Advances in Environmental Biology, 8(25) Special 2014, Pages: 48-57

AENSI Journals

Advances in Environmental Biology

ISSN-1995-0756 EISSN-1998-1066

Journal home page: http://www.aensiweb.com/AEB/

Empirical Evaluation of Competiveness Components of Iranian Container Ports Using Exploratory Factor Analysis

Ardalan Zangoui, Homayoun Yousefi, Hassan Jafari

[1]*Department of Maritime Transport, Khorramshahr University of Marine Science and Technology, Iran.*

ARTICLE INFO

Article history:
Received 26 September 2014
Received in revised form 20 November 2014
Accepted 25 December 2014
Available online 2 January 2015

Keywords:
Competitiveness,
Maritime Transport,
Iranian Container Port,
FAHP, Exploratory Factor Analysis.

ABSTRACT

This paper aims empirically investigate a structure for evaluating Competiveness of Iranian container ports. Firstly, by using factor analysis the main component which influences competitiveness identified. Then by Fuzzy Analytic Hierarchy method the weights of factors and variable of competiveness determined according to their importance level in the port competiveness. The obtained result from factor analysis showed that the following eight factors which named as Logistics Cost, Connectivity, Port facility, Port Service and Availability, Safety and security, Efficiency and Productivity, Reliability, Hinterland condition account for an accumulated explanation of variance of 73% and thus may be adequate to represent the 32 strategic dimensions.

To Cite This Article: Ardalan Zangoui, Homayoun Yousefi, and Hassan Jafari., Empirical Evaluation of Competiveness Components of Iranian Container Ports Using Exploratory Factor Analysis. ***Adv. Environ. Biol., 8(25),*** *48-57, 2014*

INTRODUCTION

The globalization of the world economy has led to an increasingly important role for transportation. In particular, container transportation plays a key role in the process, largely because of the numerous technical and economic advantages it possesses over traditional methods of transportation. Standing at the crucial interface of sea and inland transportation, the significance of the container port and its production capabilities cannot be ignored. Compared with traditional port operations, containerization has greatly improved port production performance. Port generally can be defined as interface linking marine and inland transportation. Nowadays, a port acts as a base for logistics, production, information, financial, living, international trade function and a base for economic development of hinterland [1]. Nearly ninety percent of global trade is handled through ports. Therefore, a port plays an important role in contributing to the national economy. Moreover, a port’s development is related to regional industries, port facilities, government’s port policies, and so on [2].

Port competition:

Compared with general industries or service activities, port competition was comparatively minimal in the past. Each port secured its own customers depending on the port situation. A variety of activities for these customers and industries were limited within a port area or its neighboring hinterland. Most of today's ports, however, share the hinterland and conduct a severe competition to secure cargo volume, depending on their circumstances [3]. Examining types of port competition first, Goss [4] categorized them systematically into five classifications of ports. That is, the competitive forces may be analyzed more systematically as follows:

1) Competition between whole ranges of ports or coastlines,
2) Competition between ports in different countries,
3) Competition between individual ports in the same country,
4) Possible competition between the operators or providers of facilities within the same port, and 5) competition between different modes of transport.

In the case of UNCTAD [5], types of port competition were largely classified into inter-port competition, inter-modal transportation competition, and intra-port competition. Matsbashi [6] classified port competition largely into both inter-port competition within a country, and international port competition. The latter competes

Corresponding Author: Hassan Jafari, Department of Maritime Transport, Khorramshahr University of Marine Science and Technology, Iran.
E-mail: Hassan.jafari@KMSU.ac.ir.

with competition factors such as terms of price, time and technology. Meanwhile, the former competes with terms of price, time, safety, and information functions. In this respects, it is essential for port to have a power of competition which is to defeat other ports. The competitive power of ports presents ship owners or shippers with the standard of selecting ports. Port operators can utilize that power as a guide necessary for counter measures, by grasping the advantages and disadvantages of ports, and the prime factors of opportunities and threats of ports with environments changing [7].

