MODERN EVOLUTION IN SUPPLIER SELECTION CRITERIA AND METHODS

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ABSTRACT

Supplier selection is becoming strategic importance for organization to gain competitive advantage. So, Researcher are focussing more identifying supplier selection criteria's and methods. This paper focuses on supplier selection criteria's and methods and concluded that there is shift from single criteria to multi criteria approach and methods outlined are integrated for group decision considering vague and unclear data during decision process which replaced former individual approaches with single decision maker.

Keywords: Supplier Selection, Supplier selection criteria, Supplier selection methods.

INTRODUCTION

The constant pressures of Globalization and Competitive advantage have influenced organization to attain goal of low cost, high quality, flexibility and more customer satisfaction. So organization should know to remain competitive in global market it is crucial to focus on the entire Supply Chain. Supply Chain encompasses all activities in fulfilling customer demand and requests. These activities are associated with flow and transformation of raw material, information and funds. Of the various activities, purchasing is one of the most strategic because it provides organization with opportunity to reduce costs and, consequently, increase profits. An essential task within the purchasing function is supplier selection. In most of manufacturing industries, the cost of raw materials and components comprise the major portion of product's final cost, sometime it is equal to 60% - 70% of product cost (Mostafa et.al,2012). Therefore selecting the right supplier is key to procurement process and opportunity to reduce cost across entire supply chain. The success of organization is highly depended on selection of proper supplier and it is critical task of achieving the different objectives of Supply Chain.

For many years, the traditional approach to supplier selection has been to rank and select Suppliers solely on the basis of price (James et.al,2014). However, as organizations have realised that the sole emphasis on price as single criteria for supplier selection is not efficient and therefore supplier selection focused on other criteria making supplier selection as MCDM problem. Recently, these criteria have become increasingly complex as environmental, social, political, and customer satisfaction concerns have been added to the traditional factors of quality, delivery, cost, and service. Apart from purchasing cost reduction, right selection of suppliers improves corporate competitiveness (Mehtap et.al,2013). Realization by organization that set of supplier will give strategic difference to an organization's ability to

provide continued improvement in customer satisfaction drives the search for new and better ways to evaluate and select suppliers. This project reviews the supplier selection literature concerning existing models and methodologies supporting the supplier selection process, identify some important opportunities to present new and efficient model for decision making. The project aims to present model for helping organizations for selecting most effective supplier under multi criteria decision making situations.

LITERATURE REVIEW

Recently, buyer and supplier relationships in manufacturing enterprise have received considerable attention in the business- management literature. The purchasing function is essentially seen as s strategic issue in supply chain hierarchy, material purchased can be 80% of total product cost. It is strategic important for organizations to reduce such purchasing cost to minimum. So organization must select right supplier, and this decision is referred as supplier selection problem by Weber and Current (Mehtap et.al,2013). A supplier selection problem is multi criteria problem and decision is of strategic importance to organizations (Arjit et.al, 2010). Supplier selection criteria may vary depending upon type of product and includes many qualitative factors in addition to quantitative factors. Complexity in decision of supplier selection and evaluation, motivated researcher to develop models for helping decision makers. The existing literature survey focuses on the published works supplier selection criteria and models developed for supplier selection decision making.

Supplier Selection Criteria

One of the major aspects of the purchasing function is supplier selection criteria. The analysis of criteria for selection and measuring the performance of supplier has been the focus of attention for many researcher and purchasing practitioners since 1960's. Early in 1960 Dickson identified 23 criteria that have to consider by purchasing personnel in evaluation suppliers (Arjit et.al, 2010). Dickson identified 23 criteria base on questionnaire sent to 273 purchasing agents and managers from United States and Canada (Wu et. al, 2008) Out of 23 criteria considered Dickson concluded quality, delivery, and performance history are the three most important criteria (Wu et. al, 2008; Sung et. al, 2008). Evans proposed that price, quality, and delivery are key criteria for supplier evaluation in industrial market(Chin et. al 2011). Lehman and O'Shaughnessy proposed five criteria performance, economy, plenitude, agreements and social norms (Paulo et, al, 2012). Shipley suggested that supplier selection involves three criteria namely quality, price and delivery lead time(Chin et. al 2011). Caddick and Dale referred that quality, production plan, control system validity, historic activity, item category and price are important criteria (Paulo et.al,2012). Ellaram in 1990 suggested that in supplier selection process firm must to consider whether product quality, offering price, deliver time and total service quality meet organization demand(Chin et. al 2011). In 1991 Weber, Current and Benton based on reading of 74 articles and compressive review of vendor evaluation methods, they summarized that quality was important criteria followed by delivery and cost(Wu et. al, 2008; Paulo et.al,2012). Patton proposed price, quality, delivery, sales support, equipment, technology, order process, and supplier financial position as important criteria (Paulo et.al,2012). In 1997 Barbarosoglu and Yazgac determined three different primary criteria the performance of the supplier, the technical capabilities and

financial situation of the supplier, and the quality system of the supplier(Emrah and Sundus, 2013). Ghodsypour and O Brian stated cost, quality, and service have considerable effect on supplier selection parameters (Saman and Jafar, 2009). Ellram added compatibility of management and orientation strategy to usual criteria. In 2006 Chen suggested five benefit criteria, included the profitability of supplier, relationship closeness, technological capability, conformance quality and conflict resolution, Lin and Chan claimed that communication, reputation, industry position, relationship closeness, customer responsiveness and conflict solving capabilities are important criteria for vendor selection(Chin et. al 2011).

