

# Integrating the Balanced Scorecard and PROM ETHEE Methods for Seaport's Performance Evaluation

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**Abstract** This paper studies the ports performance in financial, customer, internal business process, Learning and growth and Sovereignty by employing PROMTHEE and Analytical Hierarchical process (AHP) methods. Due to manipulating the balanced score card in port's performance evaluation, this study is conducted in two steps. In the first step, according to the expert's point of view, a new perspective called Sovereignty is added to the existing four standard perspectives of balanced score card. AHP method is applied in second step to measure the weight of all mentioned five perspectives according to their importance level in ports performance evaluation. Then by using PROMETHEE studied ports such as Khoramshahr, Imam Khomeini port, Bushehr, ShahidRajae, ShahidBahonar, Anzali and Amir Abad prioritized. The resulted obtained by the PROMETHEE model showed that, ShahidRajae, Imam Khomeini and Bushehr ports get the first, second and third score, respectively.

**Keywords:** performance evaluation, Iran's Ports, classification, analytical hierarchical process, PROMETHEE

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## 1. Introduction

Seaports, as a part of an important cycle of the world's transportation, plays crucial role in the world trade. Servicing organizations which play an important role in the broadcasting and the optimization of the goods transportation cost [1]. Therefore, one standout edge that shines in the field of the trading and economic competitive world is the delivery of the high quality servicing [2]. Ports organizational managers always are trying to provide healthy servicing and enhancing its quality [3]. By this regards, enhancement of the port and the economic growth will be yield [4].

Deep consideration and analysis of the ports performances in order to achieve improvement and optimization is necessary [5]. This will help the competitive situation among the ports and results in developing the economics of the country [6,7]. This study with the aim of the use of the balanced score card, wants to evaluate the port's performance in Iran. in the first, the above mentioned model undergone to obtain four standard added perspectives from the subjects views and noticing the studied indigenous industry, then by benefiting the AHP method, all the perspectives and the indexes are measured according to their importance level in port's performance evaluation and in the second phase: by manipulating PROMETHEE method, ports such; Khoramshahr, Imam Khomeini, Bushehr, Said Rajae, Said Bahonar, Anzali and Amirabad are classified based

on the five perspectives such; financial, customer, internal business process, Learning and growth and Sovereignty.

In recent years, performance measurement has become an important issue for organizations/institutions. Many institutions spend a lot of money to get a good result in measurement [8]. A good performance measurement and clear definition can help managers to go in the right direction and focus on what really matters to achieve the goals [9,10,11]. Performance measurement is defined as evaluating the organization performance, how well institutions are managed and how the value of the institution can be delivered to customers and other stakeholders [12]. This definition gives a clear guidance and encourages institutions to deliver their institution values to their customers and it also covers the main perspectives of how performance is managed. All institutions, whether public or private institutions, are interested in developing an effective performance measurement and performance management systems to achieve their goals, since it is the only way for them to achieve a high performance [13,14].

### 1.1. Balance Scorecard

The Balanced Scorecard is one of the performance measurements and it is also as a performance management system to achieve organization goals. The Balanced Scorecard was first introduced in the early 1990s by Robert Kaplan and David Norton of the Harvard Business School. The concept has become popular and well known and then widely adopted by institution across the world.

Before Balanced Scorecard developed by Kaplan and Norton, most companies measure their performance measurement that focuses on financial performance only [15]. Meanwhile, the financial performance itself only has influence to the short term measurement; it is also insufficient because it is not focuses on other perspective of performance such as customer, internal business process and learning, and growth perspective. On the other hand, the attention in these perspectives actually can influence financial perspective, such as investing and managing the intangibles assets the same ass in learning and growth perspective can provide foundation for future financial success itself. Kaplan and Norton attempted to do this with the Balanced Scorecard [16]. The Balance Scorecard is a comprehensive and holistic performance measurement. It measures not only financial perspective, but also measures customer, internal process, and learning and growth perspective. Kaplan and Norton argue that their scorecard is not a replacement for financial measurement; it is a complement for financial measurement [17]. If the Balanced Scorecard is understood thoroughly and implemented appropriately in an organization/institution operation, it will have a potential contribution to the success of the organization/institution; however, the measurement of performance is fundamental in organization success [18].

