Strategic Analysis of Seaports using Multiple-Criteria Decision-Making Methods and TOWS

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Abstract

Aim of This research is a Strategic analysis of seaports using multiple-criteria decision-making methods. At first, the strengths, weaknesses, opportunities and threats of Iranian seaports has been extracted from literature. Then, with respect to the importance concluded from LIKRET questionnaire distributed between experts (taking the views of the experts and specialist), five high importance factors of each strategic groups have been chosen and used in ANP analysis. When, all pricewise comparison have been done, the global weights of each factor calculated and then, four strategy alternatives have been determined with respect to the importance of each TOWS factors. Finally, after final calculation, the highest priority is assigned the SO strategy (Development of port and maritime transport facilities, utilizing modern technologies to develop transit trade in Iranian ports.), The ST strategy (Development of the trade, marketing, promotion and advertisement of transit corridors (North to south and Eastern transit corridors) passing through Islamic republic of Iran to promote the portion of domestic ports in export and import of foreign countries goods and cargoes via these ports) gained the second priority.

Keywords: Commercial ports, ANP, Strategic, TOWS, Analysis, MCDM

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Introduction

Islamic republic of Iran is a country with suitable geographical position which prepares the grounds for good cargo transit activities. If, all the transport and connecting networks developed effectively, huge amount of foreign export can flow to the national markets and then, countries strategic position in the region will be enhanced prosperously. Many countries can be connected via Iran's territory, from southern province it is neighboring with the major oil producing and exporting gulf nations. Over 60 percent of the world energy is supplied from this region. The Caspian sea in the north part of the country also give the country a good advantage and can play a crucial role in connection of the nation to Russia, Ghazaghestan, Turkemenestan and Azerbaijan and also, can facilitate transit activities to this nations. In other hand, there exist many countries in west and south of Iran which demanding utilization of Iran transit potentialities to reach the global markets. It can be concluded that, Iran is neighbored with 15 countries via land and water borders. Iran can serve as a crossroad to connect these countries to each other and to other remaining nations. Beside it, these nations have huge population with unique wealth. These factors alongside with national natural wealth and resources can help the development of transit in this region. Connection of mid-Asia countries to Persian Gulf and the trade connection of eastern Asia countries to Europe through the corridors crossing from Iran can be made cheaper and easier than other trade routes and also

currently many of these countries are willing to connect to the other part of the world via these corridors (Sadeghifar, 2007). According the good strategic and transit position of the Iran and in line with the transit opportunities and capabilities of the national ports, it is obvious, that the effective utilization of this unique and genuine geographical and transit opportunities require the proper and suitable methods and models to strategically analyze the internal strengths, weaknesses and environmental opportunities and threats of these trade and then formulation of appropriate strategies in forms of the importance degree of external and internal components.

Importance of Strategic Management

Nowadays, Complexity and subtlety of business decisions make necessary the utilization of the strategic management. Management of the diverse and internal multidimensional activities is only one part of the modern manager's responsibilities. Immediate external environment of the firm will also create challenging conditions (Pears and Robinson, 2002). Managers utilize Strategic planning to effectively cope with the factors that affect the company's ability to profitable growth. A few little tools and techniques utilized in the field of strategic management. Since the main component in this field is decision making with highest multiple considerations, the multi-criteria decision making (MCDM) techniques have the highest usage. One of the tools that used in implementing step for analyzing External conditions and internal attributes of strategic

decision's analysis is TOWS analysis. The purpose of this method (TOWS) is to evaluate the ability of the firms to exploit the opportunity and utilize them and defend against the unavoidable external threats such as; inflation, political instability, social developments and changes laws and regulations, and excreta. TOWS summarize the major internal and external factors that can affect an organization's future. When used properly, TOWS can provide a good basis for strategy formulation. However, TOWS could be used more efficiently than normally has been the case in its applications. But, this approach is not without any weaknesses. One of the important weaknesses of TOWS analysis is that TOWS includes no means of analytically determining the importance of the factors or of assessing the decision alternatives with respect to the factors. The further utilization of TOWS alone is thus, mainly based on the qualitative analysis made in the planning process, and on the capabilities and expertise of the persons participating in the process. All in all, the result of TOWS analysis is too often only a listing or an incomplete qualitative examination of internal and external factors.

