An Overview of Supplier Selection Methodology in SCM- A Study Approach

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Abstract— Supplier selection is process by which the firms identify, evaluate, and select the supplier of their required raw materials. An effective supplier selection process is very important to the success of any manufacturing organization. The main objective of supplier selection process is to reduce purchase risk, maximize overall value to the purchaser, and develop closeness and long-term relationships between buyer and supplier in today's competitive industrial senior.

Key words: supply Chain, SCM (Supply Chain Management) Components of SCM, Flow of SCM, Level of SCM, Selection Methods

I. INTRODUCTION

Many factors in today's global market have influenced companies to search for a competitive advantage by focusing attention on their entire supply chain. The various activities involved in supply chain management, purchasing is one of the most strategic because it provides companies with opportunities to reduce costs and, consequently, increase profits. An essential task within the purchasing function is supplier selection. In most industries, the cost of raw materials and component parts represents the largest percentage of the total product cost. For instance, in high technology firms, purchased materials and services account for up to 80% of the total product cost. Therefore, selecting the right suppliers is key to the procurement process and represents a major opportunity for companies to reduce costs across its entire supply chain. Supplier selection is one of the most important components of purchasing and supply chain management for many companies. Supplier selection is of particular importance if companies spend a high portion of capital on supply and supply costs count a significant part of the total cost.

II. LITERATURE REVIEW

Molamohamadi Z, et al. (2013) represented that an extended framework of sustainable supply chain and then explains the expectations of supply chain members from the focal company and defines the most important supplier selection criteria based on sustainability. The area of sustainability in supplier selection has a great potential for further researches. This paper, for example, can be extended by conducting a survey to compare overall performance of the companies which care about sustainability issues and the ones who do not. The effects of every criterion on company's performance and stakeholders' satisfaction can be then studied statistically to ascertain the most critical measures.

Om Pal, et al. (2013) concluded that importance of supplier selection by emphasizing the impact that decisions throughout the entire supply chain have, from procurement of raw materials to delivery of finished products to final customers. In order to help decision makers or purchasers make sound decisions with respect to supplier selection, researchers have developed different criteria and decision methods and models dealing with different aspects of the supplier selection process. This paper throws light on supplier selection criteria and methods. Based on review, it would not be irrational to suggest that the supplier selection issues need further attention in order to harmonize the combination of qualitative and quantitative criteria to develop the best criteria and methods for the selection of the best suppliers.

Bakshi Satpreet Singh (VIT UNIVERSITY) (2014) Supply chain Management is practiced by many companies across the world. With Supply chain management companies have attained competitive advantage. They have been able to reduce costs, wastage and improve their lead time. Today in the age of globalization it is very necessary for every company to provide flexibility in terms of customer demands. Therefore, the company has to focus on their Supply Chain management. So, a proper supply chain management can give a competitive edge to one company over the other.

Chandraveer Singh Rathore et al. (2016) discussed that got success in achieving its objectives. The contribution was a development of a multi-criteria model for analysis and choice which is employed for Supplier choice in JSW Steel Limited. The use of AHP process is critical in the Supplier Choice process and the latest Software Packages like MATLAB can be used to solve for the weights and decide the relative importance of the criterion. The supplier selection problem for multiple suppliers reduces to the Eigen value problem which can be solved using mathematical software tools like MATLAB. The priority vector is found as an Eigen vector which can be normalized to find the relative rates. The process is repeated at all levels and for all suppliers and local and global weights are found which can be used to decide the best supplier.

III. WHAT IS A SUPPLY CHAIN?

A supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request. The supply chain not only includes the manufacturer and suppliers, but also transporters, warehouses, retailers, and customers themselves. Within each organization, such as manufacturer, the supply chain includes all functions involved in receiving and filling a customer request. These functions include, but are not limited to, new product development, marketing, operations, distribution, finance, and customer service.

