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Using Degree of Adaptive (DOA) Model for Partner Selection in Supply Chain

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Abstract**—**In order to reduce cost, increase quality, and for timely supplying production systems has considerably taken the advantages of supply chain management and these advantages are also competitive. Selection of appropriate supplier has an important role in improvement and efficiency of systems.

The models of supplier selection which have already been used by researchers have considered selection one or more suppliers from potential suppliers but in this paper selecting one supplier as partner from one supplier that have minimum one period supplying to buyer is considered.

This paper presents a conceptual model for partner selection and application of Degree of Adoptive (DOA) model for final selection.

The attributes weight in this model is prepared through AHP model. After making the descriptive model, determining the attributes and measuring the parameters of the adaptive is examined in an auto industry of Iran(Zagross Khodro co.) and results are presented.

Keywords**—**Partnership, Degree of Adaptive, AHP, Supply Chain.

I. Introduction

WITH implementing of supply chain management and system approach towards material and part supply, the necessity of continuation of relationships between producer and supplier, specially in long run, became more apparent. Therefore, researchers and mangers tried to make appropriate and quantitative models for right supplier selection and creation of long run relationships. This effort has lead to "supplier selection procedures".

This procedure was simultaneous with just in time supply and is basically one of its requirements.

In this situation, parts and materials were delivered to producer with better quality and lead time, but there was a significant problem with the efficiency and effectiveness of supply procedure[1].

After developing "Lean Production" and because of the needs of this production and also implementation of "Reengineering and Value Engineering Methods, a new subject evolved called "Lean Supply" that considered long run relationship and longer relationship together with reduction of waste and supply efficiency improvements. However, one problem still remained that was the slow reactions of producer to demand change and customer's needs[2].

In other words, the problems is the response to customer's needs and the ability of fast reactions to demand and even faster them competitors. This problem was essentially related to slow procedure of supply chain.

In late 1990's, a new approach was created to solve the problem of slow supply procedure.

The name of this approach was "Implementation of business Partnership, Participation and Coalition in Supply Chain" that considered issues like "Participation in Design and Development" as well as previous issues.

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II. Research Objectives

A. Presentation of a Conceptual Model for Selecting a Supplier as Partner in Supply Chain in One from One Condition

B. The Implementing and Analysis of DOA Models for Partner Selection

III. Partnership and Attributes of Selecting

Partnership was introduced after Lean Production, and in Lean Supply but the concept of partnership as an ideal relationship was proposed by Ellram [3]and in 1996, under the same topics by Lambert [4] From 1990 to 2000, fundamental researches in partnership has been conducted by Lamming and Lambert, studying Lean Supply.

In supply chain, price, cost and Lead time have been considered as the most important criteria of relationship but recent approaches are also considering competitive advantages and consequently speed and flexibility were considered too[5]. Therefore, if success in competition is concerned, the market and customer's needs should be satisfied as fast as possible. In business partnership mutual planning of strategies, product among partners and their simple implementation have been considered. As well as performing operations, the flow of information and materials, marketing and fulfilling the needs by deleting interruptions[6,p.78].

Lean and Agile Production being introduced, shortening the time of designing to manufacturing is concerned, but mere appropriateness of production policies and their internal flexibilities in manufacturer (purchaser) is not enough.

IV. Research Model

By Studying the references and according to the researches, the conceptual and descriptive model of partner selection is made in one of one case.[7],[8].