Methodology

Analytical Network Process

ANP is the generalization of Saaty's analytical hierarchy process (AHP), which is one of the most widely employed decision support tools. AHP is limited to locally static and unidirectional interactions with little feedback among decision components and alternatives. On the other hand, ANP and its super-matrix technique can be considered as an extension of AHP that can handle a more complex Decision structure, as the ANP framework has the flexibility to consider more complex inter-relationships (outer-dependence) among different elements. It incorporates both qualitative and quantitative approaches to a decision problem. It is also capable of capturing the tangible and intangible aspects of local criteria that have some bearing on the decision making process, but AHP cannot deal with interconnections (inner-dependence) between decision factors in the same level (Saaty, 1986). This is because an AHP model is structured in a hierarchy in which no horizontal links are allowed. In fact, this weakness can be overcome by using the advance multi-criteria making technique, which is ANP. Thus, ANP consists of three parts: the first part is the control hierarchy for the network of the criteria and sub-criteria, the second part is a network of influences among the elements and clusters, and the third is the feedback between the various clusters and elements within a cluster. Therefore, ANP is a more powerful technique in modeling complex decision environments than AHP because it can be used to model very sophisticated decisions involving a variety of interactions and dependencies that exist in real-world problems like selecting a waste disposal method, which is a complex network of various issues.

Network Model Applied to Analyze TOWS

Network model utilized for TOWS analysis is consisting of four levels. First level representing the general target (the best

strategy), second level is TOWS groups, third level, criteria or factors of each group and forth level is dedicated to available options or strategy alternatives. It is considered there exist internal dependency for TOWS groups in criteria level in network model (figure1). That is, there exists dependency between strengths and opportunities which W1 indicates the target vector affecting TOWS groups, W2 indicates internal relationship vector between each groups, W3 indicates affecting vector of TOWS groups to the group factors and W4 is also representing affecting vector of factors to the strategic options (Sehat, 2008).

Steps and Algorithm of Applying ANP into TOWS Analysis

It should be noticed, that steps in analytical network process are preceded into two ways. Either big matrix method is applied and the Weights of options and finally their priority are determined with respect to the big matrix evaluation and its normalization or all steps are preceded in accordance with matrix operations (Saaty, 1986) which proposed model prefers the second algorithm to the first one. Then, there exist no need to develop big matrix and its normalization and selecting the strategies according the big matrix. According to the designed network model and general principles of ANP, the steps of applying analytical hierarchy process is written as follows:

1)   Step one: identification of factors and criteria of TOWS

2)   Second Step: assuming no dependency between components, the importance degree of each group of TOWS is

measured in a range from 1 to 9 (1-9) using a pairwise comparison (calculation of W_1).

3)   Third Step: because, there exist no relationships between each TOWS groups, the internal dependency of each group is measured by the 1-9 scale and pairwise comparisons (calculation of W_2).

4)   Fourth Step: Determining the priority (importance) of each TOWS groups by multiplying W_1 by W_2 (calculation of W3).

5)   Fifth Step: determining local importance of each TOWS factors using 1-9 scale and pairwise comparisons (W3- sub – F.LOCAL).

6)   Sixth Step: determining global importance of each TOWS factors by multiplying the result of step four into the result of step five (W – sub – F.LOCAL).

7)   Seventh Step: in this step four type or four groups of alternative strategies are formulated using TOWS matrix.

8)   Eighth Step: determining importance of alternative strategies with respect to each TOWS factors by 1-9 scale and pair wise comparisons.

9)   Ninth Step: determining the global priority of each strategic option by multiplying the result of step 6 into step 8 (W - alternatives).

Case Study

The sample of 15 experts has been chosen to answer the questionnaire. 10 out of 15 persons have chosen from the Iranian port and maritime organization commuters, 5 out of 15 have been chosen from university teachers. All of the pairwise comparisons and answering the questionnaire have been done by this group. It must be noticed that, the size of the sample in AHP and ANP are not

chosen in accordance with the population and normal statically sampling formulas. In this technique, the sample size is determined with respect to the compatibility rate. If the capability rate of the selected sample size is less than 0.1, the sample size is accepted. All the capability rates taken from the pairwise comparisons in this paper are less than 0.1. That is, the sample size is in minimum acceptable level.

Implementation Steps

In the First step, major part of the strengths, weaknesses, opportunities and threats for this research are taken from literature, library studies, and interviews with experts and commuters special commuters of Iranian port and maritime organization (PMO). 8 strengths factors, 14 weaknesses factors, 17 opportunity factors and 19 threat factors have been identified. Finally, LIKRET questionnaire has been chosen to select 5 factors for each group from above mentioned factors. At first all the factors listed in the questionnaire, then the experts have been asked to give scores to the factors (1 for), finally, 10 factors which the maximum scores are assigned to them have been selected to analysis the ANP model.