Researches on Competitiveness Evaluation:

This section reviews some of the researches related to industrial and port competitiveness. Booming international trade and the fast-growing shipping industry have aroused port competitiveness, which has altered port market positions. As a consequence, ports are no longer seen as a safe business. In order for a port to have good performance and to be selected by customers, it should be competitive. Porter [8] notes that competitive advantages are created in the interplay between the rivalry, demanding customers, and the quality of related and supporting sectors, whereas a port‘s related and supporting sectors have much to do with its hinterland; hence, the port hinterlands are crucial for port performance and port choice. The competition has drawn the attention of a number of researchers who have proposed different competitive components of port competition, the following are some reviews of previous foreign studies on the extraction of the components of port competitive power.

French [9] suggested terminal facilities, tariffs, port congestion, service level, connectivity, and port operators as internal components, while considering the economy of hinterland, the economic status of the nation, trade policy, and the world economic trend external components. Pearson [10] considers confidence in port schedules, frequency of calling vessels, variety of shipping routes and accessibility of the port as port competitive components. Collison [11] identifies average waiting time in port and port service capacity as competitive components. Brooks [12, 13] proposes three more components: port costs, port reputation and/or loyalty and experience of cargo damage. Slack [14], Willingale [15] surveyed the selection standards of port as well as the decision making process of the calling port, for the 20 liners in 1982. His study reveals that the selecting process consists of the following stages: the available port locating stage, judgment and examination stage, approach, visit and evaluation stage, preliminary discussion stage, negotiation stage, and selection stage. In the process of selecting a particular port, shipping lines consider the location factor, technical factor, operational factor, fiscal factor, and manpower factor. Murphy et al. [16, 17, 18, 19] consider the port facilities and equipment available, convenient pickup and delivery times, information concerning handling, assistance in claims handling and cargo handling flexibility, port operations policy, international politics, change of social environment, trade market, economic factors, and features of competitive ports as the important competitive components.

Peters [20], put emphasis on the service level, available facility capacity, status of the facility, and port operation policy, calling them internal factors. As external factors he took the examples of international politics, change of social environment, trade market, economic factors, features of competitive ports, functional changes of transportation, and materials handling. Calling frequency, tariffs, accessibility to the port, port congestion, and inter-linked transportation network were considered affecting factors by Peters [20]. UNCTAD [5], notes geographical location, networks in the hinterland, availability and efficiency of transportation, stability of the port and port information system as competitive components. Kim [21] analyzed the decision factors of port selection for Korean shippers, consignees, and liners. Distance between origin and destination, annual cargo handling volume, loading hours, average detention hours at port, goods value per tonnage, and inland trucking cost per kilometer affect exporting from higher to lower influencing order. Meanwhile, sea transportation distance, number of liners for calling-in, annual volume by import, inland transportation cost are the major factors for import port selection. McCalla [22] considers container transport routes as a specific important component. Starr [23] considers Geographic location of ports, Inland railway transportation, investment of port facilities, and stability of port labor as competitive components. Tengku [24] considers Port tariffs, safety handling of cargoes, and confidence in port schedules. And Chiu [25] considers Custom service, rapidness, and simple documents in port, cargo damage and skills of port as competitive components. Lirn et al. [26] studied transshipment port selection criteria from a container carrier‘s perspective. Their study revealed the criteria to be handling cost of containers, proximity to main navigation routes, proximity to import/export area, basic infrastructure conditions and existing feeder network, which were identified as important in descending order of importance. Tongzon and Heng [27] studied port competition and choice and proposed eight key determinants of port competitiveness: Port (terminal) operations efficiency level, Port cargo handling charges, Reliability, Port selection preferences of carriers and shippers, the depth of the navigation channel, Adaptability to the changing market environment, Landside accessibility, and Product differentiation. Cullinane et al. [28] analyzed port competition between Shanghai and Ningbo, which share the same hinterland. They found that market-based reforms, the increasing globalization of China‘s economy, continuing economic development in the hinterland and China‘s entry into the WTO all contributed to the growing demand for port services. They identified that low price, quality of services, central government policies on regional development, natural endowments (particularly depth of water), good inland transport infrastructure and logistical systems, growing cargo resources and leading liners such as Maersk and K-Line contributed to ports ‘competitiveness. Yeo et al. [29], conducted an empirical study in China and South Korea with carriers and port operators and the study results revealed that port service, hinterland condition, availability, convenience, logistics cost, regional center and connectivity are the determining factors in Northeast Asia.