The process of this research follows as:

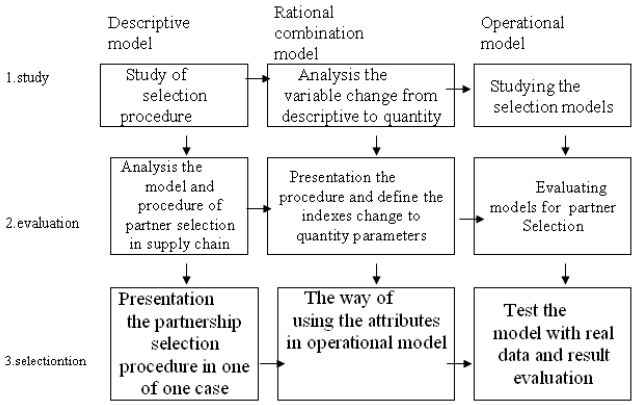

Fig. 1 Research Model

TABLE I
DESCRIPTIVE MODEL

steps	Sub step	Iteration
I before the final partner selection	Attribute and criteria for partner selection	1. Determine the strategic and operation goods 2.determine the goals achieving producers 3.determine and introduce the attribute 4.relation steps from 1 to 4
II Data collective	Determining the rank and the weights and supplier analysis	1.List the attributes in step I 2. Determine weight and important of the attributes
III operation analysis and selection	Supplier operation in premier selection	1. Determining Acceptable measures for selection. 2.Solve the DOA model with the attributes and Criteria 3. Analysis the results.

As it is determined in descriptive model, after defining the selection attributes and criteria, the standard or acceptable condition are determined by the buyers, in this research they are called producers.

V. USING DOA MODEL

A. Attributes in Model

In Table II there are acceptable attributes for partner and supplier selection that have issued in the most of references.

B. Adaptive Model for Selection

The adaptive model for partner selection measured the xi to the standard or to the acceptation parameters (Yi).

X_i: The parameter of model which are the attributes of table-2

Y_i: The decision – maker's minimum acceptation for parameters

TABLE II
THE IMPORTANT INDEX IN MODEL

ROW	Attribute
1	Reliance and commitment
2	Quality in the Operation period
3	On Time Delivery
4	Relations and information exchange
5	Coordination and planning condition
6	Flexibility and change
7	Engineering and design power
8	Cooperation in logistics
9	Financial strength
10	Distance
11	Production capability
12	Capability & Technology
13	Interesting in partnership
14	Experts

C. Determination of Attributes Weights

The criteria weight in this model is prepared through AHP model of course, the managers, and responsibilities ideas of supply component parts, logistics, parts suppliers, planning unit and production control unit in Zagros Khodro Co. have been analyzed. The weights are considered from to the below formula will determined the relations and cooperation for supplier.

$$RV_{ij} = \frac{\sum_k \sum_i W_{ki}^R E^R kij}{\sum_k \sum_i W_{ki}^R} \; j = 1,\ldots,n$$

W: attributes weights
E: attribute value in supplier
i: product
j: supplier
k: required attribute

$W_{1I}^R = 3.5$ The attribute of reliance and commitment bilateral view with 3.5 weight from 10

$W_{2I}^R = 2.5$ The attribute of relation and information exchange with the weight 2.5 weight from 10

$W_{3I}^R = 1.5$ The attribute of Cooperation in logistics with the weight 1.5 from 10

$W_{4I}^R = 1$ Planning and coordination condition with
The 1 weight from 10

$W_{SI}^R = 1.5$ Interesting degree to cooperation with 1.5 weights from 10

$\sum W_{ki}^R = 10$

Example:

$$RV_{ij} = \frac{\sum_k \sum_i W_{ki}^R E^R kij}{\sum_k \sum_i W_{ki}^R} \; j = 1,\ldots,n$$

$$RV_{ij} = \frac{3.5(E_{ilj}^R) + 2.5(E_{2ij}^R) + 1.5(E_{3ij}^R) + 1(E_{4ij}^R) + 1.5(E_{5ij}{}^R)}{10}$$

Using the pair comparison and AHP model, the weight of every attribute in engineering and technology are determined.