## 1.2. Balance Scorecard Perspectives

**Finance perspective:** The BSC retains the financial perspectives, as financial data are valuable in calculating the readily measurable economic consequences of the previous actions. Measures of financial performance indicate whether a company's strategy, implementation and execution contribute to bottom line improvement. Financial objectives typically relate to measures of profitability, including operating income, return on capital and economic value added [19].

**Customer perspective:** As customers are the source of business profits, satisfying customer needs is the ultimate objective of enterprises. With this perspective, management determines the expected target customers and market segments for operational units and monitors the performance of operational units in these target segments [20].

**Internal business process perspective:** The objective of this perspective is to satisfy shareholders and customers by excelling in some business processes with the greatest impact. In determining the objectives and measures, the first step should be to incorporate value chain analysis. An outmoded operating process should be adjusted to factor-in financial and customer dimension objectives. A complete internal business process value chain that can meet the current and future needs should then be constructed [21].

**Learning and growth perspective:** The BSC's learning and growth element is intended to identify the criteria for establishing the infrastructure of an organization's growth. This indicator is arguably the most critical of the BSC perspectives for addressing the future needs of an organization. It may also be the most difficult parameter to measure. As Kaplan & Norton pointed out: "Managers in several organizations have noted that when they were evaluated solely on short term financial performance, they often found it difficult to sustain investments to enhance

the capability of their people, systems, and organizational processes" [15].

## 2. Material and Methodology

In this study, subjects individuals are consists of ports organization and maritime experts and all of the related companies experts specially those who offering port's logistic servicing and also Iran's port operations terminal experts. It is worth to note here that in this model mean hierarchical process, the number of the subjects will not calculated by statistics formula but determined by the corresponding value, so if the corresponding value of the subjects were under (0.10), the number of the obtained subjects is acceptable. In this study subject's number consist of 35 persons on which are selected randomly, say 5 persons from each port and so called the research subjects on which will zoom their perspectives on the study process that calculated by pair comparative and finally the mean will obtain from.

Expert choice 11 software is used for analyses the gathered data and for the PROMETHEE model calculation, MATLAB software is benefited.

The instrument on which get used in this study is the questionnaires that come into oral and phone call frame form. The reliability of this questionnaire is highly dependent on the reliability of the analytical hierarchical process and delves to the pair comparative of the main and sub measures. The reliability of the designed questionnaires is concluded by the mal corresponding score of the pair comparative tables. According to this, if the mal corresponding score of the pair comparative tables was below (0.10), the designed questionnaire is considered of standard reliability. Hence we can claim that, the questionnaire is acceptable in this study because it showed the mal corresponding score in all of the pair comparative tables below (0.10).

### 2.1. AHP

AHP decomposes the complexity in the form of a simple hierarchy, descending from overall goal to criteria, sub-criteria (if exist) and alternatives; allocates relative weights of criteria and sub-criteria to compare the alternatives [22].

The basic principles of AHP can be summarized as defining and determining the problem; decomposing the problem in a hierarchy from top through the intermediate levels; constructing a set of pair-wise comparison matrices; testing the consistency index; synthesizing the hierarchy to find out the ranks of the alternatives. AHP makes use of pair-wise comparisons to simplify the judgment process with 1-9 ratio scaling [23] (see Table 1).

