

## Supplier segmentation using fuzzy preference relations based AHP (Case study: Fouman Shimi)

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**Abstract :** One of the strategic activities of a firm is supplier segmentation, whereby a firm creates groups of suppliers to handle them differently. This Research goal is Segmentation of Suppliers in Fouman Shimi Company. For this purpose 10 managers and supervisors were studied as a Final Sample of study. To analyze the data collected, Fuzzy AHP method by expert choice software was used. the results of this study showed that, Supplier 1(Tolid Gostaresh Company and Supplier 3 (Padine Company) with a significant difference compared to other, are the best Suppliers of Fouman Chime company.

**Keywords:** Supply chain, fuzzy analytic hierarchy process, fuzzy logic, fuzzy multi-objective planning

### Introduction

Suppliers are supplement part of the process of supply chain in an organization and management of suppliers due to the reason that they are not counted as part of an organization need expertise skill in negotiation. Suppliers should be chosen correctly because they can create a lot of positive effect in general performance of an organization. Different research denotes that problems related to product quality in organizations are resulted from deficient raw materials. Accuracy in choosing competitive suppliers can cause minimizing destructive effect and in fact increasing positive effect on quality of output of an organization (Ramanathan, 2007). Therefore choosing proper supplier is vital part of structure of an organization.

### Literature review

#### Classification of suppliers

In marketing area classification of market of industries points usually aspect of supply of a market. The goal of a company is that to classify groups of potential customers with similar demands that are proper with market combination. When companies work with suppliers having different potentials, classification of aspect of demand has the same value. In recent two decades by applying concept of supply chain management at industries, the subject of choosing supplier has attracted much attention and different identification methods have been presented for it. Since raw material and particles devote the most important section of cost of a company correct shopping management has significant importance in efficiency, effectiveness and profitability of an institute. On the other hand nowadays regarding new concepts of supply chain management and similar cases that causes creating participation with suppliers and close

relations of a company with suppliers, suppliers and customers are not known as competitors of the organization but they are members of a main set with the name of supply chain that the goal of each one is maximizing profit and increasing utilization of the whole chain. Therefore it is totally obvious that making decision about choosing supplier has significant role at production and logistics management of factories and many experienced companies believe that choosing supplier is counted as the most important activity of an organization. Also since performance of suppliers has fundamental effect on success or failure of a chain now choosing supplier is known an strategic duty. Therefore incorrect decision-making in choosing supply chain will lead to negative consequences and many losses for the company; so regarding mentioned cases considering and applying new concepts in choosing suppliers seems necessary(Olsen and Ellram, 1997).

The goal of choosing is identifying suppliers with the highest potentials for solving needs of a company with acceptable cost (Kaufman et al, 2000). Generally in decisions related choosing suppliers two subjects have importance. One is what criteria should be used and another that what methods should be applied for comparison of suppliers. Analysis of these two subjects at choosing supplier is attention to many university educators and managers of shopping since 1960. The first research about this subject was done by 1962. He presented 23 criteria for suppliers and ranked it based on the importance' that its result has been shown in table 1. New criteria in papers related to choosing suppliers have been presented since 1994 that some of them are development of primary criteria of Dickson and some other have been created by development of philosophy of management' as two criteria of delivery and quality are identified as

important criteria of choosing and designing and development of product and flexibility are two criteria that have been mentioned in related literature by development of supply chain management newly(Weber et al, 1991).

The reality is that different research use different criteria for distinguishing classes and sectioning suppliers that are usually more than two criteria; in other word the problem of classification is in fact a multi-criteria problem. Recently Rezaei and overt in a review discussed this subject that suggested a framework for classification of criteria in different classes of suppliers in two dimensions: capabilities and attitudes of suppliers. This framework in which suppliers and criteria of choosing both variables have been supposed has benefits such as:

1- it makes possible multiple criteria whereas most methods are only based on two criteria

2- Provide reasonable basis for collection of different criteria

3- it gives sufficient field for classification of suppliers by using Matrix 2\*2 and so the result of matrix is more comprehensive than other methods because dimensions have been established based on multiple criteria.