The attribute of design and power with 3.8 weight from 10

$W_{1i}^T = 3.5$

The attribute of expert with 1.5 weight from 10 $W_{2i}^{T} = 3.2$. The attribute of flexibility and change with 1.5 weight from 10 $W_{3i}^{T} = 3.3$

$$TVij = \frac{\sum_{k=1}^{l}\sum_{j=1}^{m} W^{T}{}_{ki} E^{T}{}_{kij}}{\sum_{k=1}^{l}\sum_{j=1}^{m} W_{ki}} \quad , \quad j = 1,..n \text{ T}$$

$$TV_{ij} = \frac{3.5(E^{T}{}_{ij}) + 3.2(E^{T}{}_{2ij}) + 3.3(E^{T}{}_{3ij})}{10} \quad \text{Supplier}$$

finance capability, strength and geography distance from supplier to producer, there are criteria that have less rank.

$$F_{ij} = \frac{\sum_a \sum_i V^{f}{}_{ki} E^{f}_{kij}}{\sum_k \sum_i VK_i^{f}} \quad j = 1,2,..., n$$

In this research finance capability is taken from properties and heavy machineries and finance ratio. The capacity is the capability and operation capacity of supplier in supplying period and geography is exactly the distance of supplier based on km.

D. Data Collection for Testing the Model

The model test for(1) Exhaust and (2)fuel tank parts which every one has supplier A,B whit operation in at least one period with zagros khodro co (Buyer). The suppliers with their related information and measured attributes are recorded in Table III.

TABLE III
THE SUPPLIER POSITION IN ATTRIBUTES

ROW	Supplier B	*Supplier A*	Attribute
1	4 average	6 good	Lead time
2	4 average	6 good	Quality and standard maintenance
3	7 good plus	8 excellent	Capability and supplier technology
4	6 good	8 excellent	Innovation in design and logistics
5	8 excellent	8 excellent	Flexibility and change
6	4 Average	5 good minus	Cooperation in logistics
7	5 good minus	7 good plus	Finance strength
8	7 good plus	8 excellent	Interesting in partnership
9	7 good plus	8 excellent	The information and relation exchange level
10	3 low	7 good plus	Commitment and bilateral view
11	5 good minus	6 good	operational coordination and planning
12	7 good plus	7 good plus	Experts
13	having necessary capacity	More than demand	Production capacity
14	350 km	200 km	Supplier distance

The standard and measures of zagros khodro is presently in Table III.

TABLE IV
ZAGROS KHODRO ACCEPTABLE MEASUREMENTS FOR PARTS

ROW	Acceptable measurements for Exhaust part	Max.Acceptable measurements for Fuel tank Part	Attribute
1	≥ 7	≥ 7	Relation value
2	≥ 6	≥ 6	Technology value
3	≥ 6	≥ 6	Finance strength
4	<400 Km	<400 Km	Geography distance

Cooperation value and suppliers relations are accounted from this formula. For example considering the Tables III, IV RV is:

$$R_{V\,ij} = \frac{3.5(7) + 2.5(5) + 1.5(8) + 6 + 1.5(8)}{10} = 6.7$$

The remained attributes are lead time, quality, capacity, and geography.

According to the AHP conclusion, the quality, because JIJ in IRAN, and also because the warehouse are near to the producers we don't consider the geography distance in this model.

So with the criteria from 1 to 5 the model is accounted.

The acceptable standard measurement, for zagros khodro as in Table VI is determined.

TABLE V
THE RESULTS OF MULTI-INDEXES CRITERIA

Suppliers	Finance Strength	Technology Value	Relation Value
A	7	7.53	6.7
B	7	6.9	4.65

TABLE VI
MINIMUM AND MAXIMUM OF CRITERIA VALUES

	Maximum Acceptable measures(M)	Minimum Acceptable measures(S)	Criteria
1	10	7	Relation value
2	10	7	Quality
3	10	6	On Time Delivery
4	10	6	Technology
5	10	6	Finance strength

Of course the criteria importance to decision makers aren't the same ones – so the weight (Wi) is added to the model the degree of the adaptive is calculated as fallow:

$$DOAs = \sqrt{\prod_{i=1}^{m} (Xi / Yi)^{wi}}$$

Xi: suppliers' criteria
Yi: max of amount
Wi: criteria weight

The following is the wi (criteria weight) in a pair-comparison among the criteria as tables from 1 to 5. This is

supplied from manager of supply quality and planning in Zagros Khodro.