When it is assumed  $(A_1, A_2, \dots, A_n)$  is any set of  $n$  elements than a sample of square matrix can be produced as below by pair wise comparisons of each element. Here, each  $(A_i, A_j)$  judgment represented as " $a_{ij}$ ". Because  $a_{ii}=1$  for all  $i$  diagonal of the matrix contains entries of 1.

$$\begin{pmatrix} a_{11} & a_{12} & \Lambda & a_{1n} \\ a_{21} & a_{22} & \Lambda & a_{2n} \\ \text{M} & \text{M} & & \text{M} \\ a_{n1} & a_{n2} & \Lambda & a_{nm} \end{pmatrix} \quad (1)$$

**Table 1. The pairwise comparison scale [23]**

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favour one activity over another
5	Strong importance	Experience and judgment strongly favour one activity over another
7	Very strong or demonstrated importance	An activity is favoured very strongly over another; its dominance demonstrated in practice
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation
2,4,6,8		Intermediate values

When  $(w_1, w_2, \dots, w_n)$  are the elements corresponding weights; the dominance of an element in the row over the element in the column represented as  $w_i/w_j$ . AHP method compares the related weights of each element in a set with respect to the goal. The general form of comparison matrix of AHP is given as follows;

$$A = \begin{pmatrix} w_1 & w_1 & \Lambda & w_1 \\ w_1 & w_2 & & w_n \\ w_2 & w_2 & \Lambda & w_2 \\ w_1 & w_2 & & w_n \\ M & M & & M \\ w_n & w_n & \Lambda & w_n \\ w_1 & w_n & & w_n \end{pmatrix} \quad (2)$$

Then the problem turns in to general process to calculating the largest eigenvalue corresponding to eigenvector to assess the Consistency Index (C.I.) where  $A$  is the matrix,  $x$  is the eigenvector and  $\lambda$  is the eigenvalue. When we divide C.I. by the random consistency number the final value must be less than 0.10 [23].

$$C.I. = \frac{\lambda_{\max} - n}{n - 1} \quad Ax = \lambda x \quad (3)$$

### 2.2. The PROMETHEE Method

The PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation) is a multi-criteria decision-making method developed by Brans et al. [24]. It is a quite simple ranking method in conception and application compared with other methods used for multi-criteria analysis. It is well adapted to problems where a finite number of alternatives are to be ranked according to several, sometimes conflicting criteria. The evaluation table is the starting point of the PROMETHEE method. In this table, the alternatives are evaluated on the different criteria. The implementation of PROMETHEE requires two additional types of information, namely:

(1) Information on the relative importance that is the weights of the criteria considered.

(2) Information on the decision-maker's preference function, which he/she uses when comparing the contribution of the alternatives in terms of each separate criterion. The weights coefficients can be determined according to various methods [25]. AHP method is used to determine the criteria weights in this study. The PROMETHEE method is appropriate to treat the multi-criteria problem of the following type:

$$\max \{f_1(a), f_2(a), \dots, f_n(a) \mid a \in A\}, \quad (4)$$

Where  $A$  is a finite set of possible alternatives, and  $f_j$  denotes  $n$  criteria to be maximized. For each alternative,

$f_j(a)$  is an evaluation of this alternative. When we compare two alternatives  $a, b \in A$ , we must be able to express the result of these comparisons in terms of preference. We, therefore, consider a preference function. The preference function translates the difference between the evaluations of two alternatives ( $a$  and  $b$  in terms of a particular criterion, into a preference degree ranging from 0 to 1. Let

$$P_j(a, b) = G_j[f_j(a) - f_j(b)] \quad 0 \leq P_j(a, b) \leq 1, \quad (5)$$

The preference function associated to the criterion,  $f_j(i)$  where  $G_j$  is a non-decreasing function of the observed deviation ( $d$ ) between  $f_j(a)$  and  $f_j(b)$ . In order to facilitate the selection of specific preference function, six basic types of this preference function are proposed to decision maker as it presented in Table 2.

In each case no more than two parameters (threshold,  $q$ ,  $por$ s) have to fix [26]. Indifference threshold  $q$ : the largest deviation to consider as negligible on that criterion. It is a small value with respect to the scale of measurement. Preference threshold  $p$ : the smallest deviation to consider decisive in the preference of one alternative over another [27]. It is a large value with respect to the scale of measurement. Gaussian threshold  $s$ : it is only used with the Gaussian preference function [28]. It is usually fixed as an intermediate value between indifference and a preference threshold. PROMETHEE permits the computation of the following quantities for each alternative  $a$  and  $b$ :

$$\pi(a, b) = \frac{\sum_{j=1}^n w_j P_j(a, b)}{\sum_{j=1}^n w_j} \quad \Phi^-(a) = \sum_{x \in A} \pi(x, a), \quad (6)$$

$$\Phi^+(a) = \sum_{x \in A} \pi(x, a), \quad \Phi(a) = \Phi^+(a) - \Phi^-(a), \quad (7)$$

