Ranking Ports Based on Competitive Indicators by Using ORESTE Method

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ABSTRACT: The research was implemented bearing the intention of determining the effective factors in competitiveness rate of container ports & ranking BIK, Shahid Rajae port, Anzali port & Amir Abad based on the competitiveness indicators using ORESTE & Shannon entropy methods in two phases. In the 1st phase lying in the country’s ports (rate of competitiveness). In the 1st phase by using Delphi method & studying the background of the research, the effective indicators in ports’ competitiveness of the country were identified & in the 2nd phase by using the known indicators through entropy method & with regard to their importance were weighted & then the ports were ranked according to these indicators & ORESTE method. The final ranking by ORESTE multi-criteria method for BIK, Shahid Rajae port, Anzali & Amir Abad ports shows that Shahid Rajae port at the final ranking of 430.5 enjoys the 1st rank, BIK with the final rank of 444.5 enjoys the 2nd rank, Amir Abad port with the final rank of 476.5 enjoys the 3rd position & finally Anzali port by little difference with the final rank of 478.5 enjoys the last position.

Keywords: Iranian seaport, competitiveness, ranking, ORESTE, Delphi.

INTRODUCTION

Nowadays worlds’ containerized ports encountering enormous changes in WTO. Maritime shipping is the essential part of WTO. The so called enormous changes, shall create competiveness between ports constantly (Brooks, 1984; Chang and Tongzon, 2008). As per this competitiveness they shall be goods attraction & consequently, economic prosperity. Therefore, providing facilities & convenience in terms of escalation customer’s satisfaction which in part can attracts a large no. of customers & increases their loyalty to port (Ha, 2003). On the other hand, due to lack of suitable facilities & convenience ports’ services commensurate with customers’ needs & failure to satisfy them shall lead to their unwillingness to use that specific port (Murphy and Daley, 1994). As a result, to protect the market position of the port in port & maritime transportation, a port should preserve its competitive situation through paying attention & identifying customers need & putting all ports activities in accordance in terms of winning more customers’ satisfaction to stay ahead of all other rivals. In this end, regarding which factors are able to escalate ports competitiveness is essential. This research was implemented with the intention to identify the effective factors in the country’s containerized ports & ranking BIK & Shahid rajae port, Anzali & Amir Abad ports based on competitiveness indicators using ORESTE & Shannon entropy methods.

The Research’s Background

The following are some reviews of previous foreign studies on the extraction of the components of port competitive power. Murphy et. al. (1992) focused on port detention, port size, port accessibility, and calling frequency; French (1979) 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. Peters (1990) 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
Delphi’s analysis

Delphi’s analysis is a method of collecting data & audiences & experts’ point of views to facilitate the process of solving the crises, decision making & planning. This way needless to physical gathering is also applicable. Instead, the information is sent through mail, fax or email. The so called technique is presented to make use of experts & audience’s point of views & creativity. The mentioned technique is based on group’s strength to solve problems & decreases group’s weak points. Thus, the so called technique was used by the most appropriate data collecting method of experts’ point of views in terms of identifying the effective factors in ports competitiveness in Iran.
Multi-criteria decision making method

If in one multi-criteria decision making case, goal, ranking option \( m \) is based on indicator \( K \) and for each indicator, a weak arrangement on the set of options is to be illustrated and the approximate significance (weight) of each indicator to be illustrated by another weak arrangement; the basics of each MADM methods being excel to ORESTE is to be established. This method provides a tool that is able to rank the decision making options completely and highlight the discrepancies eventually (Isabelle and Pastijn, 2002).

In 1979 and in a conference which was held on multi-criteria decision making issues, polytechnic university professor-Marc Roubens- in Belgium, presented his idea of one new multi-criteria decision making method called ORESTE or a collective ranking method compare the sequential evaluation options according to the presented indicators and made effort that with the help of ORESTE, to avoid the practical requirement in ELECTRE method in specifying indicators’ weight. After his 1st presentation in the conference, Professor Robins, described ORESTE in 2 articles. In 1980 in the 1st article which was limitedly published; in a nutshell, introduced the algorithm of this method and then in 1982 in another article which was published in the authorized European research magazine, described in details ORESTE and in a case study, he solved a real problem pertaining to choosing computer system. In this article, Professor Robins, in introducing his creative method states that: A is a set of the limited possible options which should be evaluated by some special indicators. This superior way with regard to the determiner’s priority on A by every indicator, a weak level may appear and also among the indicators creates a half-sequential relation. Albeit, there proposed many different methods to create the superiority relationships, the most prominent one was presented by B Roy as ELECTRE; this is while, in our method, the information pertaining to weight is replaced by the half-sequential relations (Pastijn and Leysen, 1989).

