Application of Fuzzy Cognitive Map to Design the Causal Structure and Analyze the Factors Affecting Good Governance in the Ports and Maritime Organization

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ABSTRACT

Ports always play a strategic role in the development of a country's domestic and international trade, whether it is developing or developed. Ports as a base of maritime trade have changed a lot in recent decades, but in line with these changes, the Ports and Maritime Organization, as the main custodian of port and maritime policy, must adapt quickly, and this adaptation and the process of change in the next generations of ports of the country should lead to good governance in the management of port affairs. The evolutionary process of port governance shows that a single version cannot be used for governance reforms in all ports of the world, so in this study we try to examine the factors affecting good governance at the organizational level. The present study is a descriptive-survey research in terms of applied purpose and based on its nature and method. The statistical population in this study includes 22 experts of the Ports and Maritime Organization and the sampling method is random and purposeful due to the large number of experts. In this study, we first identify the factors affecting good governance by examining past literature studies in a hybrid manner and then examine the components by surveying experts using the Fuzzy Delphi method and finally to show the causal reasoning between the components of the technique. Fuzzy Cognitive Mapping is used. Findings indicate that the components of Equal Rights and Equity, Responsiveness & Accountability, Defining Outcomes have the highest degree of centrality, respectively, and this indicates the importance of the above components compared to other components of good governance in the Ports and Maritime Organization.

1. Introduction

According to global statistics, about 90% of the import and export activities of countries and in general loading and unloading activities, as well as 90% of the volume of goods transport in the global trade process are done by sea and ports. Therefore, from this perspective, it can be said that ports have a vital and fundamental role in this process. Therefore, due to Iran's location in the path of international corridors, its special strategic position and having about 3,000 kilometers of water borders in the north and south, this country has a privileged position in international transportation [1]. Thus, it is clear that ports always play a strategic role

in the development of a country's domestic and international trade, whether it is developing or developed. Ports play a key role in the international transport chain and without them the process of production, trade and consumption will not be completed. Therefore, governments try to reduce the time and cost of trade by designing and implementing policies related to the simplification of trade formalities, and by increasing the competitiveness of ports, provide the basis for facing the challenges in port development. In terms of globalization, ports that do not adapt to these changes in terms of infrastructure and port services will lose their competitiveness in terms of throughput capacity [2].

Ports as the basis of maritime trade have changed a lot in recent decades, but in line with these changes, the Ports and Maritime Organization, as the main custodian of port and maritime policies, must adapt quickly. This adaptation and process of change, as well as the generations of ports in the country, should lead to good governance in port management. The evolutionary process of port governance shows that a single solution cannot be used for governance reform in all ports of the world, so in this study we try to analyze and evaluate the factors affecting good governance in an organization that is one of the custodians of transportation and is a link between the development of domestic trade and international trade.

2. Theoretical Framework and Literature of Review

One of the main concerns of developing countries is to be on the path of development. The study of the pathology of development programs in Iran proves that one of the most important reasons for failure in the path of development is the lack of a national and indigenous model for governance in accordance with the values of society, the situation of the country, and the ideals and macro national and local goals which be compatible with the cultural and historical issues of Iran [3]. Governance theory seeks to find the characteristics and prerequisites of development and, more than any other factor, emphasizes the evolution of the internal institutions and structures and the formal and informal laws of societies [4]. The quality of governance has always been a central concern for the political philosophers, theorists and practitioners [5].

It must be remembered that the path towards 'good governance' must involve a demonstration of the path towards a viable, unified and stable civil order [6]. Today, citizens expect to receive quality services and meet these expectations require new conditions that need new public services at the macro level of society and governance paradigms. Any model must take into account three basic queries: who, what and how it governs. These three points are directly related to the cornerstones of the governance: its structure, its actions and its own elements. The structure refers to the regulatory framework; the actions, to the tools leading to coordination; and the elements, to the agents and flows [7].

In response to the challenge, many scholars and international organizations have come up with a number of concepts, such as meta-governance, sound governance, effective governance and good governance. Among them, the most influential one is ''good governance'' [8].

So, good governance is both an end and a means . It is a key goal of development, broadly construed, and it is also an instrument for achieving better policymaking and improved economic outcomes" [9].

Now I briefly mention some recent definitions of good governance:

Good governance refers to the public administration process that maximizes public interest. One of its essential features is that it is a kind of collaborative management of public life performed by both the State and the citizens and a new relationship between political State and civil society, as well as the optimum state of the two[8].

Good governance in the definition of the World Bank is the capacity of management and institutional reforms conducted by state policy that improve coordination and delivery of effective public services, accountability of political actors and individual citizens in the driving of development policies[10].

World Bank broadened the scope in to more aspects and defines Good Governance as: Good Governance consists of traditions and institutions by which authority in a country is exercised. This includes the process by which governments are selected, monitored and replaced; the capacity of the government to effectively formulate and implements sound policies; and the respect of citizens and the state for the institutions that govern economic social interactions among them[11].

Good governance is defined by rule of law, the existence of effective state institutions, transparency and accountability in the management of public affairs, respect for human rights, and the meaningful participation of all citizens, particularly women, in political processes and decisions affecting their lives [12].

Good governance allows reducing the corruption. It promotes gender equality, has a positive impact on sustainable development, allows citizens to enjoy personal freedoms, and delivers tools for combating poverty, privation, fear and violence [13].

In contemporary usage, the concept of good governance has two main meanings. The first and more limited meaning is associated with the World Bank which interprets it in primarily administrative and managerial terms. The second meaning, associated with Western governments, is more political [5]. Since the 1990s, port governance has attracted much attention from the academic, the port authorities, as well as the policy and decision makers operating in the maritime sector, and port governance itself has gradually became an important academic and practical concept in the port field. Although a lot of studies have been published on the topic of port governance, there exists no consensus on the definition of port governance because of the complexity and vagueness of the scope of governance, which states that "governance is the adoption and enforcement of rules governing conduct and property rights [14].