So for each alternative  $a$  belonging to the set  $A$  of alternatives,  $\pi(a, b)$  is an overall preference index of  $a$  over  $b$ . The leaving flow  $\Phi^+(a)$  is the measure of the outranking character of  $a$  (how  $a$  dominates all the other alternatives of  $A$ ). Symmetrically, the entering flow  $\Phi^-(a)$  gives the outranked character of  $a$  (how  $a$  is dominated by all the other alternatives of  $A$ )  $\Phi(a)$  represents a value function, whereby a higher value reflects a higher attractiveness of alternative  $a$  and is called net flow. The two main PROMETHEE tools can be used to analyze the evaluation problem: (1) the PROMETHEE I partial ranking, (2) the PROMETHEE II complete ranking. The PROMETHEE I partial ranking

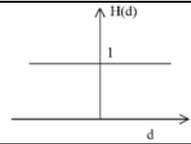
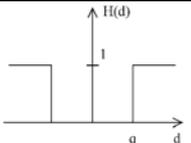
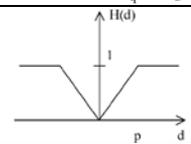
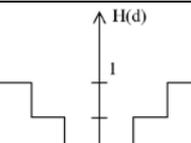
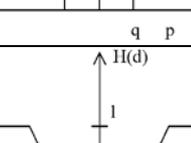
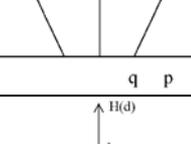
provides a ranking of alternatives. In PROMETHEE I, alternative  $a$  is preferred to alternative  $b$ ,  $aPb$ , if alternative  $a$  has a greater leaving flow than that of alternative  $b$  and  $a$  smaller entering flow than the entering flow of alternative  $b$  :

$$apb \text{ if } : \Phi^+(a) > \Phi^+(b) \text{ and } \Phi^-(a) < \Phi^-(b); \text{or} \quad (8)$$

$$\Phi^+(a) > \Phi^+(b) \text{ and } \Phi^-(a) = \Phi^-(b); \text{or} \quad (9)$$

$$\Phi^+(a) = \Phi^+(b) \text{ and } \Phi^-(a) < \Phi^-(b); \text{or} \quad (10)$$

Table 2. Generalized criteria [26]

Type of generalized criteria	Analytical definition	Shape	Parameters to define
Type I. Usual criterion	$H(d) = \begin{cases} 0, & d = 0; \\ 1, &  d  > 0. \end{cases}$		--
Type II. Quasi-criterion	$H(d) = \begin{cases} 0, &  d  \leq q; \\ 1, & \text{otherwise.} \end{cases}$		$q$
Type III. Criterion with linear preference	$H(d) = \begin{cases} \frac{ d }{p}, &  d  \leq p; \\ 1, &  d  > 0. \end{cases}$		$p$
Type IV. Level-criterion	$H(d) = \begin{cases} 1, &  d  \leq q; \\ 1/2, & q <  d  \leq p; \\ 1, & \text{otherwise.} \end{cases}$		$q, p$
Type V. Criterion with linear preference and indifference area	$H(d) = \begin{cases} 1, &  d  \leq q; \\ \frac{ d  - q}{p - q}, & q <  d  \leq p; \\ 1, & \text{otherwise.} \end{cases}$		$q, p$
Type VI. Gaussian criterion	$H(d) = 1 - \exp\{-\frac{d^2}{2\sigma^2}\}$		$\sigma$

PROMETHEE I evaluation allows indifference and incomparability situations. Therefore, sometimes partial rankings can be obtained. In the indifference situation ( $aIb$ ) two alternatives  $a$  and  $b$  has the same leaving and entering flows [29]:

$$aIb \text{ if } : \Phi^+(a) = \Phi^+(b) \text{ and } \Phi^-(a) = \Phi^-(b) \quad (11)$$