If we consider \( A \) as a limited \( m \) set, these options shall be analyzed by the set \( C \) including \( k \). in this method, the relative importance of each index is not specified by their weight, but it is stated by a superiority structure on the index \( C \), which is described under a weak level. The so called weak level is stated in a full and transition relation of \( S \), which is consisted of \( P \) and \( I \) relations. \( P \) or superiority show discrepancy and \( I \) shows incuriosity, which the representative of superiority coordination among the indexes. Also for each of the indexes of \( j=1,..., k \), a superiority structure in the set \( A \) is described, which is similar to \( C \) indexes of the superiority structure is transitional and consisting of a set of \( P \) and \( I \) relationships (Roubens, 1982). Thus, the 1st superiority structure is established based on indexes’ relative importance to each other and the 2nd superiority structure also created on the optional set and according to each one of them individually. After formation of the abovementioned 2 superiority structures, we should pay attention to the preliminary ranking of these structures. To do so, we may use Besson average ranking method. In such a way to refer to the superiority structure 1st and according to its rank in comparison to all other indexes, dedicate numbers 1-K (k index) and for all options numbers 1-m (m indicator). Then we obtain the mean from the maximum or the minimum dedicated number which is constructed based on the superiority structure enjoys similar superiority or \( I \) (relation1). In other words, instead of dedicating grades 1 and 2 to the so called two indexes (options), we shall grant it to both ranks (1/5); therefore, with Besson average ranking, the priorities shall turn to ranks. The obtained rank for indexes shall be represented by \( r_k \) and the gained rank for each option in each index shall be represented by \( r_k(m) \) (Zak, 2005).

\[
\frac{x_1 + x_2}{2} = \bar{x} \tag{2}
\]

\( x_1 \) is the maximum amount while \( x_2 \) is the minimum amount and \( \bar{x} \) is regarded the average distance.

ORESTE Method to perform the ranking process has 3 phases as the following:

Projection of options intervals \( d(o,m) \): Estimating in ORESTE method is based on using the hypothetical matrix called position- matrix that in all its columns the decision options are organized from the best to the worst and accordingly the columns are arranged based on the indexes ranks. By scanning matrix’s members eventuating from the main diameter, the best situation are listed on the left side of the diameter and the worst are at the right side. Then a zero offset is located at the very end of the left side of the diameter and all the formed pictures are considered and their intervals are determined from the zero offset which is shown by \( d(o,m) \) as it is shown below (Geldermann and Rentz, 2000):

\[
\text{if } a_{k,b} \text{ then } d(o,a_{k}) < d(o,b_{k})
\]

\[
\text{if } r_{2(b)} \text{ then } 1 \text{ P } 2 \text{ then } d(o,a_{1}) < d(o,b_{2})
\]

The interval estimation \( d(o,m) \), which was explained above is executed for different modes including: Direct linear estimation: In this mode to perform the interval estimation \( d(o,m) \) from \( r_k \) and \( r_{k(m)} \) for option \( m \) in \( k \) index we shall comply to relation (4).

\[
d(o,m) = \frac{1}{2} [r_k + r_{k(m)}] \tag{4}
\]
Indirect linear estimation: In this mode, pictures’ intervals from the offset point are computed as the following using relation (5):
\[ d(o,a_k) = a_k + (1 - a)r_k(m) \] (5)

Non-linear estimation: In non-linear scanning mode to determine the pictures distances from the desired origin we use relation (6):
\[ d'(o,m_k) = \sqrt{r_k^R + r_k(m)^R} \] (6)

To achieve more general conditions, relation (6) shall change as follows:
\[ d''(o,m_k) = \frac{r_k^R + r_k(m)^R}{(1 - a) r_k(m) + (1 - a)} \] (7)

And finally if we add the normal weights of \(1 - a\), relation (8) shall be gained:
\[ d'''(o,m_k) = \frac{r_k^R + r_k(m)^R}{(1 - a) r_k(m) + r_k(m)^R} \] (8)

In this regard, with respect to some amounts, the R distance of \(d\) shall be illustrated.