The research in question has shed much light on the new modes of governance, the distribution of the various functions of ports and is now attempting to

explain the complex link between performance and governance [15].

The evolution in governance structures of other countries indicate that there is no simple "one size fits all" approach that can be applied to port reform. Some governments around the world view privatization and competition as a solution to attaining port efficiency.

Good ports has different interpretations. For example, privatization in the United Kingdom did not lead to or improve port efficiency; rather it has led to heavy reliance on subsidization in the maritime sector. On the contrary, in China and Korea, it resulted in more efficient ports. As a result of privatization, more transparent governance has been achieved by Korea. Companies that adhere to Companies Act 71 of 2008 and the King Code of Corporate governance are considered to have good governance. The King Code outlines elements for good governance such as transparency, independence, responsibility, discipline, social responsibility and fairness [16]. Figure 1 shows the main actors in governing the port [17].
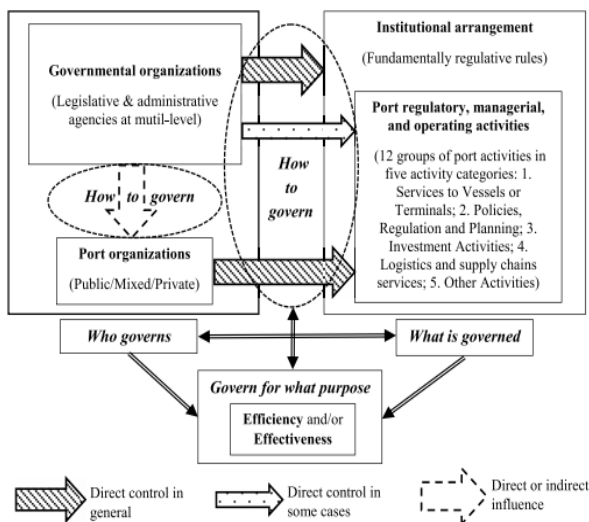
Figure 1. The relationships between the four basic questions of port governance.

Good governance does not form on its own, and various causes and factors play a role in its formation. This model is not limited to one sector or level, but is a pervasive thing that needs to exist in all sectors of a society and its realization requires coordination and readiness of all sectors [18].

Therefore, before presenting and explaining the indicators of good governance and measuring it, it is necessary to determine its level for assessing good governance.

There are four areas or zones where the concept is particularly relevant:

1. Governance in 'global space', or global governance, deals with issues outside the purview of individual governments.

2. Governance in 'national space', i.e. within a country: this is sometimes understood as the exclusive preserve of government, of which there may be several levels: national, provincial or state, indigenous, urban or local. However, governance is concerned with how other actors, such as civil society organizations, may play a role in taking decisions on matters of public concern

3. Organizational governance (governance in 'organization space'): this comprises the activities of organizations that are usually accountable to a board of directors. Some will be privately owned and operated, e.g. business corporations. Others may be publicly owned, e.g. hospitals, schools, government corporations, etc.

4. Community governance (governance in 'community space'): this includes activities at a local level where the organizing body may not assume a legal form and where there may not be a formally constituted governing board [19].

Therefore, in this study, the study of good governance at the organization level in one of the agencies active in the transportation sector is considered, which researchers have paid less attention to it.

Since today's society is an "organizational society", one of the main pillars of achieving good governance is definitely the governing organizations in that society.

Indicators are a good mechanism for introducing and measuring a phenomenon. In this regard, various individuals and institutions introduced indicators of good governance in order to be able to define and identify it, and thus, while identifying good governance, using indicators to measure and assess it in different societies. Considering that there was no pre-determined framework for presenting the components of good governance in the country's ports to study and find the key factors or indicators affecting good governance; therefore, first, through a comprehensive study of previous research records, during library studies of sources such as books, articles and theses, and various publications of domestic and international institutions that were done in order to prepare and compile research literature, we achieved a relatively comprehensive knowledge about good governance, then, by analyzing the content of the most referenced writings and opinions of professors and experts in the field of good governance, the main concepts and characteristics of this approach were identified, which we will use them to explain the components of good governance as follow:

1. Rule of law: The rule of law means that all citizens, especially managers and rulers, obey the law. In this way, all government actions should be within the framework of the law and rulers should be responsible for their actions [20] and knowing how laws are real in a society and to what extent can be enforced [21].

2. Responsibility: In good governance, organizations and institutions must serve the stakeholders and be responsible for the tasks assigned to them [22].

3. Transparency: The free flow of information exchange indicates transparency. Processes, institutions and

information are available to citizens who want access and sufficient information is provided to them [23].

4. Participation: The concept of participation refers to the freedom of expression and diversity of views and the organization of a civil society [24].

5. Effectiveness: Processes and institutions produce results that meet needs while making the best use of resources [25].

6. Efficiency: the best use of resources should always be made [25].

7. Responsiveness & Accountability: Who is accountable and to whom varies according to the type of decisions and activities of organizations and individuals. In general, each organization is accountable to those who are affected by its activities. The important point here is that accountability can only be achieved through the exercise of transparency and the rule of law [22].

8. Strategic vision: Leaders and the public have a broad and long-term perspective on good governance and human development, along with a sense of what is needed for such development. There is also an understanding of the historical, cultural and social complexities in which that perspective is grounded [25].

9. Equal Rights and Equity: All men and women have opportunities to improve or maintain their wellbeing [25].

10. Consensus orientation: Good governance mediates differing interests to reach a broad consensus on what is in the best interest of the group and, where possible, on policies and procedures [25].

11. Promoting Values: This index is obtained by measuring and explaining values and behavioral standards for members of the organization and adhering to these values in practice [26].

12. Defining Outcomes: Having a clear organizational goal is a sign of good governance [27]. Because service recipients are confident that they are receiving high quality services [28].

