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International Supplier Partner Selection – Using An MADM models

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Abstract

The paper concentrates mainly on international supplier partner selection problem and demonstrates how the MADM models, particularly TOPSIS method can be effectively used for partner selection decision in foreign market (especially Iran and Sweden companies). The result showed that, the Sweden's best suppliers are not necessarily the most appropriate partner for Iranian companies because the importance of effective criteria is not the same for two countries.

Keyword: International Supplier Partner Selection, MADM, Topsis

Introduction

Effective partner selection is regarded as one of the most crucial tasks in internationalisation. Manufacturing and sales companies have to be looking into sourcing the best suppliers and capturing the best opportunities in order to compete in the global economy. The selection of a good and reliable trading partner in a foreign market is one of the most difficult and challenging tasks. Furthermore, the choice of partners is bound to have a profound impact on the success on international endeavors (Patto, 2009). Multi Attribute Decision Making (MADM) is the well-known branch of decision-making. It is a branch of a general class of Operations Research (or OR), models which deal with decision problems under the presence of a number of decision criteria. This super class of models is very often called Multi Criteria Decision Making (or MCDM) (Triantaphyllou *et al*., 1998). On the other side, TOPSIS is a multiple criteria method to identify the solution from a finite set of alternatives. The basic principle is that the chosen alternative should have the shortest distance from the positive ideal solution and the farthest distance from the negative solution (Iravani *et al*., 2009). This method is simple and yields an indisputable preference order of solution (Hwang and Yoon, 1981).

This paper aims to use a numerical example to illustrate the process of the proposed MCDM method in international supplier partner selection context.

The paper is organised as follow. In the second section, the literature and in the third section, the proposed approach is discussed. A numerical example is provided in the next section. The paper is concluded in the fifth and the last section.

Literature Review

Some models have been used for international supplier partner selection in the past. Here, we will mention some of them.

Nielsen (2002) identified the relative importance of a set of selection criteria when selecting a partner for an international strategic alliance. Overby (2005) showed that appropriate partner selection criteria are dynamic and may involve allying with weak partners in the initial exploratory stage, with weak and/ or strong partners in the development stage and with strong partners in the maturity stage. Ghalami (2006) developed a model of supplier selection to support the contribution of suppliers in product development process, and eventually, developing a strategically integrated supply base for VOLVO Power train Corporation (VPT). The first part covers the theories emerging from a large number of stochastic studies concerning hypotheses proofing of relations between diverse aspects of hypothetical influential characteristics of partnership and its performance. And the second part deals with theory of suppliers association. The conducted

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survey shows that two-way communication and mutual trust are the most vital elements to partnership survival. Jiang and Tian (2009) analysed the implementation of global sourcing in Chinese manufacturing companies at various stages in order to identify and address the problems caused there in. the goal is to compare and contrast the experience of Chinese companies with that of western ones, to identify what problems are unique to the Chinese experience, and develop solutions accordingly. Patto (2009) examined what factors have an influence (driving forces) on using international sourcing, to develop a business model derived from these factors to seize the IS (International Sourcing) opportunity, and to find out what are the critical foreign supplier characteristics appreciated by internationalizing SMEs. Tektas and Aytekin (2011) used AHP and linear programming model to ranking an Australian and a Turkish company, to maximise the buyer's total value of purchasing through optimal order splitting among suppliers, respectively. The results indicate some structural differences in criteria prioritisations and decision making habits of the two companies. Deldoost and Faizollahi (2011) concentrate mainly on seller selection problem or in some cases it also refers to vendor or supplier selection problem (SSP) and demonstrates how the Multiple Attribute Decision Making (MADM) methods can be effectively used for vendor selection decision in various situations of project management and supply chain environment. A case study has been carried out within two different countries (Sweden and Iran) in order to help practically managers to choose the best alternatives among their preferences. In addition, Ref.12 (Global-production.com, Inc Report, 2008) helped the reader decide on where to locate ones business by helping identify sourcing strategy, structured approach, analyze the locations competitiveness, and gain insights to location advantages.

This paper focused on the application of a MCDM models; particularly TOPSIS method, for solving an international supplier partner selection problem. In the next section, the proposed method will be considered.

Proposed Approach

Hwang and Yoon (1981) developed the technique for order preference by similarity to ideal solution (Topsis) based upon the concept that the chosen alternative should have the shortest distance from the ideal solution and the farthest from the negative ideal solution. Topsis assumes that we have m alternatives (options) and n attributes/ criteria and we have the score of each option with respect to each criterion. Let x_{ij} score of option i with respect to criterion j. we have a matrix $X = (x_{ij})_{m.n}$ matrix. Let J be the set of benefit attributes or criteria (more is better). Let J' be the set of negative attributes or criteria (less is better). The idea of Topsis can be expressed in a series of steps (Tayeb et al., 2007):

Step 1: Obtain performance data for n alternatives over k criteria. Raw measurements are usually standardised; converting raw measures x_{ij} into standardised measures s_{ij}. Construct normalised decision matrix. This step transforms various attribute dimensions into non-dimensional attributes, which allows comparisons across criteria. Normalise scores or data as follows:

$$r_{ij} = X_{ij} / \sqrt{\sum_i X_{ij}^2} \text{ for } i = 1, \ldots, m; j = 1, \ldots, n.$$

Step 2: Develop a set of importance weights wk, for each of the criteria. The basis for these weights can be anything, but usually, is ad hoc reflective of relative importance. Scale is not an issue if standardizing was accomplished in step 1. Construct the weighted normalised decision matrix. Assume we have a set of weights for each criteria wj for j = 1, …, n. multiplies each column of the normalised decision matrix by its associated weight. An element of the new matrix is:

$$V_{ij} = w_j r_{ij}$$

Step 3: Determine the ideal and negative ideal solutions.