In the research different framework has been done for suppliers: capabilities and capacities of suppliers and attitudes of suppliers by distinct buyer for applying in an strategic and effective participation with suppliers regarding business operations and activities that is implemented in a supply chain. Any buyer may seem different criteria of capability and attitude for assessment and classification of suppliers(Rezaei & Ortt, 2013).

Table 1.Dickson criteria for choosing supplier of Dickson (weber et al, 1991)

Rank	Criteria
1	quality(ability of any supplier for achieving qualitative features)
2	time of delivery(ability of any supplier for achieving time of delivery)
3	historical record of performance
4	policies of guarantee and paying damage
5	installments and capacity of production
6	Price
7	technical ability(including facilities for research and development)
8	financial situation of company
9	compatibility with process of purchaser(accepting approach and instruction of purchaser by supplier)
10	communicative system
11	situation at industry between competitors
12	tendency to trade
13	management and organizing
14	operational control(including reporting, quality control and reservoirs control system)
15	after sale service
16	the way of confrontation of seller with an organization
17	our speculation of seller
18	ability of pacing(ability of each supplier for achieving required packing of product)
19	record of working relation
20	geographical situation
21	Business record
22	educational plans(existence of educational assistance for product by supplier)
23	Mutual relationship

**Techniques of choosing supplier**

Weber et al have classified quantitative approach for choosing supplier in three groups: linear weight model, models of planning mathematic and statistical /probable approach(Weber et al, 1991).

**A-linear weight model**

In these models a weight (that is usually determined mentally) is given to each criterion that the highest weight shows the highest importance. Rank of any criteria is multiplied in its weight and then for achieving a united shape for each supplier result is collected with each other's. Therefor supplier is chosen with the highest general rank. These models include

methods like AHP, ANP and multiple-attribute utility approach (Kalafatis & Cheston, 1997).

### **B- Mathematic planning model**

Models of mathematic planning provide the possibility of setting the problem of decision-making based on function of mathematic goal for decision-makers. Based on number of functions of goal, the process of choosing suppliers can be divided into two groups: 1- model of mathematic planning of a goal 2- multi-purpose mathematic planning model. Most researchers apply single-goal technique such as mixed or integer planning in which a criteria- usually-cost- is seemed as target function and other criteria are counted as limitations. Most one-way model are applied for minimizing collection of cost of shopping, cost of inventory and order cost but in multiple goals method researcher is going to achieve some criteria simultaneously that some target functions are presented in the form of maximized or minimized (Wang et al, 2007).

### **C- Statistical models**

These models are applied in conditions of random uncertainty in selection. Most existing statistical models at any time seem only uncertainty related to a criteria and some choices are chosen that have the highest expected effectiveness (Bensaou, 1999).

In this research a combined method are used for assessment and choosing suppliers along supply chain that includes method of fussy hierarchical analysis process and classification in a matrix of  $2 \times 2$ .

### **Fuzzy analytic hierarchy process**

Methodology of FAHP has been established based on theoretical concept of fuzzy set-that was presented by professor lotfizadeh in 1965. The process of FAHP, develops <<watch>> AHP in the aspect of its combination with theory of fuzzy set. In Fuzzy AHP, after creating hierarchy structure for a problem that should be solved, in order to show relative importance of factors corresponding with criteria fuzzy relative scales are used. Therefore a matrix of Fuzzy judgment is made, final scores of choices are presented by fuzzy numbers and optimized choice are obtained in the view of ranking fuzzy numbers by using specific arithmetic operators (Duran & Aguilo, 2008).

### **Research Background**

Gabala was the first researcher who applied mathematics planning for choosing supplier in a real case in 1974. He used mind planning of one-goal integer for minimizing total shopping, inventory cost

and transportation-by considering some items, sometime range, quality, delivery and capacity (Van Weele, 2000).