- Mean of balanced arithmetic \(R = 1 \rightarrow d''\)
- Geometry mean \(R = -1 \rightarrow d''\)
- Mean of squares \(R = 2 \rightarrow d''\)
- \(R = +\infty \rightarrow d''\)

Global ranking of the options interval \(R(m_k)\): By determining the interval of the scans pertaining to matrices’ members, the sources’ position and the global ranking shall be implemented by one of the abovementioned styles. Generally speaking, selecting every mode or different R amounts for scanning and determining intervals \(d(o,m_k)\) with the solemn intention of creating an impact on their position in comparison to each other which in progress, the intervals with the assistance of Besson average ranking method and consequently the issue shall revert to its original sequential essence. The result of this ranking equals to the obtained rank by Besson method and the intervals of \(d'(o,m_k)\) is \(R(m_k)\) in a way that we shall have the following e.g (Isabelle and Pastijn, 2002)
\[ R(a_1) \leq R(a_2) \] if \(d(o,a_1) \leq d(o,b_2)\) (9)

The obtained ranks are called the total ranks and all exist in the following scope:
\[ 1 \leq R(m_k) \leq m.k \] (10)

Thus an incremental sequential structure is modified based on \(R(m_k)\) and with regard to the following relations:

\[ \text{If } R(a) < R(b) \text{ then } a \text{ Pb } \] (11)
\[ \text{If } R(a) = R(b) \text{ then } a \text{ Pb } \] (12)

An option that the relative \(R(m_k)\) is smaller is more appropriate and a better rank shall be awarded to it; in other words, it is the top option in which the total sum of all its indexes is less than the others.

**Entropy method**

When the data of one decision-making matrix is specified totally, the entropy method can be of use in evaluating weights. Entropy is a very important concept in social science, physics and information theory. In information theory, entropy is a discrepancy scale which is stated by Pi probability distribution. Scaling this discrepancy is stated as follows (Roubens, 1982):
\[ E_i = S(P_1, P_2, \ldots, P_m) = -K \sum_{i=1}^{m} P_{ij} \ln P_{ij} \] (14)
In this relation \( k \) is a fixed amount. Since the above equation is used in statistical computations, probability distribution entropy is called \( P_i \). Entropy words and discrepancy are used in one concept. Where \( P_i \) are equal to each other (for \( I \) and \( J \) amounts) then:

\[
P_i = \frac{1}{n}
\]

(15)

In the decision making matrix, \( P_{ij} \) can be used to evaluate different options. In the decision making matrix the option \( m \) and \( n \) are the required (standard) index. The content of the information shall be computed below from this matrix as \( (P_{ij}) \). The result of the abovementioned matrix for \( j \) shall be as follows:

\[
p_{ij} = \frac{r_{ij}}{\sum_{l=1}^{n} r_{lj}}; \quad j = 1, \ldots, n
\]

(16)

Entropy \( E_j \) is computed as follows:

\[
E_j = -K \sum_{i=1}^{m} P_{ij} \ln P_{ij} \quad \forall_{ij}
\]

(17)

And \( K \) as a fixed amount is calculated as below:

\[
K = \frac{1}{\ln mn}
\]

(18)

We hold \( E_j \) between 1-0. after that \( d_j \) (deviation degree) is computed which explains the relative \( j \) index in that how much useful information presents to the decision maker.

As much as the scaled indexes are closer to each other, indicates that the rival options are not that much different from each other. Thus, the role of that index should be the same in the decision making process.

\[
d_j = 1 - E_j \quad \forall_{ij}
\]

(19)

Then \( W_i \) is computed in which the best way of determining weight be extracted:

\[
W_{ij} = \frac{d_{ij}}{\sum_{i=1}^{n} d_{ij}} \quad \forall_{ij}
\]

(20)

**RESULTS**

In the 1st phase the effective factors in ports competition by using Delphi method & studying the indexes’ background were determined.

<table>
<thead>
<tr>
<th>W sub criteria</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skilled HR in port operations</td>
<td>C1</td>
</tr>
<tr>
<td>Geographical location of the port (supply sources &amp; markets ...)</td>
<td>C2</td>
</tr>
<tr>
<td>Size of the free economic zone at the back of the port</td>
<td>C3</td>
</tr>
<tr>
<td>The effectiveness of the system &amp; documents’ clearance &amp; customs rules &amp; regulation</td>
<td>C4</td>
</tr>
<tr>
<td>Ports exploitation</td>
<td>C5</td>
</tr>
<tr>
<td>Level of the internal side services in the port (fueling, ship repair, drinking water, tolling &amp; lashing...)</td>
<td>C6</td>
</tr>
<tr>
<td>The applied technology level at the port</td>
<td>C7</td>
</tr>
<tr>
<td>Port services capacity (berthing of big vessels &amp; port capacity)</td>
<td>C8</td>
</tr>
<tr>
<td>Multiple transportation cost</td>
<td>C9</td>
</tr>
<tr>
<td>Relative costs to vessels &amp; imported cargo</td>
<td>C10</td>
</tr>
<tr>
<td>Multiple transportation infrastructures (road, rail way, airplane...)</td>
<td>C11</td>
</tr>
<tr>
<td>Deviation from main shipping line routes</td>
<td>C12</td>
</tr>
<tr>
<td>Port’s infrastructures</td>
<td>C13</td>
</tr>
<tr>
<td>Services without waiting time</td>
<td>C14</td>
</tr>
<tr>
<td>Authorized shipping lines schedule</td>
<td>C15</td>
</tr>
</tbody>
</table>

