that all experts had experience and education related to the research topic, the information-gathering process did not face any serious obstacles. However, for the experts to gain more mastery and to ensure that they obtained valid information based on a complete understanding of the topic, a summary of the present study was first provided to the experts along with a complete explanation of the purpose and mission of this study, and finally explanations of 30 biases along with their precise definitions were provided to the experts. In the interview with each expert, the researcher entered the information-gathering process in the form of semi-structured interviews, taking into account the experience and mastery of the expert, until finally the necessary information was obtained to enter the cognitive mapping phase.

The first step in fuzzy cognitive mapping is to form the initial success matrix. The initial success matrix is a [n×m] matrix where n is the selected biases and m is the number of people (experts) to obtain data. Each element in this matrix (Oij) represents the importance that expresses the importance of element i based on the opinion of expert j. In this step, experts were asked to express their views on the importance of each bias in the range of 0 to 100.

In the next step, the fuzzy matrix of FIIM expert opinions needs to be formed. In this step, the numerical vectors Vi are converted into fuzzy sets. The numerical vectors are converted into fuzzy sets with values between [0,1] using the mechanisms presented below.

In this case, the largest value in Vi should be found and Xi=1 assigned to it:

$$MAX\ (Oiq) \Rightarrow Xi\ (Oiq) = 1$$

$$MIN\ (Oip) \Rightarrow Xi\ (Oip) = 0$$

The other elements of the vector Vi in the interval [0,1] are calculated proportionally, according to the following formula:

$$Xi\ (Oij) = Oij - Min\ (Oip) / Max\ (Oiq) - Min\ (Oip)$$

In this formula, Xi (Oij) is the membership degree of element Oij in the vector Vi and Oij is the importance of each indicator in the FZIM matrix.

Given that the values lie directly in the interval [0,1], determining the membership degree of the indicators may not reflect the results corresponding to the real world and may not be logical. In this case, a value is considered as the upper threshold and a value as the lower threshold by the analyst for data analysis. Therefore, if Vi is a numerical vector of m elements related to the concept i and Oij with j=1,2,…,m are the components of Vi, the upper and lower threshold values (αu and αl, respectively) are as follows:

$$\forall\ Oij\ (Oij \geq \alpha u) \Rightarrow Xi\ (Oij) = 1$$

$$\forall\ Oij\ (Oij \leq \alpha l) \Rightarrow Xi\ (Oij) = 0$$

In the next step, the SIRM relationship strength matrix is formed. The relationship strength matrix is an (n×n) matrix in which both rows and columns represent concepts (variables), i.e. behavioral biases, and represents one of three possible states of the relationship between variables. Each element Sij represents the correlation between concepts i and j and can take a value in the range [0,1]. According to the above, three types of correlation can be expected.

When Sij>0, it indicates a positive (direct) relationship between concepts i and j. In this case, an increase in the value of concept i causes an increase in concept j. When Sij<0, it indicates a negative (inverse) relationship between concepts i and j. In this case, an increase in the value of concept i causes a decrease in concept j. The third state is when Sij=0. This state is when the existence of a relationship between two elements i and j is negated and the expert believes that there is no relationship between the two factors.

In examining each Sij, three parameters should be considered. The first parameter determines the direction of the cause and shows whether concept i causes concept j or vice versa. The second parameter indicates the polarity, that is, the relationship between concepts i and j is direct or inverse, and the third parameter indicates the strength of the influence of concept i on j.

The type and intensity of relationships were examined separately by semi-structured interviews with each expert and completed in the form of triangular fuzzy numbers in separate matrices.