With this in mind, this paper aims to empirically investigate a structure for evaluating container ports in Iran using factor analysis to identify the components which influence competitiveness. And also application of Fuzzy Analytic Hierarchy method to determine the weights of factors and variable of competiveness of Iranian container ports.

Methodology:

Data collection:

We have conducted face-to-face interviews with participants of this research in April and May 2013. For our research main tests were conducted with 300 useable responses from 320 questionnaires. Attitudes on each of the variables has been evaluated using five-point Likert scales attached firmly by the agreement level of each question with point of 1 = very poor and 5 = excellent.

Factor analysis:

Factor analysis is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors. In other words, it is possible, for example, that variations in three or four observed variables mainly reflect the variations in fewer unobserved variables. Factor analysis searches for such joint variations in response to unobserved latent variables. The observed variables are modeled as linear combinations of the potential factors, plus "error" terms. The information gained about the interdependencies between observed variables can be used later to reduce the set of variables in a dataset. Computationally this technique is equivalent to low rank approximation of the matrix of observed variables. Factor analysis originated in psychometrics, and is used in behavioral sciences, social sciences, marketing, product management, operations research, and other applied sciences that deal with large quantities of data [30].

There are two major classes of factor analysis: Exploratory Factor Analysis (EFA), and Confirmatory Factor Analysis (CFA). Broadly speaking EFA is heuristic. In EFA, the investigator has no expectations of the number or nature of the variables and as the title suggests, is exploratory in nature. That is, it allows the researcher to explore the main dimensions to generate a theory, or model from a relatively large set of latent constructs often represented by a set of items. Whereas, in CFA the researcher uses this approach to test a proposed theory (CFA is a form of structural equation modeling), or model and in contrast to EFA, has assumptions and expectations based on priori theory regarding the number of factors, and which factor theories or models best fit [30]. This study adopted the second approach, first of all, to explore and categorize the variables and then form clusters of components and the evaluation structure.

Fuzzy AHP method:

AHP is a well-known MCDM technique which was used to estimate the weighting values of some indicators and system components. The AHP method concept is based on an additive weighting process, in which several relevant attributes are represented through their relative importance. Saaty [31] decomposes a decision-making problem into a system of hierarchies of objectives, attributes, and alternatives. AHP is capable of handling decision situations involving subjective judgments, multiple decision makers, and the ability to provide measures of consistency of preference [32, 33]. It combines qualitative and quantitative approaches and has the following benefits [31]: 1) it helps dissect the problem and structure it into a rational decision hierarchy; 2) it gives an insight about the right data that needs to be collected for the alternatives at hand by the pair-wise comparisons concluded under each criterion or sub-criterion; 3) it prioritizes alternatives according to the criteria or makes a decision out of different scenarios; and 4) it examines the validity of the comparisons made between alternatives by testing these comparisons with consistency measures. The analytic hierarchy process, since its invention, has been a tool at the hands of decision makers and researchers, becoming one of the most widely used multiple criteria decision-making tools [34].

Fuzzy Analytic Hierarchy Advantages:

Even its popularity, the pure AHP model has some shortcomings. The traditional AHP utilizes exact values to express the decision maker’s opinion in a comparison of alternatives [35]. However, due to its inability to adequately handle the inherent uncertainty and impression in the pair-wise comparison process, traditional AHP has been often criticized for the shortcomings [36].Yang & Chen [36] pointed out that the AHP method is mainly used in nearly crisp-information decision applications; nevertheless, the AHP method does not take into account the uncertainty associated with the mapping of human judgment to a number by natural language. The ranking of the AHP method is rather imprecise; and the subjective judgments by perception, evaluation, improvement and selection based on preference of decision-makers have great influence on the AHP results. To overcome these problems, several researchers integrate fuzzy theory with AHP to improve the uncertainty.

So in this research the Fuzzy Analytic Hierarchy method has been used to determine the weights of factors and variable of port competiveness. There are different methods for calculating the weights which this research to determine the priority vector for each matrix the Chang's extent analysis has been used.