13. Control of Corruption: capturing perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests [29].

14. Capacity Building: Capacity building includes improving human resources, strengthening policy and financial management, and establishing and promoting partnerships for effective economic growth and equity at the global, regional, national, and local levels [20].

15. Regulatory Quality: the capacity of the government to effectively manage resources and implement sound policies, which include the two indicators of "government effectiveness and quality of laws and regulations"[30]. The more the government can develop and implement the activities of the private sector and provide more impact on the governance of society by formulating and implementing various policies and systems, the higher level of governance will occur [21].

Here are some researches on good governance:

-Monios, J. (2016): this paper describes and discusses the UK port sector, the main ports and cargo types, the governance system and recent developments. Recent changes in national policy are reviewed and potential new developments in governance are considered, reflecting on how the UK case represents some key theoretical considerations regarding infrastructure governance within a modern political system favouring private ownership and operation of the transport sector [31].

-Wilmsmeier, G., & Sanchez R.J. (2017): This paper analyses the evolution of port development and port governance in Chile since the 1990s. Current port development is not only challenged by a volatile and slowed down economic environment, but also by changing industry and sclerotic institutional conditions. Applying the matching framework in combination with the life cycle theory, aims to identify how the institutional structures created by port reform evolved and whether these are suitable to manage current and future devolution and changes in the Chilean port system. The paper describes the gains of technical efficiency in the early years after the reform in a decentralized governance structure and asks whether this governance structure is still congruent in the current environment. Some recent attempts to regain national influence have been inhibited by the institutional setting implemented by port reform. The asymmetries of the institutional capacity local and national level become more evident as the life-cycle of the current concession contracts reaches its end, and the existing institutional structure itself might evolve to be the impediment to change [32].

- Zhang & et al (2018): this paper investigates and presents generalized answers to the two basic questions of port governance, namely who governs and what is governed. There are totally 77 studies selected as the core literature sample according to a five-step approach. The results from literature review show evidences in favor of the important roles played by governmental organizations and port organizations as the main governing bodies of port governance. Furthermore, our analysis shows first, that multilevel governance has become a notable feature of port governance. Second, there are increasing involvements by national or regional levels of government in some countries such as the USA, Brazil, China. Third, port authorities at local level are generally holding the Centre-stage position with further autonomy in managing port operations. Fourth, not-for-profit organizations related to port activities play the role of coordinators in port governance. Finally, different governance regimes with different specific governing actors for different port classifications can be identified for many nations. This study shows that fundamentally

institutional arrangements and specific port activities are the two basic categories of what is governed [17].

-Zhang & et al (2019): The review paper investigates and presents generalized answers to the two basic questions of port governance, namely how to govern and for what purpose. The study is based on a total sample of 118 studies on port governance. The results from the analysis of these studies show that port devolution and port re-centralization are the main governance tools at the institutional level. At the strategically level, the main governance tools are port competition, port regionalization, port integration, stakeholder management strategy, and corporate governance. While at the managerial level, the main governance tools are port pricing, port concession, port user/ customer relationship management, monitoring and measuring, regulatory control, port security management, and information and communication technologies [14].

3. Methodology

The main purpose of this study is to design an optimal model for the factors affecting good governance in the Ports and Maritime Organization. Therefore, the present study is applied in terms of the purpose of research. Considering that in this research, library study methods as well as field methods have been used, it can be said that the present research is a descriptive-survey research based on its nature and method, and since in this method to collect data about a one or more attributes in a period of time, the community sampling method is used, it can be called cross-sectional survey research.

Since quantitative research methods such as descriptive-survey, descriptive-analytical and experimental alone cannot achieve the reality of phenomena related to organization and management [33], so to eliminate this shortcoming in this research, Fuzzy logic and fuzzy systems theory were used. Given that our real world is too complex to provide an accurate description and definition; so, an approximate or fuzzy description must be introduced for a research model that be acceptable and analyzable [34].

Thus, the fuzzy analysis method introduces both the type of membership (qualitative differences) and the amount of membership (quantitative differences) simultaneously in a "continuum set" that represents the grading of the qualitative states and the amount of membership. Fuzzy science bridges the gap between quantitative and qualitative approaches, and this bridge is built by fuzzy analysis method [35].

4. Statistical Community and Sampling

The statistical population in this study, in order to collect the required information and validate the components of good governance, includes 22 experts in the Ports and Maritime Organization - it is worth mentioning that when there is homogeneity among members, about 10 to 20 members are recommended [36]. The main criteria and characteristics for selecting

experts are at least a master's degree in management (theoretical mastery), experience of research activities, practical experience, willingness and ability to participate in research, accessibility and at least 12 years of work experience. The sampling method used in this study, due to the familiarity of specialists and their large number, was random and purposeful sampling method [37].

This questionnaire was approved by professors and experts in terms of apparent validity and conceptual validity. It is worth mentioning that in qualitative research, gaining validity is also associated with gaining reliability. Danaeifar and Mozaffari state that research audit strategies provide us with reliability and validity, which are: 1. Researcher sensitivity: means the existence of creativity, sensitivity, continuous analysis, proficiency and flexibility of the researcher in the research process; 2. Methodological coherence: means the alignment between the question and the elements of the research method; As a result, the research process is done back and forth with continuous re-reading and analysis; 3. Adequacy of sampling: Instead of referring to different people who may not have the necessary information for the researcher, he refers to experts; Therefore, sampling occurs intentionally and selectively. The reference to experts continues until the researcher achieves theoretical saturation (consensus) and concludes that nothing new will be discovered; 4. Simultaneous data collection and analysis; 5. Theoretical thinking: During the research, ideas come to the researcher's mind that are reaffirmed in the new data and may even lead to the modification of previous data and methods. Therefore, all of these strategies gradually and interactively play a role in creating validity and reliability and thus scientific accuracy [38].