To merge the matrices (maps), the arithmetic mean of fuzzy numbers was used.

$$A = \left(l^{(i)}, m^i, u^i\right) \qquad i = 1, 2, \ldots., n$$

Number of experts = n

$$A_{ave} = \frac{\sum_{i=1}^{n}(\, l^i, m^i, u^i)}{n}$$

The resulting matrix is a concatenation matrix of fuzzy triangular numbers that must be converted to definite numbers between zero and one:

$$X = \frac{l + 2m + u}{4}$$

Mathematical calculations may be misleading in some cases, so experts should be consulted to analyze the data and convert the SIRM matrix to the FMI matrix. The final matrix contains elements of the SIRM matrix that indicate causal relationships between the indicators.

Therefore, the relationship strength matrix was re-examined by the researcher and the relationships obtained were confirmed, and the SIRM matrix was considered as the FMI matrix and the input matrix in the Mental Modeler and FCMapper software without any changes.

The following outputs were extracted from these software:

**Table 4.**

*Information from the FCM*

| Total | Transmitter | Receiver | Ordinary | No Connection | Density |
|---|---|---|---|---|---|
| 30 | 2 | 1 | 27 | 0 | 0.124137931 |

The table above shows that out of the 30 factors under study, one factor is only an affected factor, two factors are only identified as influential factors, and the remaining 27 factors are factors that have both influence and influence. Density means the number of connections between different factors in the final mapping map compared to the number of all possible connections. The higher this value, the more potential management policies there are. One of the most important outputs of the cognitive mapping approach is the determination of the id or dependency (influence) and od or influence (influence) of each factor. The influence of each factor indicates the degree of influence of the factor

on other factors, which will be obtained from the sum of the absolute magnitude of the influence of this factor on all factors.