Triangular fuzzy numbers (TFNs):

A TFN can be defined by a triplet (l, m, u) and the membership function can be defined by Equation (1) [37].

$$\mu = \begin{cases} \frac{(x-l)}{(m-l)} & l \le x \le m \\ \frac{(u-x)}{(u-m)} & m \le x \le u \\ 0 & x < l \quad andand \quad x > x \end{cases} \tag{1}$$

Algebraic Operations on TFNs

The algebraic operation for the triangular fuzzy number can be displayed as follows:

- Addition of a fuzzy number $\oplus$

$$(L_1, M_1, U_1) \oplus (L_2, M_2, U_2) = (L_1 + L_2, M_1 + M_2, U_1 + U_2) \tag{2}$$

- Multiplication of a fuzzy number : $\otimes$

$$(L_1, M_1, U_1) \otimes (L_2, M_2, U_2) = (L_1 L_2, M_1 M_2, U_1 U_2) \tag{3}$$

- Any real number k:

$$K(L, M, U) = (KL, KM, KU) \tag{4}$$

- Subtraction of a fuzzy number Θ

$$(L_1, M_1, U_1) \Theta (L_2, M_2, U_2) = (L_1 - L_2, M_1 - M_2, U_1 - U_2) \tag{5}$$

- Division of a fuzzy number

$$(L_1, M_1, U_1)(L_2, M_2, U_2) = (L_1 / L_2, M_1 / M_2, U_1 / U_2) \tag{6}$$

- Average of fuzzy number:

$$\begin{aligned} A_{ave} &= (A_1 + A_2 + \ldots.. + A_n) \\ A_{ave} &= [(L_1 + \ldots\ldots + L_n) + (M_1 + \ldots.. + M_n) + (U_1 + \ldots. + U_n) / n \end{aligned} \tag{7}$$

Chang's extent analysis:

The extent Chang's extent analysis is utilized in four steps, as stated below [38]:

Let $X = \{x_1, x_2, \ldots, x_n\}$ be an object set, and $G = \{g_1, g_2, \ldots, g_m\}$ be a goal set. According to the method of Chang's extent analysis, each object is taken and extent analysis for each goal, gi, is performed, respectively [39]. Therefore, m extent analysis values for each object can be obtained with the following signs:

$$M_{gi}^1, M_{gi}^2, \ldots, M_{gi}^m \qquad i = 1, 2, \ldots, n \tag{8}$$

Where, all of the M_{gi}^j $j = 1, 2, \ldots, m$ are TFNs. Followings are the steps of Chang's extent analysis [40]:

Step 1: The value of fuzzy synthetic extent with respect to the ith object is defined as:

$$S_i = \sum_{j=1}^{m} M_{gi}^{j} \otimes \left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} \quad (9)$$

To obtain the $\sum_{j=1}^{m} M_{gi}^{j}$ we perform the fuzzy addition operation of m extent analysis values for a particular matrix such that [41]:

$$\sum_{j=1}^{m} M_{gi}^{j} = \left[\sum_{j=1}^{m} l_{ij}, \sum_{j=1}^{m} m_{ij}, \sum_{j=1}^{m} u_{ij}\right] \quad (10)$$

Obtaining the $\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1}$ we perform the fuzzy addition operation of M_{gi}^{j} $j = 1,2,\dots,m$ values such that [40]:

$$\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j} = \left(\sum_{i=1}^{n} L_i , \sum_{i=1}^{n} M_i , \sum_{i=1}^{n} U_i\right) \quad (11)$$

Compute the inverse of the vector above, such that:

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} L_i}, \frac{1}{\sum_{i=1}^{n} M_i}, \frac{1}{\sum_{i=1}^{n} U_i}\right) \quad (12)$$

As $\tilde{M}_1 = (l_1, m_1, u_1)$ and $\tilde{M}_2 = (l_2, m_2, u_2)$ are two TFNs, the degree of possibility of $\tilde{M}_2 = (l_2, m_2, u_2) \geq [M_2 = (l_1, m_1, u_1)$ is defined as:

$$V.(\tilde{M}_2 \geq \tilde{M}_1) = sup_{y \geq x}[\min(\mu_{s_1}(x), \mu_{s_2}(y)] \quad (13)$$

This can equivalently be expressed as:

$$V(\tilde{M}_2 \geq \tilde{M}_1) = hgt(\tilde{M}_2 \cap \tilde{M}_1) = \mu_{s_2}(d) = \begin{cases} 1 & if (m_2 \geq m_1) \\ 0 & if (l_1 \geq u_2) \\ \dfrac{l_2 - u_1}{m_2 - u_2 - m_1 + l_1} & otherwise. \end{cases} \quad (14)$$