**2nd phase**

At 1st using Shannon entropy method, the known indexes earlier & with respect to their significance are weighted. Table 2 shows the dedicated weight per index.
Table 2. Dedicated weight per index

<table>
<thead>
<tr>
<th>Sub-indexes</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
<th>C9</th>
<th>C10</th>
<th>C11</th>
<th>C12</th>
<th>C13</th>
<th>C14</th>
<th>C15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>0.07</td>
<td>0.05</td>
<td>0.07</td>
<td>0.06</td>
<td>0.1</td>
<td>0.05</td>
<td>0.06</td>
<td>0.05</td>
<td>0.08</td>
<td>0.09</td>
<td>0.07</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
<td>0.07</td>
</tr>
</tbody>
</table>

After that BIK, Shahid Rajaee’s, Anzali & Amir Abad ports are ranked based on the mentioned indexes & using ORESTE method in the sub-rating steps.

Forming a superiority structure on options & indexes’ set

For rating purposes using this method, 1st of all there should be 2 superiority structures for the set of options & indexes. To establish the superiority structure for indexes out of the obtained weights we have used Shannon entropy method. Similarly, for the set of options & based on the indexes individually & by using the decision-making matrix’s data, the superiority structure as it is illustrated in table 3, is formed.

Table 3. Superiority structure of options & indexes’ set

<table>
<thead>
<tr>
<th>Indexes</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
<th>C9</th>
<th>C10</th>
<th>C11</th>
<th>C12</th>
<th>C13</th>
<th>C14</th>
<th>C15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amir Abad</td>
<td>6</td>
<td>6.5</td>
<td>4</td>
<td>5.76</td>
<td>7.18</td>
<td>7.69</td>
<td>6.98</td>
<td>7.1</td>
<td>6.89</td>
<td>3.13</td>
<td>7.9</td>
<td>6.93</td>
<td>8</td>
<td>7.8</td>
<td>7.5</td>
</tr>
<tr>
<td>BIK</td>
<td>7.5</td>
<td>8</td>
<td>5</td>
<td>6.7</td>
<td>8</td>
<td>8.33</td>
<td>8.4</td>
<td>8.6</td>
<td>7</td>
<td>3.2</td>
<td>8.66</td>
<td>8</td>
<td>8.3</td>
<td>8</td>
<td>8.5</td>
</tr>
<tr>
<td>Anzali</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>5.8</td>
<td>7.25</td>
<td>7.82</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>3</td>
<td>6.99</td>
<td>5.96</td>
<td>7.88</td>
<td>7.9</td>
<td>7.3</td>
</tr>
<tr>
<td>Shahid Rajaee</td>
<td>8</td>
<td>9</td>
<td>7</td>
<td>7</td>
<td>8.23</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>7.63</td>
<td>9</td>
<td>8.66</td>
<td>8</td>
<td>8.3</td>
<td>8</td>
<td>8.5</td>
</tr>
<tr>
<td>Weight</td>
<td>0.07</td>
<td>0.05</td>
<td>0.07</td>
<td>0.06</td>
<td>0.1</td>
<td>0.05</td>
<td>0.06</td>
<td>0.05</td>
<td>0.08</td>
<td>0.09</td>
<td>0.07</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Specifying the primary rating on the options- indexes set

By having the abovementioned relations & structures & using Besson average rating, the primary rating of the options & indexes is computed. Accordingly, no. 1-15 were given to index & the rk is formed. The mentioned processes are applicable for options, too. Table 4 presents the primary indexes & options.

Table 4. primary rating for options & indexes

<table>
<thead>
<tr>
<th>Indexes</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
<th>C9</th>
<th>C10</th>
<th>C11</th>
<th>C12</th>
<th>C13</th>
<th>C14</th>
<th>C15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amir Abad</td>
<td>3.5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>BIK</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Anzali</td>
<td>3.5</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Shahid Rajaee</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Projection of options’ intervals $d(o,m_k)$

By obtaining the primary levels for the set of indexes & options based on each index, we have used direct linear evaluation method for gaining the intervals. The evaluated intervals for all options & based on the indexes are presented in table 5.