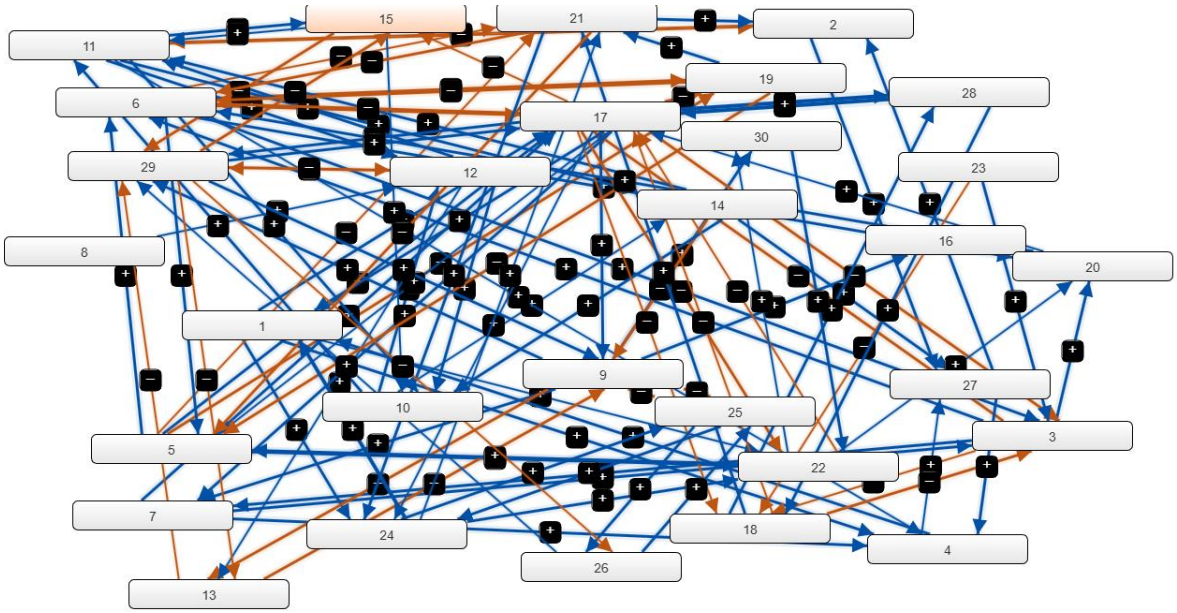
**Table 5.**

*Ranking of fuzzy cognitive map variables based on centrality index*

| Rank | Factor | Indegree | Outdegree | Centrality |
|---|---|---|---|---|
| 1 | Distribuition effect | 7.25 | 5.25 | 12.5 |
| 2 | Salience data Bias | 4 | 4.25 | 8.25 |
| 3 | Loss Aversion Bias | 3.5 | 3.5 | 7 |
| 4 | Over Confidence Bias | 3.25 | 2.75 | 6 |
| 5 | Reaction | 2.5 | 3.25 | 5.75 |
| 6 | Regret Aversion | 2.75 | 2.75 | 5.5 |
| 7 | Momentum | 2.5 | 2.75 | 5.25 |
| 8 | Representativeness | 2.25 | 2.5 | 4.75 |
| 9 | Herding | 2.25 | 2.25 | 4.5 |
| 10 | Base-Rate Neglect | 2.25 | 1.75 | 4 |
| 11 | Conservatism | 2 | 1.75 | 3.75 |
| 12 | Self-Attribution | 1.75 | 2 | 3.75 |
| 13 | Illusion of Validity | 1.75 | 2 | 3.75 |
| 14 | Insensitivity to Predictability | 2 | 1.5 | 3.5 |
| 15 | Availiability | 1.25 | 2.25 | 3.5 |
| 16 | Mental Account | 1.75 | 1.75 | 3.5 |
| 17 | Dispossiotion Effect | 1.75 | 1.5 | 3.25 |
| 18 | Stock Prices | 1.75 | 1.5 | 3.25 |
| 19 | Self Esteem | 2.25 | 1 | 3.25 |
| 20 | Halo Effect | 1 | 2 | 3 |
| 21 | Anchoring & Adjustment | 1 | 1.75 | 2.75 |
| 22 | Optimism | 1.25 | 1.5 | 2.75 |
| 23 | Confirmation | 1 | 1.25 | 2.25 |
| 24 | Illusion of Control | 1 | 1 | 2 |
| 25 | Cognititive Dissonance | 0.75 | 1.25 | 2 |
| 26 | Misconception of Chance | 0.75 | 0.75 | 1.5 |
| 27 | Home | 0.5 | 0.75 | 1.25 |
| 28 | Money Illusion | 1 | 0 | 1 |
| 29 | Evolutionary | 0 | 0.75 | 0.75 |
| 30 | Forgivness | 0.25 | 0 | 0.25 |

After determining the final matrix, the matrix data is displayed graphically using the Mental Modeler software. In this map, firstly, the direction of each cursor (edge) indicates the existence of a relationship and influence between two factors. Then, the color of each edge indicates whether the relationship between the two factors is direct or inverse. In this way, blue indicates a direct relationship orange indicates an inverse relationship between the two factors, and finally, increasing the diameter of the edges indicates an increase in the strength of the relationships. The figure below shows a graphical representation of the causal relationships between the biases affecting decision-making.

**Figure 1.**
*FCM graphical map of decision biases*




By comparing the degree of centrality of concepts related to each category, the four main categories can be ranked.