Step 3: The possibility degree for a convex fuzzy number to be greater than *k* convex fuzzy numbers can be defined by:

$$V(M_2 \geq M_1, \quad M_2, \dots, \dots, \dots, M_k) = V[(M \geq M_1) and\ (M \geq M_2) and\ \dots \dots and\ (M \geq M_k)] = min\ V(M \geq M_i), i = 1, 2, 3, \dots \dots \dots, k \quad (15)$$

Assume that $d'(A_i) = min\ V(S_i \geq S_k)$ for $(k = 1,2,\dots,n)$ $k \neq i$ the weight vector is given by:

$$W' = \left(d'(A_1), d'(A_2), \dots, d'(A_n)\right)^T \quad (16)$$

Wherein, $A_i = (1,2,\dots n)$ are n elements.

Step 4: Via normalization, the normalized weight vectors would be:

$$W = \left(d(A_1), d(A_2), \dots, d(A_n)\right) \quad (17)$$

Where W is a non-fuzzy number.

Result:

Factor analysis results:

At first 60 components of port competitiveness were extracted from the Literature review of components of port competitiveness for further analysis. In the second step of this research, KMO and Bartlett's Test is used to know whether it is possible to employ factor analysis to reduce attributes of the research. The Kaiser-Meyer-Olkin measure of sampling adequacy figure is 0.812 higher than 0.6 and near to 1. It shows either the number of respondents is adequate. The quantity of Bartlett's sig. is 0.001 less than 0.05. It indicates factor analysis is appropriate for to identify the model of factors (Table 1). Totally, these two outputs demonstrate we have permission to run factor analysis.

Table 1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.812
Bartlett's Test of Sphericity Approx. Chi-Square	926.412
df	298
Sig.	0.001

Then, a varimax rotation, used to transform a set of interrelated variables into a set of unrelated linear combinations of these variables, was employed to identify strategic dimensions. To aid interpretation, only variables with factor loadings greater than 0.5, were extracted. Table 2 shows that these eight factors account for an accumulated explanation of variance of 73% and thus may be adequate to represent the32 strategic dimensions.

Table 2: Loadings on Each Factor Extracted from Rotated Component Matrix

Factor								Variable
8	7	6	5	4	3	2	1	
							0.852	Inland transportation cost and Intermodal transportation cost
							0.725	Cost related vessel and cargo entering
							0.685	Free dwell time on the terminal
							0.778	The operating cost (port and cargo/passenger dues, berth charges, victualing, hire of handling equipment, pilotage, towage and passenger and cargo handling costs)
						0.798		Land distance and connectivity to major shippers
						0.735		Efficient Intermodal links to the port (road, rail, air, feeder, …)
						0.564		Deviation from main shipping lines -trunk routes
						0.711		Port accessibility
						0.511		Efficient inland transport network
					0.602			Peripheral resources within the port (Ship Chandelling)
					0.784			Sufficient draft in approach channel and at berths
					0.715			The degree of technology employed in the port operations
					.0.650			Sophistication level of port information and its application scope
					0.744			Customs handling and Electronic customs procedures
				0.759				Zero waiting time service
				0.712				Seaport service level
				0.692				Service capacity for ship's size
				0.622				Availability and Capacity of port facilities
				0.532				Availability empty container
			0.744					Port safe entrance
			0.686					Port security level
			0.578					Port's reputation for cargo loss and damage and accidents
		0.732						Numerous Port efficiency factors
		0.690						Port productivity
	0.690							Confidence in port schedules
	0.654							Liners' schedule reliability and service frequency
	0.501							Risk of cancellation/delay
	0.532							Disruption of port operation
0.698								Professional and skilled labors in port operation
0.583								Size of contiguous city's economy
0.537								Size and activity of FTZ in port hinterland
0.524								Volume of total container cargoes
8.7	9.33	9.9	10.23	12.84	14.11	16.89	18.93	Percentage variance 0.73

For the second step, a reliability test, based on Cronbach's a, was used to test the internal consistency of questionnaire responses. Given that Cronbach's a values from 0.5 to 0.7 indicate normal consistency and are sufficiently reliable, and those exceeding 0.7 indicate high consistency, computed results (Table 3) indicate normal internal consistency [42, 43, 44].