Parashormen (1980) considered some-step approach. The first step: identification of the key future of customer classification. Second step is identification of critical features of suppliers. third step: choosing dependent variables for classification of suppliers and fourth step is identification of classes of suppliers (Parasuraman, 1980). Cralgic (1983) seems two variables of profit coefficient and supply risk for classification of suppliers. By using these two variables suppliers are classified in 4 sections. 1-non-critical items (low-shopping risk, low profit coefficient) 2-leverage items (low shopping risk, high profit coefficient) 3- bottleneck items (high shopping risk, low profit coefficient) 4- strategic items (high shopping risk, high profit coefficient). Any section of this grouping needs strategy of confrontation with its specific supplier (Kraljic, 1983). "obrin and Ghodsipour" in 1997 created a system of supporting decision for reducing number of suppliers-based on strategy of optimizing location of supply. They used a process of hierarchical analysis with mixed planning of integer and seemed limitation of budget and quality of buyers. In another research they presented a combined model of AHP and linear planning for helping managers about choosing suppliers in 1998 that counts both quantitative and qualitative factors in shopping activity (Amid et al, 2006). Weber et al in 2000 used a combined optimizing approach including multipurpose planning and DEA approach (Weber et al, 1991). In this approach firstly multi-purpose planning was used for choosing suppliers and then for assessing efficiency of selected suppliers based on some criteria DEA approach was used. Dohol presented an approach of planning of multi-purpose combined integer that simultaneously determined number of suppliers and amount of especial orders to each one at the environment of finding source of multi-source with some products. Shu sin liav and yen Zhu Chen (2004) in this paper customer classification is used for internet marketing and designing internet catalogues in order to increase direct and internet sale that present advertisement and information of product through telephone and private internet networks (media). Classification is done through designing relations based on data and information of customers (Liao & Chen, 2004). Wang et al in 2005 designed a method of decision-making for supply chain that enables manager of the factory for choosing proper supplier. In this methodology AHP technique and ideal planning have been used (Wang et al, 2007). Soman Malik and Dilip Chajed (2006) in this paper considered strategy of assessment of quality in confrontation with methods of

customers shopping at different times. Three parameters are considered for grouping choices in order to do the best choices, saving cost, changing customer's assessment and management of costs in this model (Mallik & Chhajed, 2006). Gabor poler Valen Dick (2006) in this paper a home model of profit was created for having the highest profit in the chain of distributing food by marking and enhancing valuable customers. This sectioning includes 1: analysis of classification of houses by using loyalty cards and dynamic data 2: price and analysis of flexible discounts 3: assimilation of the effect of price and discount 4: price and optimized discount for the highest profit (Pauler & Dick, 2006). Chan chu et al(2006) in this paper classification of customers are used for identification and forming excellence matrix of internet service so that customers are considered (Chen et al, 2006). Michael Zhang and Piterbel(2007), in this paper classification of market is used for determining price in different classes. By this classification we can determine separate prices in each class and prevent identifying unfavorable demands(Zhang & Bell, 2007).

Krik Johnson (2007) in this paper classification of internet services presented by government into two sections of service of government to citizens and service of government to trade for correct presentation and choosing correct strategy of pricing. Result of this classification is increasing additional income of government and customers(Johnson, 2007). Elsandrobern and Sisilia Kastli(2008) in this paper tree classification method was used for sectioning concentrated projects in supply chain and strategies of classification has been established based on 3 axis of famous products, brand and channels of distribution(Brun & Castelli, 2008). Selik et al(2009): used a combined method in comparison with a state that the problem of choosing supplier is solved only with AHP model, has more adaption worth reality and so they suggested using combined method for pieces in Class A (Celic & Ozoc, 2009). Miao ling Wang et al(2009) in this paper classified customer for considering difference among different customers. Parameters such as behavioral and psychological geographical and statistical variables, and regression and ANOVA analysis are used for defining proper variables for classification. Customers are sectioned in different groups pioneer or passive in any cluster. This is a two-purpose non-linear problem combined with the problem of zero and 1 that is structured with the theory of multi-index problem theory(Wang et al, 2009).