Table 5. evaluated intervals for all options

<table>
<thead>
<tr>
<th>Indexes</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
<th>C9</th>
<th>C10</th>
<th>C11</th>
<th>C12</th>
<th>C13</th>
<th>C14</th>
<th>C15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amir Abad</td>
<td>3.76</td>
<td>10.41</td>
<td>4.55</td>
<td>6.60</td>
<td>3.19</td>
<td>11.19</td>
<td>7.34</td>
<td>11.93</td>
<td>3</td>
<td>2.59</td>
<td>4.95</td>
<td>8.00</td>
<td>8.78</td>
<td>9.57</td>
<td>5.69</td>
</tr>
<tr>
<td>BIK</td>
<td>3.30</td>
<td>10.33</td>
<td>4.23</td>
<td>6.38</td>
<td>1.65</td>
<td>11.12</td>
<td>7.16</td>
<td>11.91</td>
<td>2.59</td>
<td>2</td>
<td>4.82</td>
<td>7.95</td>
<td>8.74</td>
<td>9.52</td>
<td>5.59</td>
</tr>
<tr>
<td>Anzali</td>
<td>3.76</td>
<td>10.36</td>
<td>3.97</td>
<td>6.45</td>
<td>2.41</td>
<td>11.14</td>
<td>7.23</td>
<td>11.98</td>
<td>3.57</td>
<td>3.30</td>
<td>5.19</td>
<td>8.10</td>
<td>8.86</td>
<td>9.53</td>
<td>5.88</td>
</tr>
<tr>
<td>Shahid Rajaee</td>
<td>3.19</td>
<td>10.32</td>
<td>4.05</td>
<td>6.35</td>
<td>1</td>
<td>11.11</td>
<td>7.14</td>
<td>11.90</td>
<td>2.41</td>
<td>1.65</td>
<td>4.77</td>
<td>7.94</td>
<td>8.73</td>
<td>9.64</td>
<td>5.56</td>
</tr>
</tbody>
</table>

Aggregation phase

By obtaining $R(mk)$ for all the options of the indexes, the aggregating step should be taken; in other words, to be computed for all options that its amount equals the general sum of the computed $R(m)$ for each option regarding each index. Thus, $R(m)$ is shown for all options in table 7.

Table 7. Aggregation results

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shahid Rajaee</td>
</tr>
<tr>
<td>2</td>
<td>BIK</td>
</tr>
<tr>
<td>3</td>
<td>Amir Abad</td>
</tr>
<tr>
<td>4</td>
<td>Anzali</td>
</tr>
</tbody>
</table>

Comparing the results & specifying the top choice in ORESTE method

Finally to determine the top choice, we compare the aggregation results from the decision-making phase. In this section the less the total sum, the higher the rank will be. Thus, the final rating of ORESTE for decision-making options is as follows:

Shahid Rajaee < BIK < Amir Abad < Anzali port
CONCLUSION

The research was implemented bearing the intention of determining the effective factors in competitiveness rate of container ports & ranking BIK, Shahid Rajaee port, Anzali port & Amir Abad based on the competitiveness indicators using ORESTE & Shannon entropy methods in two phases. In the 1st phase by using Delphi method & studying the background of the research, the effective indicators in ports' competitiveness of the country were identified & in the 2nd phase by using the known indicators through entropy method & with regard to their importance were weighted & then the ports were ranked according to these indicators & ORESTE method. With respect to researches background & the results of Delphi method, 15 indicators were identified. The final ranking by ORESTE multi-criteria method for BIK, Shahid Rajaee port, Anzali & Amir Abad ports shows that Shahid Rajaee port at the final ranking of 430.5 enjoys the 1st rank, BIK with the final rank of 444.5 enjoys the 2nd rank, Amir Abad port with the final rank of 476.5 enjoys the 3rd position & finally Anzali port by little difference with the final rank of 478.5 enjoys the last position. The results showed that ORESTE method has high capacity in rating & one can use the so called method as an effective & accurate tool in marine transportation researches.

Suggestions

Since ORESTE, like some other methods to analyze the indifferences & inconsistencies among the rated options, has a few steps to be taken; the referred steps are included in ORESTE || method which can be beneficial for following studies.

ORESTE method to perform its evaluation step makes use of 3 ways. In this research to do so, we have used the direct linear evaluation method. Using the other 2 methods presents different results that comparing the computation’s results using the so called 3 methods can be regarded as a base for future researches & studies.

REFERENCES


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