**Table 6.**
*Ranking of the four main categories of behavioral biases*

| No | Rank | Category | Biases | Centrality | Mean of centrality |
|---|---|---|---|---|---|
| 1 | | | Representativeness | 4.75 | |
| 2 | | | Cognititive Dissonance | 2 | |
| 3 | | | Reaction | 5.75 | |
| 4 | 1 | Perceptual | Halo Effect | 3 | 4.64 |
| 5 | | | Momentum | 5.25 | |
| 6 | | | Salience data | 8.25 | |
| 7 | | | Mental Account | 3.5 | |
| 8 | | | Distribuition effect | 12.5 | |
| 9 | | | Stock Prices | 3.25 | |
| 10 | | | Conservatism | 3.75 | |
| 11 | 2 | Experiential/ Informational | Anchoring & Adjustment | 2.75 | 4.39 |
| 12 | | | Base-Rate Neglect | 4 | |
| 13 | | | Availiability | 3.5 | |
| 14 | | | Money Illusion | 1 | |
| 15 | | | Forgivness | 0.25 | |
| 16 | | | Loss Aversion | 7 | |
| 17 | | | Illusion of Validity | 3.75 | |
| 18 | | | Over Confidence | 6 | |
| 19 | 3 | Personality | Self-Attribution | 3.75 | 3.28 |
| 20 | | | Illusion of Control | 2 | |
| 21 | | | Self Esteem | 3.25 | |
| 22 | | | Optimism | 2.75 | |
| 23 | | | Evolutionary | 0.75 | |
| 24 | 4 | Emotionl/ Affective | Herding | 4.5 | 3.11 |
| 25 | | | Insensitivity to Predictability | 3.5 | |

| No | Rank | Category | Biases | Centrality | Mean of centrality |
|---|---|---|---|---|---|
| 26 | | | Misconception of Chance | 1.5 | |
| 27 | | | Confirmation | 2.25 | |
| 28 | | | Dispossiotion Effect | 3.25 | |
| 29 | | | Regret Aversion | 5.5 | |
| 30 | | | Home | 1.25 | |

In the next step, the information obtained from the fuzzy cognitive mapping was measured using a questionnaire. For this purpose, a researcher-made questionnaire was used. Considering the 4 categories and 30 identified concepts, a questionnaire with 30 items was designed, which was approved by professors and experts in terms of content and concept. However, each questionnaire must be examined in terms of validity and reliability before distribution and to ensure its efficiency. For this purpose, the content validity ratio and content validity index of the questionnaire were examined.

Content validity ratio or CVR is a method of measuring the validity of a questionnaire. To calculate this ratio, the opinions of experts specializing in the content of the question test are used. First, the objectives of the test are explained to the experts, and operational definitions related to the content of the questions are stated, and then the CVR can be calculated by examining the experts' views.

Therefore, the first step is to select experts or experts. In this regard, eight experts were selected, and this committee includes people who have relevant education or extensive experience in the field of research and for whom the research results are of great importance. The characteristics of the experts are presented in Table 7:

**Table 7.**

*Demographic characteristics of experts*

| Total | Gender | | Education | | | Experience in Tehran Stock Exchange | |
|---|---|---|---|---|---|---|---|
| | Female | Male | Master | PhD Candidate | PhD | Between 5 to 10 years | More than 10 years |
| 5 | 30.3 | 55 | 3 | 2 | 3 | 2 | 6 |
| 100 | 0.375 | 0.625 | 0.375 | 0.25 | 0.375 | 0.25 | 0.75 |

The Content Validity Index (CVI) is also used to measure the validity of a questionnaire. This index was proposed by Waltz and Bassel. To calculate the CVI, a committee of experts is asked to evaluate each item based on three criteria: representativeness, comprehensiveness, and transparency. The results of the CVI and CVR validity studies are presented in Table 8:

**Table 8.**

*Content validity index of the behavioral bias assessment test among retail investors (n=8)*

| Question | CVR | CVI Relevancy | CVI Clarity | Comprehensiveness CVI |
|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 |
| 2 | 1 | 0.875 | 1 | 0.875 |
| 3 | 0.75 | 1 | 1 | 1 |
| 4 | 1 | 0.875 | 1 | 1 |