Two alternatives are considered incomparable  $aRb$ , if alternative  $a$  is better than alternative  $b$  in terms of leaving flow, while the entering flows indicate the reverse:

$$aRb \text{ if } : \Phi^+(a) > \Phi^+(b) \text{ and } \Phi^-(a) > \Phi^-(b); \text{or} \quad (12)$$

$$\Phi^+(a) < \Phi^+(b) \text{ and } \Phi^-(a) < \Phi^-(b) \quad (13)$$

PROMETHEE II provides a complete ranking of the alternatives from the best to the worst one. Here, the net flow ( $\phi$ ) is used to rank the alternatives. The alternative with the higher net flow is assumed to be superior. Since PROMETHEE I does not provide a complete ranking, resulting ranking cannot be compared with the ranking provided by PROMETHEE II. PROMETHEE I ensure

creation of indifferent and incomparable alternatives. In some ranking problems, PROMETHEE I can give a complete ranking depending on the evaluation matrix values and, this ranking cannot be different from the one achieved with PROMETHEE II.

### 3. Results

In the beginning, additional perspective named "Sovereignty" is added into its four traditional perspective of balanced score card. Then by benefiting the hierarchical process, all the perspectives and the indexes were measured according to their importance level in the port's performance evaluation. Table 3 shows the obtained results of this model. According to the obtained results, among all of these five measures, the financial and governing aspect with the score of (0.242) and score of (0.150) gained the most and the least weight, respectively. In the financial measures, the enhancement of the benefits, get the highest measure (0.306). Among the customer measures, enhancement of the servicing quality gets the highest measure (0.283) and consideration in the internal

processes, results that the dropping time of the ship servicing gets highest measure (0.234). The growth and training measures are considered as next indexes and the mechanisms of the maritime and ports process achieves highest measure (0.234) and finally among the governing aspect measures, the controlling and decreasing the security events gets highest measure (0.395).

In the second phase according to the PROMETHEE model, ports are probed based on the five perspectives such: financial, customer, internal business process,

Learning and growth and Sovereignty. According to these five perspectives, performance of each port is measured 1 to 100. As a result, the decision Matrix of the PROMETHEE model is formed as shown in Table 4.

Then by applying PROMETHEE method, positive prominent outside stream, negative prominent outside stream and pure one are calculated for each parameters as shown in Table 5. The ports have been prioritized according to the obtained parameters for each port in Table 5.

**Table 3. Weight of Balanced Scorecard Perspective and criteria**

Perspective	W	Criteria	Local	Global
Finance perspective	.242	total income increase	.289	0.073
		Cost reduction	.242	0.060
		Reduction of trade debtors	.164	0.040
		Profit increase	.306	0.078
Customer	.233	retain existing customers	.241	0.055
		Attract a new customers	.214	0.048
		Increase customer satisfaction	.262	0.060
		Increase the quality of services	.283	0.067
Internal business process	.182	Reduction of ship waiting time	.212	0.040
		Reduction of ship service time	.234	0.041
		Reduction of trucks service time	.181	0.032
		Being standby, port and marine equipment.	.203	0.036
		increasing loading and unloading tonnage	.170	0.031
Learning and growth	.193	Information exchange with port stack holders	.214	0.042
		Mechanization of port and marine processes	.234	0.044
		Productivity Increase	.181	0.034
		Establishment of the partnerships system	.161	0.030
		development of human resource training	.210	0.040
Sovereignty	.150	Control and monitor the implementation of the Convention and national law	.352	0.053
		Control and prevention of safety and environmental incident	.395	0.060
		Management of the Coastal and Inland Waterway	.253	0.038