Ideal solutions:

$$A^* = \{v_1^*, \ldots, v_n^*\}, \text{ where}$$

$$V_j^* = \{\max_i (v_{ij}) \text{ if } j \in J; \min_i (v_{ij}) \text{ if } j \in J'\}$$

Negative ideal solutions:

$$A' = \{v_1', \ldots, v_n'\}, \text{ where}$$

$$V_j^* = \{\min_i (v_{ij}) \text{ if } j \in J; \max_i (v_{ij}) \text{ if } j \in J'\}$$

Step 4: Calculate the separation measures for each alternative. The separation from the ideal alternative is:

$$S_i^* = [\sum_j (v_j^* - v_{ij})^2] \wedge^{1/2} \quad i = 1, \ldots, m.$$

Similarly, the separation from the negative ideal alternative is:

$$S_i' = [\sum_j (v_j' - v_{ij})^2] \wedge^{1/2} \quad i = 1, \ldots, m.$$

Step 5: Calculate the relative closeness to the ideal solution C_i^*:

$$C_i^* = S_i' / S_i^* + S_i' \quad 0<C_i^*<1$$

Step 6: Rank order alternatives by maximizing the ratio in step 5. Select the option with C_i^* closest to 1.

Numerical Example

In some cases, there is no possibility of providing the local and national supplier partnership. Therefore, to demonstrate the application of the proposed approach in international supplier partner selection context, we use the partially data set (Table 1) from Deldoost and Faizollahi (2011).

Table 1: Comparison of Sweden and Iran supplier evaluations criteria

Criteria	*Swedish evaluation*	*Iran evaluation*
Performance of supplier	Top priority	Extreme importance
Geographical location	Average importance	Top priority
Reputation	Considerable importance	Considerable importance
Financial status	Average importance	Extreme importance
Price and cost	Considerable importance	Average importance
Technical capability	Extreme importance	Average importance
Quality system of supplier	Slight importance	Slight importance

Ref. Deldoost and Faizollahi, 2011, p. 42.

The decision matrix (Table 3) of the international supplier partner selection problem, after the quantification of no numerical attributes (Table 1) with interval scale (Table 2) is:

Table 2: The used Scale in the Study

Slight importance	1
Average importance	3
Considerable importance	5
Extreme importance	7
Top priority	9

Table 3: Transformation of Attribute Matrix

criteria	*Swedish evaluation*	*Iran evaluation*
Performance of supplier (C_1)	9	7
Geographical location (C_2)	3	9
Reputation (C_3)	5	5
Financial status (C_4)	3	7
Price and cost (C_5)	5	3
Technical capability (C_6)	7	3
Quality system of supplier (C_7)	1	1

To determine the weights of the criteria, a simple method was used. To consider the criteria importance, one classifies them at least importance to most important. To the least important criterion, one gives value 1, with the second value 2 and with the third value 3. Then, standardizes the values obtained while dividing by the sum (Tayeb *et al*., 2007). The weights for the various criteria's were obtained from transformation of attribute matrix (Table 3) and are shown therein Table 4.

Table 4: The Criteria Weights

Criteria / Country	(C_1)	(C_2)	(C_3)	(C_4)	(C_5)	(C_6)	(C_7)
Sweden	0.250	0.100	0.150	0.100	0.150	0.200	0.050
Iran	0.190	0.238	0.143	0.190	0.095	0.095	0.048

As seen from Table 4, performance of the supplier is the most important criteria for Swedish companies whereas a geographical location criterion plays the most considerable role for Iranian company in supplier selection process.

Now assume, there are five alternatives (Swedish supplier partner; S_1, S_2 … S_5) and seven criteria (as noted earlier; C_1, C_2 … C_7). The performance values of the alternatives under these seven criteria are shown in table 5.