In this study, Fuzzy Cognitive Mapping is used. Fuzzy Cognitive Maps are a combination of tools that take advantage of the features of fuzzy logic and artificial neural networks. We will implement the technique for fuzzy cognitive mapping of 15 research criteria in order to design the causal structure and analyze the factors affecting good governance in the Ports and Maritime Organization.

5. Findings

On the one hand, due to that there is a lot of ambiguity in the analysis of factors affecting good governance in the Ports and Maritime Organization, and on the other hand, because that the cause-and-effect relationship between the components cannot be well identified; therefore, in this section, in order to analyze the data, three methods of content analysis, fuzzy Delphi technique and Fuzzy Cognitive Map have been used and each part of the analysis is discussed according to the research questions.

5-1: Content Analysis

In the first part, in order to analyze the content of the research conducted in the field of good governance, the following question is asked:

1. What are the components of good governance based on the content analysis of the existing literature?

Due to the comprehensive study of the components of good governance in related books and articles and the frequency and repetition of the extracted components, a set of components that were comprehensive and covered other components and also were related to the

Resources	Components
(WGIs [39]) , (AGR [40]) , (WBI [41]) , (UNDP [42]) , (Kaufmann et al [29]) , (UNESCAP [43]) , (UN-HABITAT [44]) , (Elahi [45]) , (CIPFA & OPM [46]) , (EC [47]) , (OECD [48]) , (AsDB [49]) .	Responsiveness &Accountability
(IIAG [50]) , (Juiz et al [51]) , (UNDP [42]) , (UNESCAP [43]) , (AfDB [52]) , (UN-HABITAT [44]) , (Elahi [45]) , (CIPFA & OPM [46]) , (OECD [48]) , (AsDB [49]) .	Transparency
(Juiz et al [51]) , (CIPFA & OPM [46]).	Defining Outcomes
(Juiz et al [51]) , (CIPFA & OPM [46]).	Capacity Building
(OPM & CIPFA [46]) , (WBI [41]), (Juiz et al [51]) , (EC [47]) .	Effectiveness
(Juiz et al [51]) , (CIPFA & OPM [46]).	Promoting Values
(WGIs [39]) , (AGR [40]) , (WBI [41]) , (UNDP [42]) , (Kaufmann et al [29]) .	Rule of law
(WBI [41]) , (Kaufmann et al [29]) .	Regulatory Quality
(WGIs [39]) , (AGR [40]) , (IIAG [50]) , (Juiz et al [51]) , (WBI [41]) , (Kaufmann et al [29]) , (AfDB [52]) ,	Control of Corruption
(UNDP [42]) , (OECD [48]) , (UNESCAP [43]) , (UN-HABITAT [44]) (Elahi [45]) .	Equal Rights and Equity
(WGIs [39]) , (AGR [40]) , (Juiz et al [51]) , (UNDP [42]) , (Kaufmann et al [29]) , (UNESCAP [43]) , (UN-HABITAT [44]) , (Elahi [45]) , (CIPFA & OPM [46]) , (EC [47]) , (OECD [48]).	Efficiency
(UNDP [42]) , (UN-HABITAT [44]).	Consensus orientation
(Juiz et al [51]) , (UNDP [42]) , (UN-HABITAT [44]) , (Elahi [45]) , (OECD [48]) , (AsDB [49]) .	Responsibility
(IIAG [50]) , (Juiz et al [51]) , (UNDP [42]) , (UNESCAP [43]) , (AfDB [52]) , (UN-HABITAT [44]) , (Elahi [45]) , (EC [47]) , (OECD [48]) , (Huther, & Shah [53]) , (AsDB [49]) .	Participation
(Juiz et al [51]) , (OECD [48]) ,(UNDP[42]) ,	Strategic vision

analysis unit of this research - i.e. organizational level - were provided to the group of experts with the initial consent of professors and experts and in order to reduce subjective judgment to extract the final components of good governance in the Ports and Maritime Organization By evaluating and modifying the components. Table 3 summarizes the various indicators of good governance from the perspective of international institutions and researchers:

Table ١. Extracted components of good governance

5-2. Fuzzy Delphi Technique

In the second part, fuzzy Delphi technique was used to refine and determine the degree of agreement on the identified indicators. Accordingly, the second research question was presented in the following order and then examined:

What are the main components of good governance in the Ports and Maritime Organization?

In this study, the fuzzy Delphi technique was used due to the agreement of the experts on the indicators that are the basis of decision-making and in the fuzzy space that analyzes the verbal opinions of the experts in more detail and was performed in three rounds. In the first round of the questionnaire, which included the identified components of good governance from the content analysis method, experts were asked to rate their agreement on each component in the form of verbal variables in the questionnaire in a seven-choice range ((Completely insignificant 1, Very insignificant 2, Insignificant 3, Medium 4, Significant 5, Very Important 6, Completely important 7). In this regard, in the survey of experts, according to the law 30-70, the limit of acceptability of the criterion is considered to be around 7. If the diffused value of a triangular fuzzy number is 7 or higher according to experts, it is accepted as an acceptable criterion and otherwise it will not be accepted [54].

Then, after the second and third rounds of fuzzy Delphi, the components whose definite mean was less than 7 were removed. In this study, according to the fuzzy Delphi technique, 15 criteria were approved as the final components of good governance according to table 4 and were used to perform the Fuzzy Cognitive Map.