**Table 4. Decision Matrix of PROMETHEE**

Port	Finance Perspective	Customer	Internal Business Process	Learning And Growth	Sovereignty
Weight	.242	.233	.182	.193	.150
Port ShahidRajae	85	79	89	95	90
Port ofImam Khomeini	83	77	90	91	93
Port ofBushehr	76	70	84	83	88
Port ofKhoramshahr	73	72	78	79	84
Port ofAnzali	67	68	79	81	83
Port of Amirabad	62	63	76	78	86
Port ofShahidBahonar	59	59	67	73	81

**Table 5. Partial ranking and complete ranking (PROMETHEE flows)**

Alternative	F	F+	F-	Ranking
Port ofShahidRajae	0.88933	0.94467	0.05533	1
Port of Imam Khomeini	0.77733	0.88867	0.11133	2
Port of Bushehr	0.25567	0.62783	0.37217	3
Port ofKhoramshahr	-0.09733	0.45133	0.54867	4
Port ofAnzali	-0.25833	0.37083	0.62917	5
Port ofAmirabad	-0.56667	0.21667	0.78333	6
Port ofShahidBahonar	-1.00000	0.00000	1.00000	7

## 4. Conclusions

In this paper, two steps study are applied due to manipulate the balanced score card in evaluation the ports performance. In first phase, an extra perspective is added to existing four standard perspectives according to expert points of view. Second phase by using AHP method, all the perspectives and the indexes are measured according to their importance level in port's performance evaluation. And then PROMETHEE model has been manipulated to prioritized studied ports such as Khoramshahr, Imam

Khomeini port, Bushehr, ShahidRajaei, ShahidBahonar, Anzali and Amir Abad. The priorities of these ports are determined according to five mentioned perspectives. The resulted values by PROMETHEE model showed that, ShahidRajaei port get the prominent score in general (0.88933) and represented as number one. The other ports such Imam Khomeini Port with general score of (0.77733) become number two, Bushehr port with general score of (0.25567) identified in the third rank, Khoramshahr port with general score of (-0.09733) highlighted as fourth rank keeper, Anzali port with general score of (-0.25833) reached the fifth rank, Amir Abad port with general score of (-0.56667) acquired the sixth rank and finally ShahidBahonar with general score of (-1.00000) impetrated the seventh rank on its own subsequently. According to these result we can conclude that the balanced score card is rich of capability and high reliability in evaluating the ports performance and it can be used it in other maritime transportation industry field.