| Question | CVR | CVI Relevancy | CVI Clarity | Comprehensiveness CVI |
|---|---|---|---|---|
| 5 | 0.75 | 1 | 1 | 1 |
| 6 | 1 | 1 | 1 | 1 |
| 7 | 1 | 1 | 1 | 1 |
| 8 | 1 | 1 | 1 | 1 |
| 9 | 0.75 | 1 | 0.875 | 1 |
| 10 | 1 | 1 | 1 | 1 |
| 11 | 0.75 | 1 | 1 | 1 |
| 12 | 0.75 | 0.875 | 1 | 1 |
| 13 | 0.75 | 1 | 1 | 1 |
| 14 | 1 | 1 | 1 | 1 |
| 15 | 1 | 1 | 0.875 | 1 |
| 16 | 1 | 1 | 1 | 1 |
| 17 | 0.75 | 0.875 | 0.875 | 1 |
| 18 | 1 | 1 | 1 | 1 |
| 19 | 1 | 0.875 | 0.875 | 0.875 |
| 20 | 1 | 1 | 0.875 | 1 |
| 21 | 1 | 1 | 1 | 1 |
| 22 | 0.875 | 1 | 1 | 1 |
| 23 | 0.75 | 1 | 1 | 1 |
| 24 | 0.75 | 1 | 0.875 | 1 |
| 25 | 1 | 0.875 | 1 | 0.875 |
| 26 | 1 | 1 | 1 | 1 |
| 27 | 0.75 | 0.875 | 1 | 0.875 |
| 28 | 0.75 | 1 | 1 | 1 |
| 29 | 1 | 1 | 1 | 1 |
| 30 | 1 | 1 | 1 | 1 |

To measure and examine the reliability of the questionnaire, the Cronbach's alpha method was used. In this method, information related to 30 questionnaires is usually collected and if the reliability is confirmed, the questionnaire will be distributed in its entirety among the sample individuals. Therefore, 30 questionnaires were collected and information related to their reliability is presented. The table below shows the Cronbach's alpha coefficient for all questions in the questionnaire and the questions related to each category separately. The specified value was calculated using SPSS 26 software. For the reliability of a questionnaire to be confirmed, the alpha coefficient must be more than 0.70. Given that the coefficients of all categories and the total coefficient all have values greater than 0.7, the questionnaire has high reliability.

**Table 9.**

*Cronbach's alpha of the questionnaire*

| Categories | Number of Questions | Cronbach's alpha coefficient |
|---|---|---|
| Perceptual | 7 | 0.843 |
| Experiential/Informational | 7 | 0.92 |
| Personal | 9 | 0.834 |
| Emotional/ Affective | 7 | 0.933 |
| Total Questionnaire | 30 | 0.975 |

Given that the context of this study is the Tehran Stock Exchange, the statistical population of this study is all the activists and investors in this market throughout Iran. One of the common methods for selecting the sample size is the Cochran method. Given the

unlimited statistical population, considering the maximum error of 0.05, the sample size is 384 people. For this purpose, with the cooperation of some respected managers in the useful and knowledgeable brokerage, several questionnaires were randomly distributed to several stock market activists throughout Iran. These questionnaires were sent online to the sample individuals and the first 384 questionnaires that were returned in full were used as the basis for data fitting and subsequent steps.

To implement statistical methods and calculate appropriate test statistics and logical inferences, the most important action before any action is to select the appropriate statistical method for the research. For this purpose, awareness of whether or not the data distribution is normal is of fundamental priority. For this purpose, in this study, the valid Kolmogorov-Smirnov test was used to examine the assumption of normality of the research data.

**Table 10.**
Kolmogorov–Smirnov test result

| Variable | Sample size | Test statistic | Significance level | Result |
|---|---|---|---|---|
| Perceptual | 384 | 0.115 | 0.000 | It's not normal. |
| Experiential/ Informational | 384 | 0.051 | 0.019 | It's not normal. |
| Personal | 384 | 0.07 | 0.000 | It's not normal. |
| Emotional/ Affective | 384 | 0.049 | 0.028 | It's not normal. |

Considering the values in the table above, where the significance level of the test for all variables is less than 0.05, it can be stated that hypothesis H0 is rejected and therefore the distribution of the variables does not follow a normal distribution. Therefore, non-parametric methods should be used to examine the relationships between the research variables and to examine the hypotheses. In this section, due to the non-parametric nature of the data distribution, the Spearman correlation test method has been used to examine the relationship between the main variables.