Table 1: TOWS Matrix

Strengths:	S1: existence of the free trade and industrial zones in vicinity of important domestic maritime industries and the turning of seaports into special economic ports and capitalizing the associated rules and regulation associated to this zones and then, facilitating transit activities. S2: enjoying the capacity to loading, discharging and stowage of 8.3 million TEUs of containers in domestic commercial ports. S3: enjoying huge shipping fleet and adequate capacity to attract and export goods of target transit demanding countries to/from Iranian seaports (merchant fleet with capacity to transport up to 5 million tons of cargo and oil fleet to handle 7 million tons). S4: utilizing suitable maritime, road and rail fleet and capability to provide transit services in forms of Door to Door and MMT services to the customers (specially the linkage of north to south of the country via road and rail networks). S5: existence of approximately 3100 kilo meters of coastal areas in south and north of the country, and enjoying 11 major commercial ports with capacity to handle 148 million tons of cargo, and suitable geographical and commercial position to acting as major trade and transit country in the region (capability to serve as Hub port) and high capability of existing commercial port which enable them to export and import at least 12 million tons of transit cargoes.

Weaknesses:	W1: shortage of the active transit fleet according to the international standards, Inefficient and old transit fleet, insufficient multimodal transport facilities special for container transportation. W2: shortage of professionals and specialist in line with transit activities especially in international transport and transit companies. W3: weakness of transit and customs rules specially article 28 and 29 of Iranian customs law. Low speed of execution of national development projects in the area of transit facilities including; port and maritime affairs. Parallelism and discard in transport and transit policies and inconsistent approach of the associated organizations. W4: lack of unity of management in domestic commercial ports and insufficient powers to regulate good port tariffs to respond properly to the regional changes and competitive situation. Shortages of financial resources to build and develop appropriate port facilities and transit fleet. W5: newly emerged private sector and its inability in major field such as; investment, operation and development of transit activities in ports.
Opportunity:	O1: huge oil and gas resources in Caspian Sea countries, CIS zone and Caucasia and high capability in energy transit and sufficient domestic port tonnages to transit cargo from this region to global markets. O2: high demand in the region to use Iranian port capacity and increasing development of maritime transport and trade in the Caspian Sea region. O3: the extension of ties between region countries and membership of Iran in shanghai and ECO organizations and development of agreements of transit transport of ECO economic cooperation organization (TTFA) to develop and facilitate the transit capacities. O4: passage of important transit corridors in the territory of Islamic republic of Iran including; north to south transit corridor, silk road, Trans-Asia, South Asia corridor and vicinity to maritime enclaves (land locked countries) in CIS region, Caucasia and Afghanistan (8 land locked countries) and good capacity to provide transit services to these countries. O5: appropriate highway and motorway networks in comparison to neighboring countries. The Wide spread rail network and possibility to use multimodal transport systems (rail, road and sea).
Threats:	T1: existence of inconsistence executive organizations in entrance and exit gateways of the country and then many obstacles to transit development. Weakness of current rules and regulations (especially in the area of banking, insurance and customs) with respect to trade and competition facilitation leading to development of transit activities. T2: intense competition in port and maritime industries in the region and the necessity of development of associated facilities and utilization of new technologies. Highly progressive changes in technical and structural dimensions of the ships in the international markets which make necessitate new investment to prepare ports to accommodate and service these ships. T3: imbalance in existing port capacities in the field of hinterland and rail networks and lack of multimodal transport linkages and consequently high cost and time consumption per trip. T4: the efforts and pressures of Tran regional governments to change and replace transit and maritime transport routes from Iran to other regional countries. High Pressures and sanctions on Iranian maritime fleets and seaports operations hire modern technologies, foreign resources and foreign exchange credits. T5: powerful old and new competitors in the region such as: Jibel Ali, Rashid and Salalah. New emerging competitors in the region (such as: Pakistan, Iraq major port, khalifah in Abu Dubai, Damam in KSA and Alt in Azerbaijan). It's predicted that TRASECA corridor can accommodate 30 million tons of transit goods.

Then, the problem will be turned into a hierarchical structure to be easily measurable by using ANP method. This structure is well illustrated in figure1. According this figure, the first level is the final goal of any strategic planning process as a whole is to develop and adopt a strategy resulting in a good fit between internal and external factors and it's called the selection of the best strategy. TOWS groups (strengths, weaknesses, opportunities and threats) are placed in the second level, factors in level tree and finally the forth level is dedicated to the four strategic options. In the Second step it's assumed, there is no dependency between each TOWS groups. Then taking in mind this assumption, all pairwise comparisons between these TOWS groups are calculated with respect to the target (selection of the best strategy) and according to a 1-9 scale. Then, using Expert Choice software (software used for the problems with hierarchical nature) the importance of each groups are calculated.