Table 3: Cronbach's a values

Factors	Cronbach's a
Logistics Cost	0.79
Connectivity	0.88
Port facility	0.72
Port Service and Availability	0.91
Safety and security	0.82
Efficiency and productivity	0.87
reliability	0.72
Hinterland condition	0.76

Taxonomy for evaluating the structure of port competition at Iranian container port emerged after factors were named as follows:

Logistics Cost:
Inland transportation cost and Intermodal transportation cost, Cost related vessel and cargo entering, Free dwell time on the terminal, The operating cost (port and cargo/passenger dues, berth charges, victualing, hire of handling equipment, pilotage, towage and passenger and cargo handling costs).

Connectivity:
Land distance and connectivity to major shippers, Efficient Intermodal links to the port (road, rail, air, feeder …), Deviation from main shipping lines -trunk routes, Port accessibility, and efficient inland transport network.

Port facility:
Peripheral resources within the port (Ship Chandelling), Sufficient draft in approach channel and at berths, The degree of technology employed in the port operations, Sophistication level of port information and its application scope, Customs handling and Electronic customs procedures.

Port Service and Availability:
Zero waiting time service, Seaport service level, Service capacity for ship's size, Availability and Capacity of port facilities, Availability empty container

Safety and security:
Port safe entrance, Port security level, Port's reputation for cargo loss and damage and accidents.

Efficiency and Productivity:
Numerous Port efficiency factors, Port productivity.

Reliability:
Confidence in port schedules, Liners' schedule reliability and service frequency, Risk of cancellation/delay, Disruption of port operation.

Hinterland condition:
Professional and skilled labors in port operation, Size of contiguous city's economy, Size and activity of FTZ in port hinterland, Volume of total container cargoes.

Then by using Fuzzy Analytic Hierarchy method weights of the factors and variable of port competiveness has been determined. The table 4 presents the abstained result from Fuzzy Analytic Hierarchy method.

Table 4: abstained result from Fuzzy Analytic Hierarchy method

Global weight	Local weight	Variable	weight	Factors
0.0768	0.32	Inland transportation cost and Intermodal transportation cost	0.24	Logistics Cost
0.0432	0.18	Cost related vessel and cargo entering		
0.0288	0.12	Free dwell time on the terminal		
0.0672	0.28	The operating cost (port and cargo/passenger dues, berth charges, victualing, hire of handling equipment, pilotage, towage and passenger and cargo handling costs)		
0.0672	0.25	Land distance and connectivity to major shippers	0.17	Connectivity

0.0425	0.22	Efficient Intermodal links to the port (road, rail, air, feeder, …)		
0.0374	0.15	Deviation from main shipping lines -trunk routes		
0.0255	0.21	Port accessibility		
0.0357	0.17	Efficient inland transport network		
0.0224	0.16	Peripheral resources within the port (Ship Chandelling)	0.14	Port facility
0.0364	0.26	Sufficient draft in approach channel and at berths		
0.028	0.20	The degree of technology employed in the port operations		
0.0196	0.14	Sophistication level of port information and its application scope		
0.0266	0.19	Customs handling and Electronic customs procedures		
0.0252	0.21	Zero waiting time service	0.12	Port Service and Availability
0.0216	0.18	Seaport service level		
0.0204	0.17	Service capacity for ship's size		
0.0168	0.14	Availability and Capacity of port facilities		
0.0132	0.11	Availability empty container		
0.0399	0.42	Port safe entrance	0.095	Safety and security
0.03325	0.35	Port security level		
0.02185	0.23	Port's reputation for cargo loss and damage and accidents		
0.05428	0.59	Numerous Port efficiency factors	0.092	Efficiency and Productivity
0.03772	0.41	Port productivity		
0.023	0.32	Confidence in port schedules	0.073	Reliability
0.01679	0. 28	Liners' schedule reliability and service frequency		
0.01241	0.23	Risk of cancellation/delay		
0.01679	0.17	Disruption of port operation		
0.203	0.29	Professional and skilled labors in port operation	0.070	Hinterland condition
0.182	0.26	Size of contiguous city's economy		
0.161	0.23	Size and activity of FTZ in port hinterland		
0.154	0.22	Volume of total container cargoes		

Conclusion:

Compared with general industries or service activities, port competition was comparatively minimal in the past. Each port secured its own customers depending on the port situation. A variety of activities for these customers and industries were limited within a port area or its neighboring hinterland. Most of today's ports, however, share the hinterland and conduct a severe competition to secure cargo volume, depending on their circumstances. The Iranian container ports are not excluded from this rule. In this light, this paper aims empirically investigate a structure for evaluating container ports in Iran using factor analysis to identify the components which influence competitiveness. And also application of Fuzzy Analytic Hierarchy method to determine the weights of factors and variable of competiveness of Iranian container ports. The abstained result from factor analysis showed that the following eight factors which named as Logistics Cost, Connectivity, Port facility, Port Service and Availability, Safety and security, Efficiency and Productivity, Reliability, Hinterland condition account for an accumulated explanation of variance of 73% and thus may be adequate to represent the 32 strategic dimensions. And also the results of Fuzzy Analytic Hierarchy method showed that between the mentioned eight factor following factor Logistics Cost, Connectivity, Port facility respectively have gained the highest weight. And between the variables of Logistics Cost, Inland transportation cost and Intermodal transportation cost, And between the variables of Connectivity, Land distance and connectivity to major shippers, And between the variables of Port facility, Sufficient draft in approach channel and at berths, And between the variables of Port Service and Availability, Zero waiting time service, And between the variables of Safety and security, Port safe entrance, And between the variables of Efficiency and Productivity, Numerous Port efficiency factors, And between the variables of Reliability, Confidence in port schedules, And between the variables of Hinterland condition, Professional and skilled labors in port operation, have gained the highest weight.

REFERENCES

[1] Frankel, E.G., 1987. Port Planning and Development, Wiley, New York.
[2] Verhoeff, J.M., 1981. Seaport Competition: Some Fundamental and Political Aspects, Marit. Pol. Manag., 8(1): 49-60.
[3] Baudelaire, J.G., 1986. Port administration and management, The International Association of Ports and Harbors, Tokyo.
[4] Goss, R.O., 1990. Economic policies and seaport 4, strategies for port authorities, Maritime Policy and Management, 17(4): 1-28.
[5] UNCTAD, 1992. Port Marketing and the Challenge of the Third Generation Port, Geneva, pp: 358-361.
[6] Matsbashi, S., 1997. Analysis of Port Competitiveness Power, Journal of Japan Marine affaire, 373: 31-47.