A supply chain or logistic network is the system of organization, people, technology, activities, information and resources involved in moving a product or service from supplier to customer. Supply chain activities transform

natural resources, raw material and components into a finished product that is delivered to the end customer.

"A supply chain encompasses all activities associated with the flow and transformation of goods from the raw material stage, through to the end-user, as well as the associated information flows".

IV. WHAT IS A SUPPLY CHAIN MANAGEMENT?

Supply chain management (SCM) can be defined as the configuration, coordination and continuous improvement of a sequentially organized set of operations. The goal of supply- chain management is to provide maximum customer service at the lowest cost possible.

A Supply chain management is a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system wide costs while satisfying service level requirements.

"Supply chain management (SCM) is the process of planning, implementing, and controlling the operations of the supply chain with the purpose to satisfy customer requirements as efficiently as possible. Supply chain management spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point-of-origin to point-of-consumption."

Fig. 1: Supply Chain Management

V. COMPONENTS OF SCM

A. Plan

This is the strategic portion of the SCM, companies need a strategic for managing all the resources that go toward making customer demand for their product or service. A big piece of SCM planning is developing a set of metrics to monitor the supply chain so that it is efficient, cost less and high quality and value to customer.

B. Source

Next, companies must choose supplier to deliver the goods services they need to create their product. Therefore, supply chain manager must develop a set of pricing, delivery and payment process with supplier and create matrix for monitoring and infusing the relationship. And then SCM manager out together for managing their goods and services inventory, including receiving and verifying shipments, transferring them to the manufacturing facilities and authorizing supplier payments

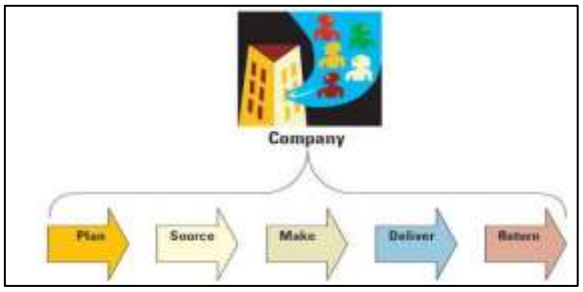

Fig. 2:

C. Make

This is manufacturing step supply chain manager schedule the activities necessary for production, testing, packing and preparation for delivery. This is most metric –intensive portion of the supply chain- one where companies are able to measure quality level, production output and worker productivity.

D. Deliver

In this, companies coordinate the receipt of orders from customer, develop a network of warehouse, pick carriers to get product to customer and set an invoicing system to receive payment.

E. Return

This can be a problematic part of the supply chain for many companies. Supply chain planners have to create a responsive and flexible network for receiving defective and excess products back from their customers and supporting customer who have problem with delivery product.

VI. SUPPLY CHAIN MANAGEMENT FLOWS

– The product flow

Flow of goods from supplier to customer, as well as any customer returns or service needs

– The information flow

Involves transmitting orders and updating the statues of delivery.

– The financial flow

Consist of credits terms, payment schedules and consignment and title ownership arrangements.

A. Supply Chain Management Levels

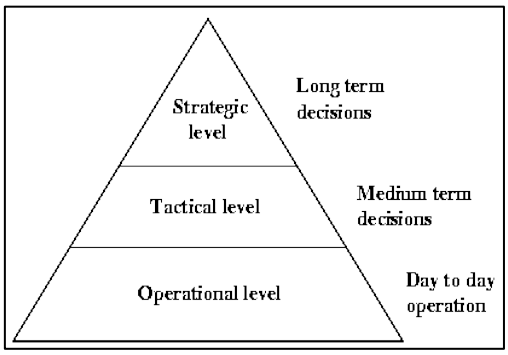

Fig. 3: SCM Level

1) Strategic

– Strategic network optimization, including the number, location, size of warehouses, distribution centers, and facilities

- Strategic partnership with suppliers, distributors, and customers, creating communication channels for critical information improvements such as cross docking, direct shipping, and third-party logistics
- Product lifecycle management, so that new and existing products can be optimally integrated in to the supply chain and capacity management
- Information Technology infrastructure, to support supply chain operations
- Where to make and what-to-make-or-by decisions
- Aligning overall organizational strategy with supply strategy
- At this level, company management will be looking to high level strategic decisions concerning whole organization.