In the Third one after interviews with many experts and specialist in port studies and port operations and after reviewing the related literature, the interdependency between TOWS groups is determined. Then, with respect to these internal dependencies (inter dependencies) the pairwise comparisons matrix have been developed. The SUPER DECISION software has been used to develop the interdependency matrix between TOWS groups. The interdependency matrix has been developed. Since, the opportunities are only affected by strengths; the pairwise comparisons between these groups are calculated once any separate comparisons have not been done. In Fourth step, priorities between each TOWS groups are calculated based on their interdependency (multiplying W1 by W2). In the Fifth, Local priorities of each TOWS factors are calculated using pairwise comparisons and then their weight vectors have been calculated in line with pairwise comparisons and using Expert Choice software. In next step (Sixth), global (total) priority of TOWS factors have been calculated by multiplying associated priority of each TOWS groups by each other which have been calculated in Fourth step or calculated by multiplying each local priority by each other that have been calculated in Fifth step.

Table 2: Local and Global Priority of TOWS Factors

TOWS Groups	Group priorities	TOWS factors	Local priority factors	Global priority of factors
S	0.1649	S1	0.198	0.0326
		S2	0.209	0.0344
		S3	0.193	0.0318
		S4	0.174	0.0287
		S5	0.226	0.0372
W	0.0293	W1	0.191	0.0056
		W2	0.173	0.0050
		W3	0.243	0.0071
		W4	0.211	0.0061

		W5	0.182	0.0053
O	0.0630	O1	0.209	0.0131
		O2	0.192	0.0121
		O3	0.203	0.0128
		O4	0.223	0.0140
		O5	0.173	0.0109
T	0.0262	T1	0.204	0.0053
		T2	0.209	0.0054
		T3	0.179	0.0046
		T4	0.195	0.0051
		T5	0.213	0.0055

Then by using TOWS matrix, Four kinds of strategies or five groups of possible strategies have been calculated based on global (total) priority of TOWS factors (calculated in step 6) and tabulated as follows:

Table 3: Formulated Strategies

Strategies	Description	Priority
SO	Development of port and maritime transport facilities, utilizing modern technologies to develop transit trade in Iranian ports.	0.0746
ST	Development of the trade, marketing, promotion and advertisement of transit corridors (North to south and Eastern transit corridors) passing through Islamic republic of Iran to promote the portion of domestic ports in export and import of foreign countries goods and cargoes via these ports.	0.0712
WO	Free or up to date transit tariffs in ports to develop and facilitate transit services through national ports.	0.0697
WT	Extension of cooperation with respect to international transportation and cargo transit especially with neighboring and regional countries.	0.0678

In the Eighth step the importance of chosen strategies have been calculated with respect to each TOWS factor. Finally In the ninth, global priorities of each strategic option have been calculated by multiplying special vector of total priority of TOWS factors by importance matrix of alternative strategies. According to the calculations and evaluations have done in this step (as presented in the Table 3), the first priority is dedicated to the SO strategy, second to the ST, third priority to the WO and finally WT strategy gained the forth priority.

Result and Discussion

TOWS analysis alone is not an efficient tool to determine the importance of the identified factors and also it is not capable to evaluate the different strategic options with respect to these factors. Then, this method has many defects to analyze, evaluate and calculate the strategic matters. Therefore, the analytical hierarchy process is a suitable method to resolve these defects. But this approach is also unable to do this task, when there exist dependence and independence relations between the factors to each other's. While, factors in hierarchical structure are

independence and this assumption is not acceptable in AHP to analyze the effect of external and internal environment. So, it is necessary to utilize a tool which can easily determine and calculate possible interdependency between TOWS factors. Based on Analytical hierarchy process, an algorithm has been used in this paper to remove this limitation. At first, the strengths, weaknesses, opportunities and threats of cargo transit from Iranian seaports has been extracted from literature. Then, with respect to the importance concluded from LIKRET questionnaire distributed between experts (taking the views of the experts and specialist), five high importance factors of each strategic groups have been chosen and used in ANP analysis. When, all pricewise comparison have been done, the global weights of each factor calculated and then, four strategy alternatives have been determined with respect to the importance of each TOWS factors. Finally, after final calculation, the highest priority is assigned the SO strategy (Development of port and maritime transport facilities, utilizing modern technologies to develop transit trade in Iranian ports.), The ST strategy (Development of the trade, marketing, promotion and advertisement of transit corridors (North to south and Eastern transit corridors) passing through Islamic republic of Iran to promote the portion of domestic ports in export and import of foreign countries goods and cargoes via these ports) gained the second priority, the strategy WO (Free or up to date transit tariffs in ports to develop and facilitate transit services through national ports), third priority and

WT strategy (Extension of cooperation with respect to international transportation and cargo transit especially with neighboring and regional countries) have been chosen as fourth and then as least priority.

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