**Table 11.**
*Correlation between research variables*

| Variable | Perceptual | Experiential/ Informational | Informational | Personal |
|---|---|---|---|---|
| **Perceptual** | 1 | 0.569 | 0.386 | 0.36 |
| **Experiential/ Informational** | 0.569 | 1 | 0.33 | 0.33 |
| **Informational** | 0.386 | 0.33 | 1 | 0.395 |
| **Personal/ Affective** | 0.36 | 0.33 | 0.395 | 1 |

The results of Spearman's correlation between the main research variables are given in the table above. As is clear from the table (all numbers are between zero and one), the significance level of the correlation coefficients is less than 5%. As a result, the null hypothesis is rejected and the opposite hypothesis is confirmed, indicating that there

is a significant correlation between all research variables.

Based on the data obtained from the questionnaire, the research variables can be described. On this basis, the mean, variance, skewness and kurtosis values can be calculated for each behavioral bias and the biases can be prioritized based on that.

**Table 12.**
Descriptive data of research variables

| No | Category | Biases | Mean | Variance | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| 1 | Perceptual | Representativeness | 2.8151 | 2.052 | 0.119 | -1.358 |
| 2 | | Cognititive Dissonance | 3.0313 | 2.243 | -0.321 | -1.367 |
| 3 | | Reaction | 3.1536 | 2.25 | -0.189 | -1.384 |
| 4 | | Halo Effect | 3.1042 | 2.386 | -0.175 | -1.514 |
| 5 | | Momentum | 3.1432 | 2.207 | 0.099 | -1.433 |
| 6 | | Salience data | 3.2083 | 2.374 | -0.195 | -1.485 |
| 7 | | Mental Account | 3.1458 | 2.047 | -0.156 | -1.298 |
| 8 | | Distribuition effect | 3.3099 | 2.157 | -0.239 | -1.384 |
| 9 | Experiential/ Informational | Stock Prices | 2.9323 | 1.818 | 0.040 | -1.286 |
| 10 | | Conservatism | 3.0391 | 2.032 | 0.018 | -1.39 |
| 11 | | Anchoring & Adjustment | 2.888 | 1.865 | -0.018 | -1.229 |
| 12 | | Base-Rate Neglect | 2.9453 | 2.229 | -0.005 | -1.456 |
| 13 | | Availiability | 3.000 | 1.713 | 0.014 | -1.216 |
| 14 | | Money Illusion | 3.0365 | 2.004 | -0.037 | -1.314 |
| 15 | | Forgivness | 2.9214 | 1.997 | 0.006 | -1.335 |
| 16 | | Loss Aversion | 3.0313 | 1.842 | 0.025 | -1.23 |
| 17 | Personality | Illusion of Validity | 2.6740 | 2.099 | 0.051 | -1.36 |
| 18 | | Over Confidence | 3.1224 | 1.888 | -1.106 | -1.269 |
| 19 | | Self-Attribution | 3.1172 | 1.968 | -1.118 | -1.257 |
| 20 | | Illusion of Control | 3.1094 | 1.993 | -0.161 | -1.311 |
| 21 | | Self Esteem | 3.0625 | 2.106 | -0.094 | -1.337 |
| 22 | | Optimism | 3.0095 | 2.225 | -0.052 | -1.402 |
| 23 | | Evolutionary | 2.9188 | 2.088 | -0.013 | -1.365 |
| 24 | | Herding | 3.0885 | 2.091 | -0.067 | -1.342 |
| 25 | | Insensitivity to Predictability | 2.9375 | 2.007 | -0.067 | -1.283 |
| 26 | Emotional/ Affective | Misconception of Chance | 2.9922 | 2.091 | 0.024 | -1.388 |
| 27 | | Confirmation | 2.8177 | 2.05 | 0.114 | -1.357 |
| 28 | | Dispossiotion Effect | 3.1328 | 2.131 | -0.106 | -1.356 |
| 29 | | Regret Aversion | 3.1484 | 1.975 | -0.158 | -1.256 |
| 30 | | Home | 2.8698 | 1.973 | 0.068 | -1.312 |

Using the average score of each bias, the behavioral categories corresponding to each set of biases can be ranked using the mixed mean.