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## References

- [1] Al-Eraqi, A. S., Mustafa, A., & Khader, A. T. (2010). An extended DEA windows analysis: Middle East and East African seaports. *Journal of Economic Studies*, 37(2), 208-218.
- [2] Hung, S. W., Lu, W. M., & Wang, T. P. (2010). Benchmarking the operating efficiency of Asia container ports. *European Journal of Operational Research*, 203(3), 706-713.
- [3] Tongzon, J. L. (1995). Determinants of port performance and efficiency. *Transportation Research Part A: Policy and Practice*, 29(3), 245-252.
- [4] Cullinane, K. Wang, T. F. and Song, D. W. Ji, P. (2006) the Technical Efficiency of Container Ports: Comparing Data Envelopment Analysis and Stochastic Frontier Analysis, *Transportation Research Part A*, 4 (1), 354-374.
- [5] Jafari, H., (2013). Empirical Study the Status of Necessary Infrastructure for Knowledge Management Implementation in Southern Ports of Iran. *International Journal of Basic Sciences & Applied Research*. Vol., 2 (4), 426-433, 2013.
- [6] Robert, S. Kaplan & David P. N. 1996. Balances Score Card. Boston Harvard Business School Press.
- [7] Jafari, H., and batvandi, z. (2013). An Empirical Study of Service Quality at Iranian Marine Container Terminals Using SURVQUAL and MAPPCC Methods. *Technical Journal of Engineering and Applied Sciences*. 3(13): 1124-1132.
- [8] Kaplan, R. S. & Norton, D. P. 1992. The Balanced scorecard-Measures that drive performance. *Harvard business Review*. 71-80, 1992.
- [9] Kaplan, R. S. and Norton, D. P. 2001. The strategy-focus organization: how balanced score card companies Thrive in the new business environment, *Harvard business school Press*, Boston. MA.
- [10] Jafari, H., (2013). Increase the Efficiency Rate of Container Loading and Unloading Using Six Sigma Method. *International Research Journal of Applied and Basic Sciences*. 4 (6): 1438-1447.
- [11] Schmidt, S. & Bateman, I. 2006. A management approach that drives actions strategically Balanced scorecard in a mental health trust case study, *International Journal of Health Care Quality Assurance*. 19(2), 119-135.
- [12] Neysi, A. Jafari, H. Askari, A. (2013). Role and Importance of Knowledge Management in Container Terminal Competitiveness, *Applied mathematics in Engineering, Management and Technology*. 2 (1) 2013:69-75.
- [13] Saeidi, Jafari, H., Aml. Zaersoleymani. (2013). Container Repositioning Management in Liner Shipping Industry. *Management Science Letters*, 3 (6): 1795-1804.
- [14] Jafari, H., (2013). Establishment of Total Quality Management in the Iranian Seaports. *Journal of Asian Business Strategy*, 3(7):140-153.
- [15] Jafari, H., and dadkhah, A. (2013). Risks Analysis of Container Handling Operation Using ELECTRE and Shannon's Entropy Methods. *International Journal of Basic Sciences & Applied Research*. 2 (4): 484-493.
- [16] Jafari, H., Saeidi, karimi. (2013). Importance - Performance Analysis of Port's Services Quality Form Perspective of Containerized Liner Shipping. *Management Science Letters*, 3 (6): 1743-1750.
- [17] Saaty, T. 1977. A Scaling Method for Priorities in Hierarchical Structure. *Journal of Mathematical Psychology*. 12(1): 30-47.
- [18] Saaty, T. 1990. How to Make Decisions; the AHP. *European Journal of Operation Research*. 48 (1): 9-26.
- [19] Jafari, H., (2013). Selecting Appropriate Quayside Equipment for Grain Unloading Using TOPSIS and Entropy Shannon Methods. *International Journal of Innovation and Applied Studies*. 3(4): 1072-1078.
- [20] Brans, J. P., Vincke, P. H., and Mareschall, B. 1986. How to select and how to rank projects: The PROMETHEE method. *European Journal of Operational Research*. 14: 228-238.
- [21] Brans, J. P., and Mareschall, B. 1994. The PROMCALC and GAIA decision support system for multi-criteria decision aid. *Decision Support Systems*. 12: 297-310.
- [22] Brans, J. P., and Vincke, P. H. 1985. A preference ranking organization method. *Management Science*. 31: 647-656.
- [23] Mergias, I., Moustakas, K., Papadopoulos, A., and Loizidou, M. 2007. Multi-criteria decision aid approach for the selection of the best compromise management scheme for ELVs: The case of Cyprus. *Journal of Hazardous Materials*. 147: 706-717.
- [24] Jafari, H., (2013). Application of ELECTRE III and Shannon Entropy for Strategy Selection. *International Journal of Innovation and Applied Studies*. 3(5): 189-194.
- [25] Wang, J. J., and Yang, D. L. 2007. Using a hybrid multi-criteria decision aid method for information systems outsourcing. *Computers and Operation Research*. 34: 3691-3700.
- [26] Diakoulaki, D., & Koumoutsos, N. (1991). Cardinal ranking of alternative actions: extension of the PROMETHEE method. *European Journal of Operational Research*, 53(3), 337-347.
- [27] VenkataRao, R., & Patel, B. K. (2010). Decision making in the manufacturing environment using an improved PROMETHEE method. *International Journal of Production Research*, 48(16), 4665-4682.
- [28] Kolli, S., & Parsaei, H. R. (1992). Multi-criteria analysis in the evaluation of advanced manufacturing technology using PROMETHEE. *Computers & industrial engineering*, 23(1), 455-458.
- [29] Zhaoxu, S., & Min, H. (2010, June). Multi-criteria decision making based on PROMETHEE method. In *Computing, Control and Industrial Engineering (CCIE)*, 2010 International Conference on (Vol. 1, pp. 416-418).