Table 2.Refined components Good governance

Definitive average	components	Definitive average	components
8.52	Control of Corruption(C9)	7.77	Responsiveness &Accountability (C1)
7.03	Equal Rights and Equity(C10)	7.42	Transparency (C2)
7.09	Efficiency (C11)	7.90	Defining Outcomes (C3)
7.01	Consensus orientation(C12)	7.30	Capacity Building(C4)
7.41	Responsibility (C13)	7.90	Effectiveness (C5)
8.10	Participation (C14)	8.65	Promoting Values(C6)
7.46	Strategic vision (C15)	7.73	Rule of law (C7)
---------------------------------		8.05	Regulatory Quality(C8)

5-3.Fuzzy Cognitive Mapping

Fuzzy cognitive mapping is one of the research techniques in soft operations in the field of problem structuring that can provide a hierarchical picture of the causes and their consequences by extracting the experts' mind map. Fuzzy cognitive mapping is an extended version of cognitive mapping that is used to

model the complex chain of causal relationships and shows the power of causal relationships with numbers in the range of 1 and -1 [55]. In fuzzy cognitive mapping models, the accumulated experiences of individuals are integrated with the existing knowledge in the field for which the model has been drawn, and based on them, cause and effect relationships are formed between the constituent factors [56]. In other words, fuzzy cognitive maps are a graphical tool for displaying beliefs and ideas, perceptions and interpretations of a situation based on the knowledge and experience of an individual or group, which are described by two elements of concept and causal relationship between concepts. A node or concept refers to an entity, a state or a feature of a system [57]. In fact, the fuzzy cognitive mapping method is one of the tools of cognitive analysis that as an efficient inferential engine has the ability to qualitatively and quantitatively modeling of complex causal relationships. Fuzzy cognitive maps are a combination of tools that take advantage of the features of fuzzy logic and artificial neural networks. Fuzzy cognitive maps are a combination of tools that take advantage of the features of fuzzy logic and artificial neural networks. Due to the focus of fuzzy cognitive maps on feedback loops, it can be considered as a kind of system dynamics method. Dynamic features and learning capabilities of fuzzy cognitive maps make them an extremely suitable tool for modeling, analysis, decision making, forecasting, etc [58].

In the third section, the following question is asked to examine the cause-and-effect relationships between the factors that make up good governance:

3.What is the structure of causal relationships between the components of good governance in the Ports and Maritime Organization?

In this section, we will implement the technique for fuzzy cognitive mapping of 15 research criteria in order to design the causal structure and analyze the factors affecting good governance in the Ports and Maritime Organization, as shown in Table 4.

In this study, this four-step method has been used to find the results of fuzzy cognitive mapping: Initial Influence Matrix of Success (IIMS); Fuzzified Influence Matrix of Success (FIMS); Strength of Relationships Matrix of Success (SRMS); and Final Matrix of Success (FMs) which are used to perform the fifth step of fuzzy cognitive mapping (FCM).

The executive calculations of the fuzzy cognition map technique were performed using FCMMAPER software in the following steps:

Step 1: Form the initial matrix of success

The initial success matrix is an [n × m] matrix in which n is the number of key success factors and m is the number of people to obtain data. Each element of the matrix (O_{ij}) represents the importance that the individual attaches to the concept. The elements O_{i1}, O_{i2}… O_{im} are vector elements related to the key success

factors belonging to the matrix row. In this step, the initial matrix of fuzzy cognition map was provided to 22 experts and the initial matrix was formed directly from the experts' response to the questionnaire (the degree of importance of each factor is based on 7-point Likert scale scoring).

Table3. Formation of the initial success matrix

IM	E1	E2	E3	…	E20	E21	E22
C1	4	۴	۵	…	۴	۴	۵
C2	۳	۳	۶	…	۳	۳	۷
C3	۳	۴	۷	…	۳	۴	۶
…	…	…	…	…	…	…	…
C13	۳	۳	۵	…	۳	۳	۵
C14	۳	۳	۶	…	۳	۳	۶
C15	۳	۴	۶	…	۳	۴	۶

Step 2: Form a Fuzzified Influence Matrix of Success

Numerical vectors V1 are transferred to fuzzy sets in which each element of the fuzzy set confirms the membership of the element Oij of the vector Vi with the vector Vi itself. For this purpose, the maximum value is found in Vi and Xi = 0 is considered for it, i.e.

Equation 1:
$$\text{MAX} (O_{iq}) \rightarrow X_i (O_{iq}) = ۱ \qquad (1)$$

Then find the minimum value in Vi and Xi=0 is considered for it, i.e.

Equation 2:
$$\text{MIN} (O_{iq}) \rightarrow X_i (O_{iq}) = ۰ \qquad (2)$$

The ratio of all other elements of the vector Vi is determined in the range of zero and one, in which the degree of membership of the element Oij is in the vector Vi.

Equation 3:

$$x_i(O_{ij}) = \frac{(O_{ij} - MIN(O_{ip}))}{(MAX(O_{ip}) - MIN(O_{ip}))} \qquad (3)$$

At this stage, a higher or lower ceiling value is set. If the numerical vector of Vi of the elements m is related to the concepts of i and Oij and is equal to j = 1, 2, 3, …, then, as elements of m, Vi of the higher and lower ceiling values are as follows:

Equation 4:

$$\forall j=1…m \ o_{ij} \ (o_{ij} \geq au) \rightarrow X_i (O_{ij}) = 1 \qquad (4)$$
$$\forall j=1…m \ o_{ij} \ (o_{ij} \geq au) \rightarrow X_i (O_{ij}) = ۰$$

The remaining vector elements are estimated in the range of zero and one. In this paper, according to experts, the number seven is considered as the maximum and the number one is considered as the minimum of the data in the calculations.

In this step, using equation (3), we form the fuzzy success matrix and for fuzzifying according to the

above relation, we will subtract each element of the initial matrix from the minimum elements of the initial matrix and divide it by the difference between the maximum and minimum values of the initial matrix and place the fuzzy value of each element in the matrix. Each element in this matrix represents the degree of membership of each agent. The result of the fuzzy matrix is given in Table 5.