### **Research methodology**

Current research regarding goal is applied and regarding method it is descriptive-analytic. Statistical

society of this research is all managers and supervisors of production of Fouman Shimi about 10 people that sampling has been done through census. In this research firstly identification of effective on choosing supplier was done that after it by using fuzzy AHP method ranking suppliers was done and finally regarding obtained scores for each supplier in two-dimensional matrix criteria of capability and capability of suppliers in a dimension and attitudes and values of supplier in another dimension to classification of suppliers is done. In current research for data collection matrix of scoring suppliers was used regarding selective criteria and managers were asked to devote score of 1-5 to any supplier regarding distinguished criteria. Then by using verbal statements for paired comparison for explaining the degree of importance of any criteria, matrix of paired comparison was completed. Regarding that for doing calculations Expert choice software has been used and validity and reliability of questionnaire were controlled and confirmed.

### **Steps of implementing research**

First step: after studying existing situation in Fouman shimi company the first questionnaire including 15 criteria for the dimension of capabilities and abilities and 21 criteria for the dimension of attitudes and demands, was distributed among related experts. After collecting viewpoint of experts, 5 criteria (price/cost, delivering good, technical capability, services after sale were chosen as criteria related to abilities and capabilities of suppliers and 5 criteria(commitment to quality, commitment to constant improvement in products and process, freedom about assessment of locating situation, mutual respect and honesty, long-term relationship were chosen as criteria related to attitudes and demands of suppliers.

Second step: after determining main criteria experts were asked to do paired comparison of some criteria and suppliers in relationship with any criteria. After combining result of paired comparisons, by fuzzy development of scale of "hours" for 7 determined spectrum in questionnaires weight of criteria of choosing suppliers and score of each supplier about each criteria was determined.

Third step: after distinguishing score of each supplier in each of two dimensions suppliers were classified based on two dimensions and by using a matrix of 2\*2.

### **Main findings of research**

Classification of suppliers is a step between choosing suppliers and management of relationship with suppliers. In this chapter after determining

criteria of each dimension, matrix that was filled by experts were collected and their average were determined. Then matrixes of paired comparisons were received from experts and necessary processing were done. By using obtained data weight of criteria and finally score of each supplier was done and finally the result of calculation of fuzzy AHP in a matrix of 2\*2 was lead to sectioning suppliers in 4 sections.

**Matrix of scoring suppliers**

After giving the first questionnaire to 10 managers of the company, mean of results were obtained that has been presented in attach. Scores were between 1-5 and maximum scores in each criterion is 5. Two matrix of paired comparison between criteria in each dimension was given to managers that its numerical result regarding table 2 is as below:

Table 2. matrix of paired comparison of criteria of capability and ability

C <sub>5</sub>	C <sub>4</sub>	C <sub>3</sub>	C <sub>2</sub>	C <sub>1</sub>	criteria of capability and ability
(0/38,0/58, 0/78)	(0/06,0/22, 0/42)	(0/3,0/5, 0/7)	(0/18,0/38, 0/58)	(1, 1,1)	C <sub>1</sub>
(0/74,0/92, 1)	(0/22,0/42, 0/62)	(0/46,0/66, 0/86)	(1, 1,1)	(0/38,0/58, 0/78)	C <sub>2</sub>
(0/38,0/58, 0/78)	(0/12,0/3, 0/5)	(1, 1,1)	(0/18,0/38, 0/58)	(0/22,0/42, 0/62)	C <sub>3</sub>
(0/66,0/86, 0/98)	(1, 1, 1)	(0/5, 0/7, 0/88)	(0/38,0/58, 0/78)	(0/58,0/8, 0/94)	C <sub>4</sub>
(1, 1, 1)	(0/02,0/14, 0/34)	(0/22,0/42, 0/62)	(0,0/08, 0/26)	(0/26,0/46, 0/66)	C <sub>5</sub>