W1= 38% w2=25% w3=20% w4=11% w5=6%

$$DOA_s = \sqrt{\left(\frac{7}{10}\right)^{38\%} + \left(\frac{7}{10}\right)^{25\%} + \left(\frac{6}{10}\right)^{20\%} * \left(\frac{6}{10}\right)^{11\%} + \left(\frac{6}{10}\right)^{6\%}}$$

$$DOA_s = 0.812$$

$$DOAs \le DOAt \le DOAm$$

So DOAt as adaptive amount for supplier must be between:

DOAs≤ DOAt ≤DOAm

.812<DOAt<1

For every criterion from 1 to 5 adaptive must be between following limits. Acceptable adaptive for every criteria is determined by the accepted limits and comparing it with maximum of that criteria.

For example, for first criteria, standard limit is 7 and its maximum is 10 therefore:

$$DOA_1 = \sqrt{\left(\frac{7}{10}\right)^{38\%}}$$

$$DOA_1 = 0.93$$

0.93<DOA1<1
0.95<DOA2<1
0.95<DOA3<1
0.97<DOA4<1
0.98<DOA5<1

Amount DOA of supplier A is 80% which is lower than, 82% (MinimumAcceptablemeasure). This unacceptability is caused from the first attribute which adaptive degree of that is 92%, in fact, it must be at least 93% .the 4,5 criterion are more than what we want, but, because of the weight of first criteria, 38%, the adaptive is at least.

TABLE VII
CRITERIA EVALUATION OF SUPPLIERS

		Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria5
1	Standard	0.93	0.95	0.97	0.95	0.95
2	A	0.92	0.93	0.95	0.98	0.99
3	B	0.865	0.89	0.91	0.98	0.9

In supplier B the 1, 2, 3 criteria D to which the sum of their weight is 87% are as the expected demand.

For both the DOA is accounted. The DOA of a company is:

$$DOA_{TT} = \sqrt{\left(\frac{6.7}{10}\right)^{\%38} * \left(\frac{6}{10}\right)^{25\%} * \left(\frac{6}{10}\right)^{20\%} * \left(\frac{7.53}{10}\right)^{11\%} * \left(\frac{7}{10}\right)^{6\%}}$$

$$DOA_{TT} = \sqrt{.6407}$$

$$DOA_{TT} = 80\%$$

VI. CONCLUSION

After making the descriptive model, determining the criteria and measuring the parameters of the adaptive is examined and results are as follows.

Amount range of DOA is between 0 and 1, the acceptable limit must be determined by buyer company. Upper limit of DOA is 1 which is introduced as with (DOA max) and the lower one which is introduced with (DOAs) or (DOA standard) is the least condition that producers accepted for suppliers so:

DOAS<DOAt<DOAm

The DOA is adopted from the attributes and their standards.

So if one of the attributes that have less weight for example %2 with zero amount will accurse DOA will be zero, so to solve this problem amending models are needed. In this research we determined that the suppliers have no zero condition for any attributes.

The attributes at this research are:

1) Partnership value, 2) Lead time, 3) quality,4) Design capability , 5)Finance strength , every attributes is considered between 1 to 10 so there is no problem with this model , also the model is

After examining we fined that the suppliers haven't conditions for making partnership.

In this case, the attributes have evaluated , so one of the suppliers instead of %93 has make the value 92%, but because partnership value (the attribute weight) is 38% of the whole, The adoption is effected completely.

We find that attributes of: information exchange, relationship and cooperation for solving the problems are below the standards, because of dependency of these attributes to internal and external organizational condition. For example, government support in electronic data interchange (EDI) or contracts in transmit loading and insurance, will decline the cooperation and information exchange between supplier and producer. In other hand, after negotiating with producer, we can consider some of attributes for developing the suppliers for achieving partnership conditions.

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