Table 4. Fuzzified Influence Matrix of Success

FIMS	E1	E2	E3	…	E20	E21	E22
C1	٠/۵٠	٠/۵٠	٠/۶٧	…	٠/۵٠	٠/۵٠	٠/۶٧
C2	٠/٣٣	٠/٣٣	٠/٨٣	…	٠/٣٣	٠/٣٣	١/٠٠
C3	٠/٣٣	٠/۵٠	١/٠٠	…	٠/٣٣	٠/۵٠	٠/٨٣
……	……	……	……	…	……	……	……
C13	٠/٣٣	٠/٣٣	٠/۶٧	…	٠/٣٣	٠/٣٣	٠/۶٧
C14	٠/٣٣	٠/٣٣	٠/٨٣	…	٠/٣٣	٠/٣٣	٠/٨٣
C15	٠/٣٣	٠/۵٠	٠/٨٣	…	٠/٣٣	٠/۵٠	٠/٨٣

Step 3: Form a Strength of Relationships Matrix of Success

The Strength of Relationships Matrix of Success is a [n × n] matrix in which each element of the matrix represents the relationship between factor i and factor j. It can also accept values in the range [1 and -1]. Each key success factor is represented as a numerical vector S_{ij} containing n elements for each concept that shown in the map. There are three possible relationships in S_{ij} between concepts i and j. So that $S_{ij}>0$ indicates direct (positive) causality, $S_{ij}<0$ indicates inverse (negative) causality and $S_{ij}=0$ indicates no relationship between the concepts of i and j. The closeness of the relationship between the two vectors V1 and V_2 indicates the strength of the relationship between the variables in relation to these two vectors, which is shown by the element S12 and is presented in the Strength of Relationships Matrix of Success.

If d_j is the distance between elements j of vectors V_1 and V_2 as follows:

Equation 5:
$$d_j = \left| X_1(V_j) - X_2(V_j) \right| \tag{5}$$

And AD is the mean distance between vectors V_1 and V_2:

Equation 6:

$$AD = \frac{\sum_{j=1}^{m} |d_j|}{m} \tag{6}$$

The closeness or similarity of S between two vectors is shown according to this equation (S = 1 confirms complete similarity and S = 0 indicates the maximum degree of dissimilarity):

Equation 7:
$$\mathbf{S} = L - AD \tag{7}$$

In this step, equations (5), (6) and (7) are used to calculate this matrix. This matrix represents the strength of the relationship between the two factors. Different calculations are needed for vectors that are directly related and those that are inversely related.

Table 5. Strength of Relationships Matrix of Success

SRMS	C1	C2	C3	…..	C13	C14	C15
C1	٠/٠٠	٠/١١	٠/۵٢	…..	٠/٠٨	٠/١٠	٠/۴٨
C2	٠/١١	٠/٠٠	٠/١٣	…..	٠/٠٨	٠/٠۵	٠/٠٨
C3	٠/١٢	٠/١٣	٠/٠٠	…..	٠/١٣	٠/٠٨	٠/٠٩
…..	…..	…..	…..	…..	…..	…..	…..
C13	٠/٠٨	٠/٠٨	٠/١٣	…..	٠/٠٠	٠/٠۶	٠/٠۵
C14	٠/١٠	٠/٠۵	٠/٠٨	…..	٠/٠۶	٠/٠٠	٠/٠۵
C15	٠/٠٩	٠/٠٨	٠/٠٩	…..	٠/٠۵	٠/٠۵	٠/٠٠

Step 4: Form the Final Matrix of Success

To analyze the data and convert the Strength of Relationships Matrix of Success to the Final Matrix of Success requires an expert opinion that identifies only those fuzzy elements that represent the causal relationships between the key factors of success. In this study, a focus group consisting of a number of experts was formed who expressed their views on the relationship between factors and identified factors that have no relationship with each other.

Table 6. Final Proximity Matrix

FM	C1	C2	C3	…	C13	C14	C15
C1	٠/٠٠	٠/١١	-٠/۵٢	…	٠/٠٨	٠/١٠	-٠/۴٨
C2	٠/١١	٠/٠٠	٠/١٣	…	٠/٠٨	٠/٠۵	٠/٠٨
C3	٠/١٢	٠/١٣	٠/٠٠	…	٠/١٣	٠/٠٨	٠/٠٩
…..	…..	…..	…..	…	…..	…..	…..
C13	٠/٠٨	٠/٠٨	٠/١٣	…	٠/٠٠	٠/٠۶	٠/٠۵
C14	٠/١٠	٠/٠۵	٠/٠٨	…	٠/٠۶	٠/٠٠	٠/٠۵
C15	٠/٠٩	٠/٠٨	٠/٠٩	…	٠/٠۵	٠/٠۵	٠/٠٠

**Step 5: Graphical representation of fuzzy cognitive map (FCM)**

At this stage, a purposeful fuzzy cognitive map is drawn to map the key success factors. In the final representation, each arrow of factors j and i has a symbolic weight that indicates the strength of the causal relationship between the factors and the value in the success matrices in the cell that presented in row i and column j [59]. Based on the final proximity matrix, a good governance graph is obtained according to the following diagram. This diagram shows the relationship between the factors along with their