Table 3. matrix of paired comparison of criteria of attitude and demand

W <sub>1</sub>	criteria of attitude				
(0/66,0/86, 0/98)	(0/34,0/54, 0/74)	(0/66,0/86, 0/98)	(0/42,0/62, 0/82)	(1, 1,1)	W <sub>1</sub>
(0/58,0/78, 0/94)	(0/3,0/5, 0/7)	(0/62,0/82, 0/96)	(1, 1,1)	(0/18,0/38, 0/58)	W <sub>2</sub>
(0/3,0/5, 0/7)	(0/14,0/34, 0/54)	(1, 1,1)	(0/04,0/18, 0/38)	(0/02,0/14, 0/34)	W <sub>3</sub>
(0/3,0/5, 0/7)	(1, 1, 1)	(0/46,0/66, 0/86)	(0/3,0/5, 0/7)	(0/26,0/46, 0/66)	W <sub>4</sub>
(1, 1, 1)	(0/3,0/5, 0/7)	(0/3,0/5, 0/7)	(0/04,0/18, 0/38)	(0/02,0/14, 0/34)	W <sub>5</sub>

After calculating weight of criteria for achieving score if each supplier, the result of multiplication of weight of criteria in each dimension at Result Shown in a two dimensional chart:

score of each supplier they obtained result will be mentioned table 4:

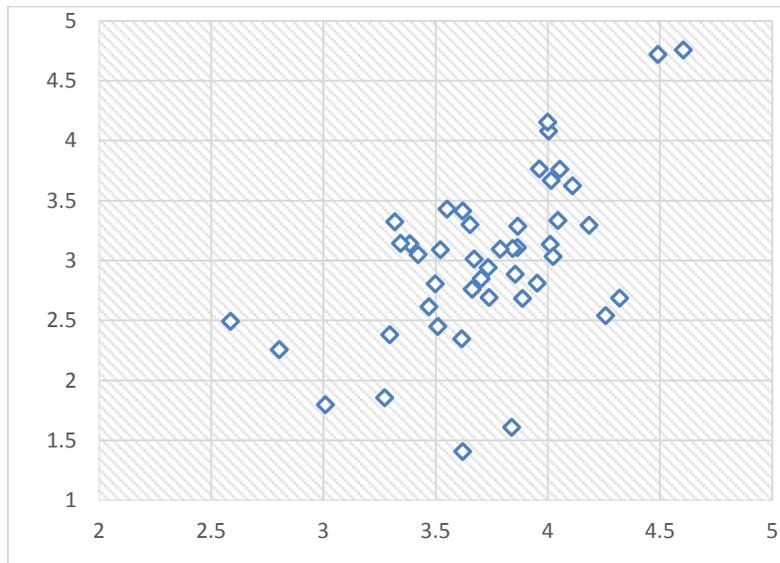


Chart 1: two-dimensional chart of capabilities and abilities- attitudes and demands

Table 4. final score of calculation in each dimension for supplier

Score of each supplier in attitude	Score of each supplier in capability and ability		Score of each supplier in attitude	Score of each supplier in capability and ability	
3.08957	3.52276	24	4.75553	4.605	1
3.32271	3.3201	25	2.68477	4.32179	2
3.76289	3.96448	26	4.72027	4.49098	3
3.62393	4.11184	27	2.68292	3.88916	4
2.61416	3.47088	28	3.10808	3.86581	5
3.14084	3.38675	29	3.29271	4.1855	6
3.09408	3.78921	30	2.88565	3.85529	7
3.76149	4.05522	31	1.60703	3.84059	8
2.54081	4.25839	32	4.07856	4.00507	9
2.3805	3.2969	33	1.40683	3.62134	10
2.49247	2.58723	34	3.4142	3.62127	11
3.14175	3.34502	35	3.29876	3.6548	12
2.34635	3.6181	36	3.10002	3.84397	13
4.15406	4.00093	37	2.9395	3.73588	14
2.45014	3.51083	38	3.13382	4.01221	15
3.43015	3.5524	39	3.0116	3.67229	16
2.25508	2.80467	40	2.76097	3.66372	17
3.28531	3.86689	41	2.81123	3.95389	18
2.80475	3.50008	42	3.0321	4.02446	19
3.04875	3.42332	43	1.85369	3.2745	20
3.33451	4.04671	44	2.691	3.74019	21
3.66726	4.01643	45	2.84673	3.70366	22
			1.79574	3.01042	23

Regarding above chart  $(a+b)\sqrt{2}=3.5$ ,  $(a'+b')\sqrt{2}=3$ , suppliers are sectioned in 4 groups. In dimension of capabilities and abilities of low range is 2 and high range is 5 that the moderate number of this

axis is 3.5, in dimension of attitudes and demands the low range is 1 and high range is 5 that moderate number is 3.