1. Calculate the normalised decision matrix

$$r_{ij} = \begin{vmatrix} .287 & .228 & .499 & .325 & .080 & .325 & .137 \\ .670 & .380 & .499 & .325 & .559 & .455 & .962 \\ .096 & .532 & .499 & .325 & .559 & .585 & .137 \\ .479 & .648 & .071 & .585 & .239 & .065 & .137 \\ .479 & .228 & .499 & .585 & .559 & .585 & .137 \end{vmatrix}$$

2. Calculated the weighted decision matrix (for Iran case, as earlier calculated (table 4), W_j =.190, .238, .143, .190, .095, .095, .048). The weighted decision matrix is then:

Table 5: Decision Matrix

Criteria / Swedish supplier	(C_1)	(C_2)	(C_3)	(C_4)	(C_5)	(C_6)	(C_7)
S_1	3	3	7	5	1	5	1
S_2	7	5	7	5	7	7	7
S_3	1	7	7	5	7	9	1
S_4	5	9	1	9	3	1	1
S_5	5	3	7	9	7	9	1

Note that all attributes except C_5 are the benefit criteria.

$$V_{ij} = \begin{vmatrix} .055 & .054 & .071 & .062 & .008 & .038 & .007 \\ .127 & .090 & .071 & .062 & .053 & .043 & .046 \\ .018 & .127 & .071 & .062 & .053 & .056 & .007 \\ .091 & .163 & .010 & .111 & .023 & .006 & .007 \\ .091 & .054 & .071 & .111 & .053 & .056 & .007 \end{vmatrix}$$

3. Determine the ideal and negative ideal solutions

$A^* = \{v_1^* \ldots v_n^*\}$; where, $V_j^* = \{\max(v_{ij})$ if j ε J; $\min(v_{ij})$ if j ε J'$\}$

$A^* = (.127 \quad .163 \quad .071 \quad .111 \quad .008 \quad .056 \quad .046)$

$A' = \{v_1' \ldots v_n'\}$; where, $V_j^* = \{\min(v_{ij})$ if j ε J; $\max(v_{ij})$ if j ε J'$\}$

$A' = (.018 \quad .054 \quad .010 \quad .062 \quad .053 \quad .006 \quad .007)$

4. Calculated the separation measures

$S_i^* = [\sum_{j=1}^{7} (v_j^* - v_{ij})^2] \wedge 1/2 \quad i = 1, 2, 3, 4, 5.$

$S_1 = .143, S_2 = .099, S_3 = .135, S_4 = .089, S_5 = .125$

$S_i' = [\sum_{j=1}^{7} (v_j' - v_{ij})^2] \wedge 1/2 \quad i = 1 \ldots m.$

$S_1 = .088, S_2 = .137, S_3 = .107, S_4 = .143, S_5 = .118$

5. Calculated the relative closeness to the ideal solution

$C_1^* = S_1' / S_1^* + S_1' = .088 / (.088 + .143) = .380$

$C_2^* = .579 \qquad C_3^* = .442 \qquad C_4^* = .615 \qquad C_5^* = .486$

6. Rank the preference order. According to the descending order of C_i^*, the preference order is:

$S_4 > S_2 > S_5 > S_3 > S_1$

The computation for Swedish case is not repeated here. The Swedish result is:

$C_1^* = .493 \quad C_2^* = .674 \quad C_3^* = .433 \quad C_4^* = .469 \quad C_5^* = .613$

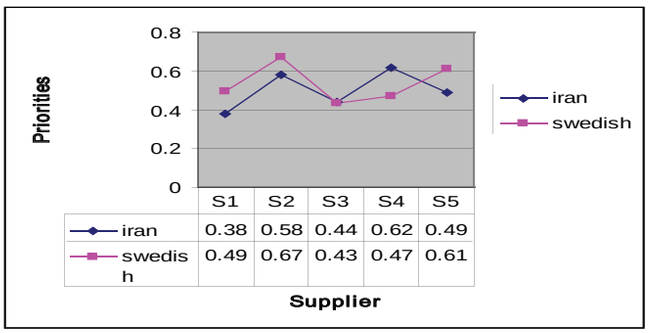
$S_2 > S_5 > S_1 > S_4 > S_3$

A comparison of the test results is given in Table 6 and Figure1.

Table 6: Comparison Results for Iran and Sweden

Priority / Country	Results
Iran	$S_4 > S_2 > S_5 > S_3 > S_1$ .615 .579 .486 .442 .380
Swedish	$S_2 > S_5 > S_1 > S_4 > S_3$ .674 .613 .493 .469 .433

Figure 1: Comparison results for Iran and Sweden



As seen from Table 6 and Figure 1, a supplier who is perfect for one country (Swedish companies) is not necessarily a suitable choice for another (Iranian companies). Since, it seems likely that this issue is one that could be subject to conflict. Because, it is apparent that S_4 receives the highest score based on the Iranian companies perspectives and thus performs better than the others. On the contrary, S_4 is the worst supplier in the Swedish company's perspective. Meanwhile, S_4 is the

worst supplier in the Sweden company's perspectives, but is the best partner for Iranian companies because of better coverage criteria considered Iranian companies.

Concluding Remarks

The paper concentrates mainly on international supplier partner selection problem and demonstrates how the MADM models can be effectively used for partner selection decision in foreign market. The results indicated that, a supplier who is perfect for one country is not necessarily a suitable choice for another. In addition, the result implicitly shows the MADM is an effective approach in dealing with this kind of decision problem. Since, to increase your chances of finding an appropriate foreign partner for your companies, we suggest using the proposed models in this paper.

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