weight. As can be seen in the figure, there are 15 factors as criteria for good governance that are related to weights. According to the causal image, the degree of impact, effectiveness and degree of centrality of the concepts can be shown as the following image. The centrality of the nodes is defined based on the sum of the impact and effectiveness of the concepts (nodes). Impact is the sum of the absolute values of the output relations of the node, and effectiveness is the sum of the absolute values of the input relations of the node. To draw a fuzzy cognitive map, we use the output of FCMapper software as input to Gefi software. The following figure shows the fuzzy cognitive map that shows the causal relationships between the factors.
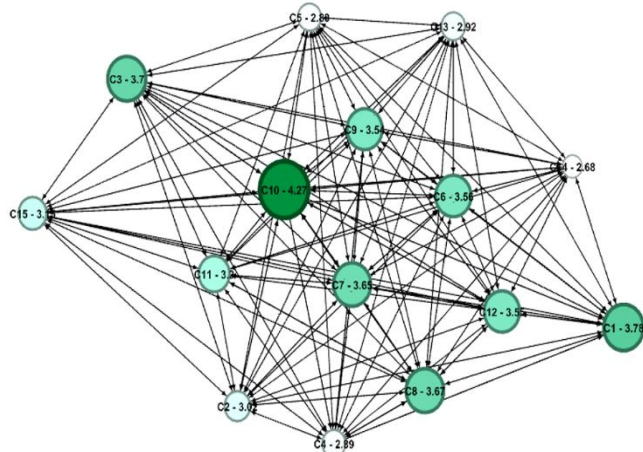
Figure 2: Fuzzy cognitive mapping of good governance (degree of centrality)
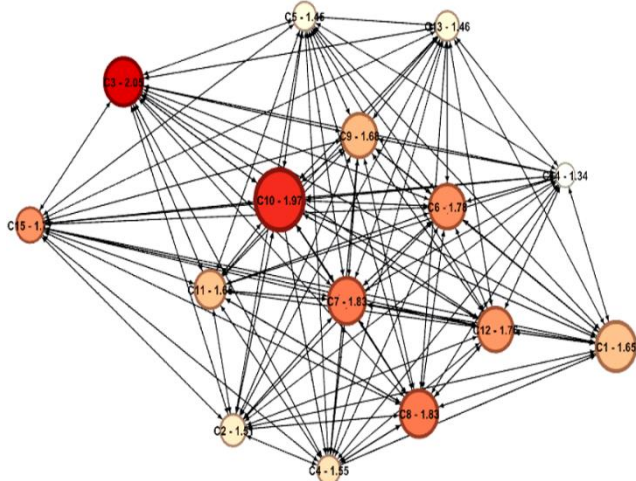
Figure 3: Fuzzy cognitive mapping (input degree)
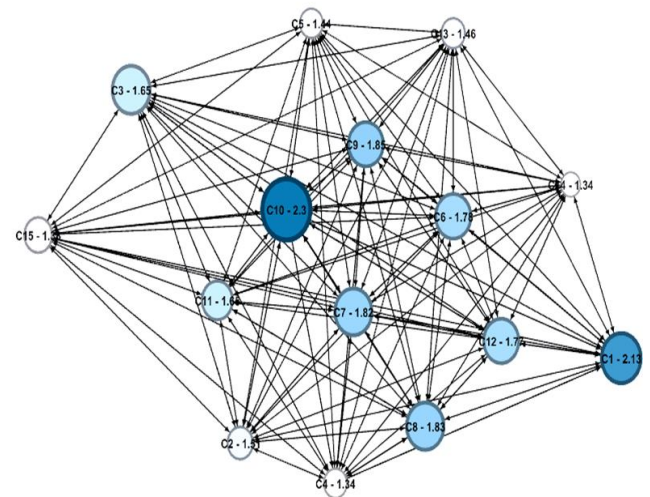
Figure 4: Fuzzy cognitive mapping (output degree)

According to 15 main criteria involved in cognitive mapping, 206 relationships between factors were extracted. The degree of input (id) is the degree of influence of the factors and the degree of output (od) represents the effects applied by a concept, in other words, it shows the degree of influence of the factors and the degree of centrality is the sum of the previous two factors. The type of elements is determined based on their input and output degrees. The input degree is obtained from the sum of the absolute value columns of the values of an element in the proximity matrix and represents the cumulative power of the influential elements in the element in question. The output degree of an element is obtained from the line sum of the values of an element in the proximity matrix and shows the cumulative power of that element [55]. The degree of centrality is the sum of the previous two factors. Any factor that has a higher degree of centrality, in fact, has either higher (od) or higher (id) than other factors, and in both cases, this factor is considered an important factor in the system and should be considered. In the above graphs, the color scheme from dark to light

| GG	Number of entry paths per node	Number of output paths per node	id	od	Cen
C10	۱۲	۱۴	۱/۹۶۲	۲/۲۹۵	۴/۲۵۸
C1	۱۴	۱۲	۱/۶۵۲	۲/۱۲۹	۳/۷۸۰
C3	۱۴	۱۴	۲/۰۴۵	۱/۶۵۲	۳/۶۹۷
C8	۱۴	۱۴	۱/۸۳۳	۱/۸۳۳	۳/۶۶۷
C7	۱۴	۱۴	۱/۸۲۶	۱/۸۲۶	۳/۶۵۲
C6	۱۴	۱۴	۱/۷۸۰	۱/۷۸۰	۳/۵۶۱
C12	۱۴	۱۴	۱/۷۷۳	۱/۷۷۳	۳/۵۴۵
C9	۱۳	۱۴	۱/۶۸۲	۱/۸۵۶	۳/۵۳۸
C11	۱۴	۱۴	۱/۶۵۲	۱/۶۵۲	۳/۳۰۳
C15	۱۴	۱۴	۱/۷۷۳	۱/۳۷۹	۳/۱۵۲
C2	۱۴	۱۴	۱/۵۰۸	۱/۵۰۸	۳/۰۱۵
C13	۱۴	۱۴	۱/۴۶۲	۱/۴۶۲	۲/۹۲۴
C4	۱۳	۱۲	۱/۵۴۵	۱/۳۴۸	۲/۸۹۴
C5	۱۴	۱۴	۱/۴۴۷	۱/۴۴۷	۲/۸۹۴
C14	۱۴	۱۴	۱/۳۴۱	۱/۳۴۱	۲/۶۸۲

indicates the degree of centrality with high to low

weights. For example, the Equal Rights and Equity node (C10) has the highest weight and the lowest weight related to participation (C14).

As shown in the table above, in this study, the factors of Equal rights and Equity (C10), Responsiveness and Accountability (C1) and Consensus Orientation (C3) have the highest degree of centrality, respectively, which indicates the importance of the above variables among the variables of good governance in the Ports and Maritime Organization.