[7] Yang, Y., 1999. A Study on Analysis of Competitiveness Edge of the Pusan Port under Strategies for the Hurb,"Unpublished PhD Thesis, Korea Maritime University.
[8] Porter, M.E., 1990. The Competitive Advantage of Nations, New York, The Free Press
[9] French R., 1979. Competition among selected eastern Canadian ports for foreign cargo, Maritime Policy & Management, 6(1): 5-14.
[10] Pearson, R., 1980. Container line Performance and Service Quality. University of Liverpool.
[11] Collison, F., 1984. North to Alaska: marketing in the Pacific Northwest-Central Alaska liner trade. Maritime Policy and Management, 11(2): 99-112.
[12] Brooks, M., 1984. An alternative theoretical approach to the evaluation of liner shipping-Part 1. Situational factors. Maritime Policy and Management, 11(1): 35-43.
[13] Brooks, M., 1985. An alternative theoretical approach to the evaluation of liner shipping – Part 2: choice criteria. Maritime Policy and Management, 12(2): 145-155.
[14] Slack, B., 1985. Containerization inter-port competition and port selection. Maritime Policy and Management, 12(4): 293-303.
[15] Willingale, M., 1981. The Port routing behavior of short sea ship operator theory and practices. Maritime Policy and Management, 8(2): 109-120.
[16] Murphy, P., D. Dalenberg, J. Daley, 1988. A contemporary perspective on international port operations. Transportation Journal., 28(1): 23-32.
[17] Murphy, P., D. Dalenberg, J. Daley, 1989. Assessing international port operations. International Journal of Physical Distribution and Materials Management, 19(9): 3-10.
[18] Murphy, P., D. Dalenberg, J. Daley, 1991. Analyzing international water transportation: the perspectives of large U.S. industrial corporations. Journal of Business Logistics, 12(1): 169-190.
[19] Murphy, P., J. Daley, D. Dalenberg, 1992. Port selection criteria: an application of a transportation research framework. Logistics and Transportation Review, 28(3): 237-255.
[20] Peters, H., 1990. Structural changes in international trade and transport markets: the importance of markets, In: The 2nd KMI International Symposium, Seoul, pp: 58-75.
[21] Kim, H.-S., 1993. Decision Components of Shippers' Port Choice in Korea. Korea Maritime Institute, Seoul.
[22] McCalla, R., 1994. Canadian Container: How have they fares? How will they do? Maritime Policy and Management, 21(3): 207-217.
[23] Starr, J., 1994. The mid-Atlantic load center: Baltimore or Hampton Road? Maritime Policy and Management, 21(3): 219-227.
[24] Tengku, J., 1995. Marketing of freight liner shipping services with reference to the Far East-Europe trade: A Malaysian perspective, Ph.D. dissertation, Cardiff University, UK.
[25] Chiu R.H., 1996. Logistic performance of liner shipping in Taiwan, Ph.D. dissertation, Cardiff University, UK.
[26] Lirn, T., H.A. Thanopoulou and A.K.C. Beresford, 2003. "Transshipment Port Selection and Decision-making Behavior: Analyzing the Taiwanese Case." International Journal of Logistics: Research and Applications, 6(4): 229-244.
[27] Tongzon, J., W. Heng, 2005. Port privatization, efficiency and competitiveness: some empirical evidence from container ports (terminals). Transportation Research Part A: Policy and Practice, 39(5): 405-424.
[28] Cullinane, K., T. Wang, S. Cullinane, 2005. Container terminal development in mainland China and its impact on the competitiveness of the Port of Hong Kong. Transport Reviews, 24(1): 33-56.
[29] Yeo, G.T., D.W. Song, J. Dinwoodie and M. Roe, 2010. Weighting the competitiveness factors for container ports under conflicting interests, Journal of the Operational Research Society, 61: 1249-1257.
[30] DeCoster, 1998. Jamie. Overview of factor analysis. Retrieved.
[31] Saaty, T.L., 1980. The analytical hierarchy process. New York, McGraw-Hill.
[32] Triantaphyllou, E., 2000. Multi-criteria decision making methods: a comparative study. Boston, Kluwer Academic Publishers.
[33] Vaidya, O.S. and S. Kumar, 2006. Analytic hierarchy process: An overview of applications. European Journal of operational research, 169(1): 1-29.
[34] Wang, T.C. and Y.H. Chen, 2007. Applying consistent fuzzy preference relations to partnership selection. Omega, 35(4): 384-388.
[35] Cheng, C.H., 1999. Evaluating weapon systems using ranking fuzzy numbers. Fuzzy Systems, 107: 25-35.
[36] Yang, C.C. and B.S. Chen, 2004. Key quality performance evaluation using fuzzy AHP. Journal of the Chinese Institute of Industrial Engineers, 21(6): 543-550.
[37] Ramik, J., 2006. A decision system using ANP and fuzzy inputs. In 12th international conference on the foundations and applications of utility, risk and decision theory, Roma.
[38] Chang, R.W., J.M.P ellissier and G.B. Hazen, 1996. A cost-effectiveness analysis of total hip arthroplasty for osteoarthritis of the hip. JAMA: the journal of the American Medical Association., 275(11): 858-865.

[39] Harel, E., G. Boaz and S. Avraham, 2008. R&D project evaluation: An integrated DEA and balanced scorecard approach, the International Journal of Management Science, 36: 895-912.
[40] Wu, H., G. Tzeng and Y. Chen, 2009. A fuzzy MCDM approach for evaluating banking performance based on Balanced Scorecard. Expert Systems with Applications, 36: 10135-10147.
[41] Sharma, M., M. Kumar and B. Rajat, 2007. An Integrated BSC-AHP Approach for Supply chain Management Evaluation. Measuring Business Excellence, 11: 57-68.
[42] Cronbach, L., 1951. Coefficient alpha and the internal structure of tests. Psychometrika, 16: 297-334.
[43] Nova´k, A., L. Christine, L. Abetz, 2004. Development and validation of an acceptability and satisfaction questionnaire for a contraceptive vaginal ring. Pharmaco Economics., 22(4): 245-256.
[44] Ware, J., M. Kosinski, D. Gandek, 1998. The factor structure of the health survey in 10 countries. International Quality of Life Assessment., 51: 159-165.