Table 5. suppliers of each section regarding chart 1

Group of supplier	Number of supplier
First section, noncritical	20 – 23 – 28 -33 -34 – 40
Second section, leverage section	2- 4-7 -8-10 -14- 17- 18 -21 -22 – 32 – 36 – 38 -42
Third section bottleneck section	25 – 29 – 35 – 43
Forth section, strategy section	1-3 -5 6-9-11-12-13-15-16 -19-24-26-27 - 30 - 31 – 37 – 39 – 41 - 44 – 45

**Conclusion and discussion**

In management science many structures have been designed for managers so that help their decision making assessment and sectioning suppliers is one of these structures. Sectioning suppliers requires many criteria and is a combination of complicated and uncertain methods. In AHP method clear hierarchy for assessment and ranking choices (in our research suppliers) have been used that complexity is taken from assessment of suppliers until uncertainty of assessments are neglected. In these problems fuzzy AHP includes both complexity and uncertainty.

Formulation that has been done in current research is the first thing in the problem of sectioning suppliers as the multi-criteria problem' in which two comprehensive dimensions have been paid attention: capabilities and attitudes of suppliers. These two dimensions cover proper criteria for each purchase that may has their own specific goals. Fuzzy AHP determined relative weight of each criterion and finally two calculated scores for capabilities and attitudes is obtained for each supplier. Point chart has been applied for showing dimension of capability and attitude. By dividing each axis into two parts, 4 sections

are formed for suppliers. Purchaser should have different strategies for interaction with suppliers of each section.

Identified methods for sectioning suppliers of Foman shimi company has been applied by considering 5 criteria for each dimension and obtained results in this research showed that supplier number 1 and 3 (company of production and development and Padineh company) by obvious difference toward other suppliers are the best suppliers of foman shimi company; also regarding that half of suppliers of foman shimi company are located in section of suppliers at the fourth section it means this company has taken the right approach in choosing primary suppliers and relationship with this group of suppliers that is similar relationship with partnership leads to profit of both parties. On the other hand second section that has the highest density shows that most suppliers of Foman Shimi Company have high capability.

Therefore analyzing situation of each supplier in each section is distinguished and in comparison with most previous approach that sectioning suppliers that only it was distinguished that each supplier belongs to what section this method helps purchaser to observe situation of any supplier in each section and on the one hand final set of scores of capabilities and attitudes has been obtained from an attached spectrum. Presented method can divide suppliers into more than 4 sections and this decision depends on the number of suppliers and ability and tendency of company (purchaser) for implementing different strategies for suppliers in different sections. This analysis shows that some suppliers don't have necessary capability or attitudes.

Due to complexity of assessment of supplier (5 criteria for each dimension capability and attitude that based on demands of managers of Foman shimi was used for assessment of suppliers) for interaction with such problems, accurate and direct assessment is not sufficient and making fuzzy criteria can order using fuzzy AHP instead of standard AHP. When result of analysis in qualitative assessment was presented it can help to correct, distinguish and update necessary strategy for assessment and sectioning suppliers. Result of sectioning are as below:

First section: supplier in this section that include 6 suppliers are the worst suppliers simultaneously have low capability and attitude level and it is better purchaser replace these suppliers.

Second section: suppliers in this section have high capability and low ability and high performance attitudes. Suggestive strategies in this section are the point that purchaser help these suppliers to improve their capabilities.

Third section: this group of suppliers have high capability but low level of attitude in cooperation

with purchaser this action is more similar to the point that supplier don't have any profit or relationship doesn't have sufficient entrance to a close relationship in these cases it is better purchaser follow hidden reasons behind this behavior.

Fourth section: this group of suppliers is the best suppliers that have high ability and high performance attitude. Purchaser can benefit from working with these suppliers. Suppliers benefit from this relationship with purchaser. It means that relationship is more similar to cooperation.