Table 1 and Table 2 shows the supplier selection criteria based on studies carried out by Sung, Chin, Mohammad (Sung and Ramayya, 2008; Chin et. al, 2011; Mohammad,2013). While a number of supplier selection criteria studies have been conducted over the years, Dickson (1966), Weber, Current and Benton are still recognized as the most common, and cited as the most comprehensive studies done on selection criteria.

Table 1: Criteria and Author details

Criteria							
1.	Price	13.	Management and Organization	25.	Operation control	37.	Dependability
2.	Product Quality	14.	Labour relations	26.	Ease to use	38.	Flexibility
3.	Delivery	15.	Relationship Closeness	27.	Maintainability	39.	Payment terms
4.	Warranties and Claim	16.	Conflict/Problem solving capability	28.	Amount of past business	40.	Productivity
5.	After Sales Service	17.	Communication System	29.	Reputation and position in industry	41.	Applicable of conceptual Manufacturing
6.	Technical Support	18.	Response to customer request	30.	Reciprocal arrangement	42.	Manufacturing Challenge
7.	Training aids	19.	E- commerce capability	31.	Impression	43.	Driving Power
8.	Attitude	20.	JIT Capability	32.	Business attempt	44.	To match lead time
9.	Total service quality	21.	Technical Capability	33.	Size	45.	Personnel Capability
10.	Performance History	22.	Production Capability	34.	Environmental Friendly Products	46.	To be solution oriented
11.	Financial Position	23.	Production Facility and capacity	35.	Product appearance	47.	Global factor
12.	Geographical Location	24.	Packaging ability	36.	Catalogue Technology	48.	Environmental risk
Author (1966-2012)							
A.	Dickson (1966)	H.	Ellram(1990)	O.	Pi and Low(2005)	V.	Betul(2011)
B.	Wind(1968)	I.	Weber(1991)	P.	Pi and Low(2006)	W.	Tektas and Aytekin(2011)
C.	Lehmann (1974)	J.	Billesbach(1991)	Q.	Chen (2006)	X.	Parthiben (2012)
D.	Perraault (1976)	K.	Segev(1998)	R.	Lin and Chang(2008)	Y.	Bilsik(2012)
E.	Evans(1980)	L.	Min and Galle(1999)	S.	Teervarprug (2008)	Z.	Peng (2012)
F.	Shipley (1985)	M.	Stavropolous (2000)	T.	Sanayei (2008)	AA.	Mehralin (2012)
G.	Abratt(1986)	N.	Tam Tummala(2001)	U.	Wang(2009)		

Table 2: Supplier selection criteria

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1	√	√	√	√	√	√	√	√	√	√		√	√		√	√			√			√		√		√	√
2	√	√	√	√	√	√		√	√	√		√		√	√	√	√		√				√	√	√	√	√
3	√	√	√	√	√	√		√	√	√		√			√	√			√	√	√	√	√	√	√		√
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Supplier Selection Methods

Supplier selection is a multiple criteria decision-making (MCDM) problem which is affected by several conflicting factors and it consists of both qualitative and quantitative factors. Over the years, a number of methodologies have been proposed for selection of supplier. The methodologies used for supplier selection are classified in different categories by different researchers. The methodologies studied by William (William at. al,2010) were divided into two main categories such as individual approach and integrated approach. William Ho carried out study on 78 journal articles in the period of 2000 to 2008. Within individual approaches; data envelopment analysis, mathematical programming , AHP, case-based reasoning, ANP, fuzzy set theory, simple multi attribute rating technique (SMART) and genetic algorithm were taken into account and within integrated approach integrated AHP

approaches, integrated fuzzy approaches and the last sub-group under integrated approaches is other approaches.

As can be concluded from study of William Ho (William at. al,2010), individual approaches were used more than integrated approaches. The most widely used three individual approaches were DEA, mathematical programming and AHP. Within the integrated approaches, the most popular one was integrated AHP approaches and specifically AHP-GP approach.

Emrah (Emrah and Sundus, 2013) classified supplier selection methodologies into four different categories. Multi criteria decision making is first category which contains Hierarchy Process (AHP), Analytical Network Process (ANP) and technique for order preference by similarity to ideal solution (TOPSIS) methods. The second category is mathematical programming methods which include data envelopment analysis (DEA) and linear programming methods. Artificial Intelligence methods, third category, contain Genetic algorithm, artificial neural network (ANN) and data mining methods. The last category is integrated approaches. Integrated approach included AHP-TOPSIS.