Table 7. Output information of fuzzy cognitive mapping model

In the following diagrams, in fact, in-degree is the degree of influence of factors and out-degree is the applied effects and centrality shows the degree of centrality of good governance.
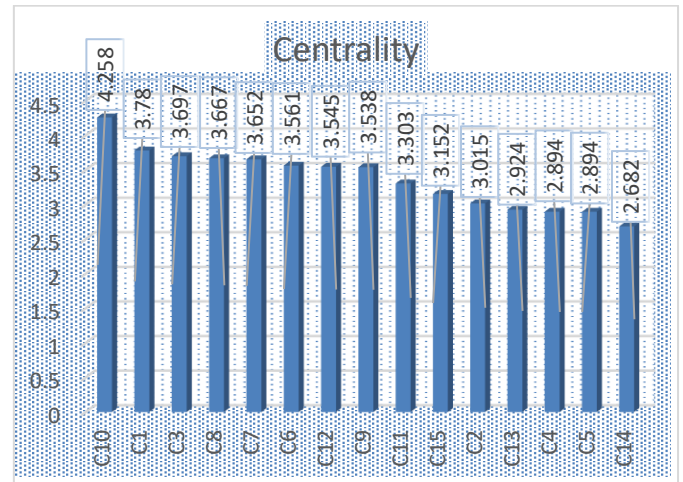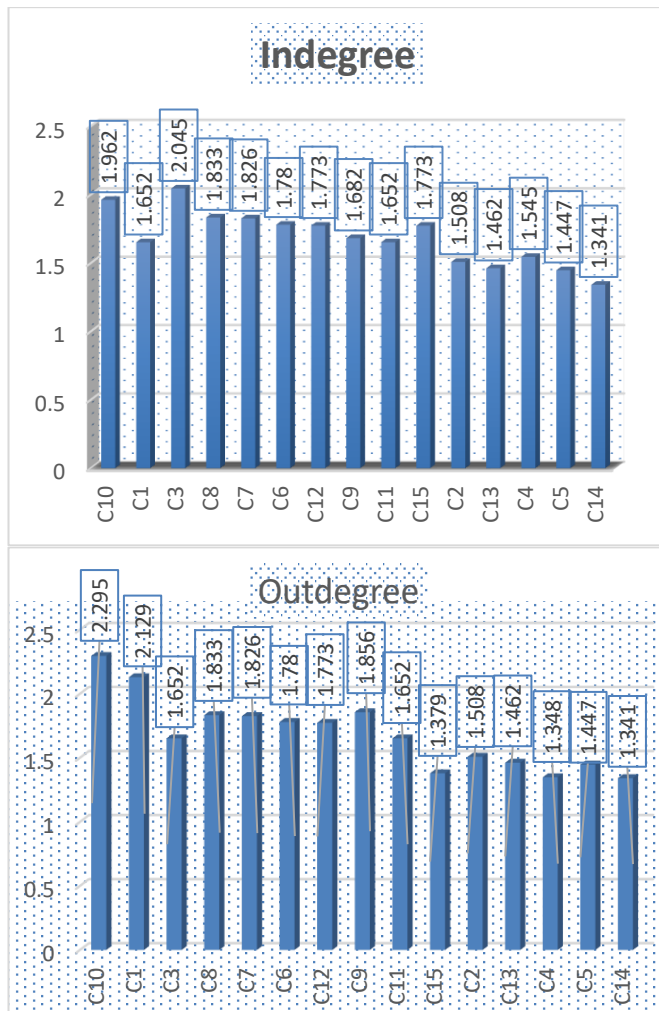
Figure ۵. Bar charts of In-degree, Out-degree and Centrality

6. Conclusion:

The Ports and Maritime Organization, as one of the governmental organizations (for-profit trade) in charge of the transportation sector, always plays a strategic role in the development of domestic and international trade. Due to the large volume of exports and imports of goods, the development of the country's ports as communication gateways is necessary because ports are among the factors accelerating the development of national and regional economy and one of the main links in maritime transport and entry and exit points of goods. Due to the growth of global trade, port traffic has increased, ships become larger, the composition of the goods that are transported has become more diverse and simultaneously with the construction of larger ships, modes of transportation have developed and the time of arrival of ships in ports has become significantly more important. Therefore, ports that do not adapt to these changes in terms of infrastructure and port services will lose their competitiveness in cargo handling throughput. On the other hand, providing services in ports is a function of the management style in them, which itself reflects the quality of governance, but in response to how the quality of governance is measured and what factors are affected, different levels of governance are considered (twelve levels) and among the various levels, the most comprehensive are good governance. Good governance has indicators such as transparency, accountability, corruption control, participation rate, rule of law, etc. In addition to measuring quality, these indicators are like a clear roadmap that facilitates the achievement to the goals. Therefore, in order to identify and extract the effective components based on previous studies, the final components

were extracted with the opinion of experts using fuzzy Delphi technique, and then the causal structure between the components was plotted through a fuzzy cognition map with the help of a graph. In this study, based on the capabilities of the fuzzy cognition map technique in modeling and decision making, the effective components in good governance were analyzed and based on the results of the data obtained from the causal structure, it was determined that the components of " Equal Rights and Equity "," Responsiveness & Accountability "," Consensus orientation ", "Quality of Regulations" and "Rule of Law" have the greatest impact on good governance and should be given special attention in decisions by those in charge. Therefore, in order to implement good governance, decision makers must first pay special attention to introducing facilities and opportunities for everyone (both organizational and non-organizational) and always plan to create equality to hold the organization accountable to stakeholders in various ways that this will certainly result in the provision of quality services and by designing a fair and impartial legal framework for   more active presence and development of the private sector, these services can be developed and implemented to be provided to stakeholders.

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