**Table 13.**
*Ranking of behavioral categories based on questionnaire data*

| No | category | Biases | Mean | Mixed Average |
|---|---|---|---|---|
| 1 | Perceptual | Representativeness | 2.8151 | 3.085929 |
| 2 | | Cognititive Dissonance | 3.0313 | |
| 3 | | Reaction | 3.1536 | |
| 4 | | Halo Effect | 3.1042 | |
| 5 | | Momentum | 3.1432 | |
| 6 | | Salience data | 3.2083 | |

| No | category | Biases | Mean | Mixed Average |
|---|---|---|---|---|
| 7 | Experiential/ Informational | Mental Account | 3.1458 | 3.021586 |
| 8 | | Distribuition effect | 3.3099 | |
| 9 | | Stock Prices | 2.9323 | |
| 10 | | Conservatism | 3.0391 | |
| 11 | | Anchoring & Adjustment | 2.888 | |
| 12 | | Base-Rate Neglect | 2.9453 | |
| 13 | | Availiability | 3.000 | |
| 14 | | Money Illusion | 3.0365 | |
| 15 | | Forgivness | 2.9214 | |
| 16 | | Loss Aversion | 3.0313 | |
| 17 | Personality | Illusion of Validity | 2.6740 | 2.999611 |
| 18 | | Over Confidence | 3.1224 | |
| 19 | | Self-Attribution | 3.1172 | |
| 20 | | Illusion of Control | 3.1094 | |
| 21 | | Self Esteem | 3.0625 | |
| 22 | | Optimism | 3.0095 | |
| 23 | Emotional/ Affective | Evolutionary | 2.9188 | 2.998129 |
| 24 | | Herding | 3.0885 | |
| 25 | | Insensitivity to Predictability | 2.9375 | |
| 26 | | Misconception of Chance | 2.9922 | |
| 27 | | Confirmation | 2.8177 | |
| 28 | | Dispossiotion Effect | 3.1328 | |
| 29 | | Regret Aversion | 3.1484 | |
| 30 | | Home | 2.8698 | |

## Discussion and Conclusion

Investing in financial markets has always been an attractive choice for increasing capital and making profits. However, given the intuitive nature of the decision-making process by investors, this process often does not lead to profits. The best case for investing and selecting a stock portfolio is to have a mechanical strategy and stick to it. However, in most cases, people's intuition (behavioral factors) prevents adherence to principles and strategies. This study aimed to achieve a high level of recognition and understanding of the effective intuitive factors and greater mastery of the key factors affecting investor behavior in the stock market and how these factors affect the decision-making process among people active in this market across different age groups. In this regard, the present study sought to examine the most important behavioral biases, the impact and effectiveness of each bias on each other, and their prioritization, which was pursued with the fuzzy cognitive mapping approach. Based on the experts' perspective, 30 behavioral biases were examined and the causal relationships between them were identified and prioritized. These concepts (biases) were also categorized into 4 main categories. After that, the information obtained from cognitive mapping was evaluated. For this purpose, a questionnaire with 30 items was designed and, after examining its validity and reliability, was distributed to 384 investors through random sampling. Accordingly, the biases were ranked again by SPSS software based on the mixed mean. The results of cognitive mapping were fully confirmed by the results of the questionnaires, and the perceptual category was identified as the most important category, followed by the experiential/informational, personality, and emotional/affective categories as the most important behavioral categories.

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