Sung (Sung and Ramayya, 2008), classified supplier selection methods based on procurement situation and selection process phases. Supplier selection decision methods used for pre qualification of supplier was a first category that included DEA, cluster analysis and case based reasoning. Supplier selection decision methods used for final choice of supplier which comprehended linear weighted, total cost of ownership and mathematical programming, statistical and artificial intelligence based method.

Nilesh (Nilesh et.al 2014) classified past work on supplier selection in two broad categories viz Quantitative models and Qualitative models. Quantitative models include linear programming, mixed-integer linear program, mixed integer non linear program, dynamic programming, multi objective programming, genetic algorithm, DEA. Similarly Qualitative models include AHP, fuzzy AHP, Analytical Network process, TOPSIS, Fuzzy TOPSIS, case based reasoning, AHP and linear programming.

Babek (Babek and Thomy, 2014) classified supplier selection methodologies in three groups: Qualitative factor approach, Quantitative factor approach, and Integrated factor approach.

Since the literature about supplier selection problem is huge, only few of the recent studies in the last five years are taken into account, table 3 shows summary of different supplier selection methods which are developed by researcher recently.

Table 3: Supplier selection method

Year	Researcher	Proposed Model	Features
2009	Saman Hassanzehad	Fuzzy QFD	Deal with imprecision human thoughts Framework combines supplier selection, evaluation & development
2010	Fatih Emre Boron Bhattacharya	Fuzzy TOPSIS AHP+QFD+CFM	Deal with multi conflicting criteria Consideration of cost factor
2011	Ching-Nung Lao	Fuzzy TOPSIS	Consideration of linguistic variable
2012	Mehtap Dursun Houshang Taghizahed	QFD QFD+ANP	Deal with multi criteria with group decision Evaluate supplier performance
2013	G Rajesh	AHP+QFD	Translate needs of internal stakeholder
2014	Xinyang Deng	D AHP	Deal with imprecise data

Saman (Saman and Jafar, 2009) proposed a new model for internet service provider based on fuzzy QFD model and triangular fuzzy number have been utilized to deal with imprecision in human thoughts, The model has added advantage of combining supplier selection, evaluation and development phases in one framework. Fatih (Fatih et. al, 2009) established model for supplier selection under conflicting multi criteria situation with decision maker having vague and imprecise knowledge over criteria. The model designed using fuzzy TOPSIS method.

Arjit (Arjit el. al, 2010) improved an integrated approach for supplier selection problem. The approach consisted of analytic hierarchy process (AHP), quality function deployment (QFD) and cost factor measure (CFM). The proposed methodology was tested with datasets that were already in literature.

Chin (Chin et. al 2011) proposed an integrated fuzzy TOPSIS and multi criteria decision making approach for supplier selection in supply chain. The approach was based on linguistic variable in decision problem. The approach was tested in large well known watch manufacturing company.

Mehtap (Mehtap and Ertugrul, 2013) developed fuzzy multi criteria group decision making approach using quality function deployment (QFD) concept. The proposed methodology initially identifies features that the purchase product must possess to meet customer needs and then establish relevant supplier assessment criteria. Earlier work of Bevilacqua was used to test effectiveness of proposed methodology. Houshang (Houshang and Mehdi, 2013) developed integrated analytical approach, combining quality function deployment and analytical network process to evaluate supplier performance. Approach effectiveness was demonstrated using case study of Water Company.

G Rajesh (Rajesh and Malliga, 2013) considered voice of company stakeholder so supplier will provide what company wants and proposed combined approach, integrating AHP and QFD, to select supplier strategically. QFD was used to translate voice of company stakeholder and AHP offers methodology to rank alternatives based on decision maker's judgements.

Xinyang (Xinyang et. al,2014) used new effective and feasible representation of uncertain information, called D- Number, and D-AHP method was proposed for supplier selection problem. Method is integration of classical AHP and extended fuzzy preference relation called D number.

CONCLUSION

From literature review, it can be concluded that even though researchers are focusing on identifying supplier selection criteria, Dickson and Weber identified criteria are most widely used for supplier selection. Review on criteria's identified by researcher from 1966-2012 signifies that quality is prime important and followed by delivery, price, reputation of organization, technical capability, after sales service, financial position, management. Recent criteria identified includes technology, payment terms, conceptual manufacturing, manufacturing challenge, driving force, lead time, personnel capability, solution oriented, global factor, environmental risk.

Study on supplier selection method deduce, in near the beginning individual models like DEA, AHP, mathematical programming were widely used for supplier selection and as supplier selection problem was transform to multi criteria problem integrated approaches were developed. As when supplier selection criteria were classified as, qualitative and quantitative hybrid method comes into existence to solve supplier selection problem. Paradigm shift in supplier selection method was noted from 20th century, researchers initiated to outline method that take into account group decision approach with vague, imprecise, unclear, satisfactory information from team of group by using fuzzy concept in method design. Methods were design that defiantly aid researcher and decision maker in solving supplier selection problem.

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