## References

- Amid, A., Ghodsypour, S. H., O'Brien, C. (2006). Fuzzy multiobjective linear model for supplier selection in a supply chain. *International Journal of Production Economics* 104. 394-407.
- Bensaou, B. M. (1999). Portfolios of buyer-supplier relationships. *Sloan Management Review*, summer, 35-44.
- Brun, A., Castelli, C. (2008). Supply chain strategy in the fashion industry: Developing a portfolio model depending on product, retail channel and brand. *International Journal of Production Economics*, Volume 116, Issue 2, December 2008, Pages 169-181.
- Celik, M., Ozok, A. F. (2009). Application of fuzzy extended AHP methodology on shipping registry selection: The case of Turkish maritime industry. *Expert Systems with Applications* 36, 190-198.
- Celik, M., Ozok, A. F. (2009). Application of fuzzy extended AHP methodology on shipping registry selection: The case of Turkish maritime industry. *Expert Systems with Applications* 36, 190-198.
- Chen, C. C., Wu, C. S., Wu, R. C. F. (2006). E-service enhancement priority matrix: The case of an IC foundry company, *Information & Management*, Volume 43, Issue 5, July 2006, Pages 572-586.
- Duran, O., Aguilo, J. (2008). Computer-aided machine-tool selection based on a Fuzzy-AHP approach. *Expert Systems with Applications* 34, 1787-1794.
- Johnson, C. L. (2007). A framework for pricing government e-services, *Electronic Commerce Research and Applications*, Volume 6, Issue 4, Winter 2007, Pages 484-489.
- Kalafatis, S. & Cheston, V. (1997). Normative Models and Practical Applications of Segmentation in Business Markets, *Industrial Marketing Management* 26, Elsevier.
- Kaufman, A. W., Theyel, G. (2000). Collaboration and technology linkages: a strategic supplier typology. *Strategic Management Journal*, 21, 649-663

- Kraljic, P. (1983). Purchasing must become supply management. *Harvard Business Review*, (September/October), 109-117.
- Liao, S. H., Chen, Y. J. (2004). Mining customer knowledge for electronic catalog marketing, *Expert Systems with Applications*, Volume 27, Issue 4, November 2004, Pages 521-532
- Mallik, S., Chhajed, D. (2006). Optimal temporal product introduction strategies under valuation changes and learning, *European Journal of Operational Research*, Volume 172, Issue 2, 16 July 2006, Pages 430-452.
- Olsen, R. F., Ellram, L. M. (1997). A portfolio approach to supplier relationships. *Industrial Marketing Management*, 26 (2), 101-13.
- Parasuraman, A. (1980). Vendor segmentation: An additional level of market segmentation. *Industrial Marketing Management*, 9, 59-62.
- Pauler, G., Dick, A. (2006). Maximizing profit of a food retailing chain targeting and promoting valuable customers using loyalty Card and Scanner Data, *European Journal of Operational Research*, Volume 174, Issue 2, 16 October 2006, Pages 1260-1280.
- Rezaei, J., Ortt, O. (2013). Multi-criteria supplier segmentation using fuzzy preference relations based AHP, *European Journal of Operational Research*, Volume 225, Issue 1, 16 February 2013, Pages 75-84.
- Van Weele, A. J. (2000). *Purchasing and Supply Chain Management*, Business Press, Thomson Learning, London.
- Wang, L., Chu, J., Wu, J. (2007). Selection of optimum maintenance strategies based on a fuzzy analytic hierarchy process. *international journal of production economics* 107, 151-163.
- Wang, M. L., Kuo, T. C., Liu, J. W. (2009). Identifying target green 3c customer in Taiwan using multiattribute utility theory, *Expert Systems with Applications*, Volume 36, Issue 10, December 2009, Pages 12562-12569.
- Weber, C. A., Current, L. R., Benton, W. C. (1991). Vendor selection criteria and methods. *Eur.J.Oper.Res.*50, 2-18.
- Zhang, M., Bell, P. C. (2007). The effect of market segmentation with demand leakage between market segments on a firm's price and inventory decisions, *European Journal of Operational Research*, Volume 182, Issue 2, 16 October 2007, Pages 738-754.