2) Tactical

- Sourcing contracts and other purchasing decisions
- Production decisions, including contracting, scheduling, and planning process definition.
- Inventory decisions, including quantity, locations and quality of inventory.
- Transportation strategy, including frequency, routes and contracting.
- Benchmarking of all operations against competitors and implementation of best practices throughout the enterprise.
- Focus on customer demand.
- Tactical decisions focus on adopting measures that will produce cost benefits.

3) Operational

- Daily production and distribution planning.
- Production scheduling for each manufacturing facility in supply chain.
- Demand planning and forecasting, coordinating the demand forecast of all the customers and sharing the forecast with all suppliers.
- Production operation, including the consumption of the materials and flow finished goods.
- Decisions at this level are made each day that affect how products move along supply chain

VII. Principles/Methodology of Supply Chain Management

There are "Seven Principles" of supply chain management:

A. Segment Customers Based Service Needs

Companies traditionally have grouped customers by industry, product, or trade channel and then provide the same level of service to everyone within a segment. Effective supply. Chain management, by contrast, groups customers by distinct service needs- regardless of industry. & then tailor services to those particular segments.

B. Customize the Supply Chain Management Network

In designing their SCM network, companies need to focus intensely on the service requirements and profitability of the customer segment identified, the conventional approach of creating a "monolithic" Supply Chain Management network runs counter to successful supply chain management

C. Listen to Signals of Market Demand & Plan Accordingly

Sales and operation planning must span the entire chain to detect early warning signals of changing demand in ordering patterns, customer promotions, and so forth, this demand. Intensive approach leads to more consistent forecast and optimal resource allocation,

D. Differentiate Product Closer to the Customer

Companies no longer can afford to stockpile inventory to compensate for possible forecasting errors. Instead, they need to postpone product differentiation in the manufacturing process closer to actual consumer demand.

E. Develop a Supply Chain-Wide Technology Strategy

As one of the cornerstone of the successful supply-chain management, information technology must support multiple levels of decision making.

F. Adopt Channel Spanning Performance Measures

Excellent supply chain measurement systems do more than just monitor internal functions. They adopt measures that apply to every link in the supply chain. Importantly, these measurement systems embrace both service and financial metrics, such as each accounts true profitability.

VIII. Selection Methods

A. Pre-Qualification Method of Suppliers

Pre-qualification is the procedure of reducing the set of all suppliers to a smaller set of suitable suppliers. The different methods available in this category are. [4]

1) Categorical Methods

Categorical methods are qualitative models fundamentally. The existing or familiar suppliers are assessed on a set of criteria, based on historical data and the buyer's know-how. Subsequent on rating of all criteria, the buyer offers an overall rating. The categorical approach enables the structural evaluation process in a systematic and solid way which is the primary advantage of the approach.

2) Analysis of Data Envelopment

Data envelopment analysis system that classifies and splits suppliers between two groups – Efficient and Inefficient. Suppliers are judged based on two sets of criteria, namely outputs and inputs. Data envelopment analysis deems a supplier to have a qualified efficiency of 100 percent if he brings out a set of output parameters which is not brought out by other suppliers with a specified set of input factors.

3) Cluster Analysis

Cluster Analysis is a method derived from statistics. Cluster Analysis employs a sorting algorithm to cluster a number of items which are explained by a set of numerical aspect scores into a number of clusters. It identifies the differences between items within a cluster. This categorization is applied to decrease a larger set of suppliers into smaller convenient subsets.

B. Multi-Attribute Decision Making Techniques (MADMT):

This technique is implemented to resolve the problem coming across in supplier's selection. Generally, a supplier selection problem includes more than one criterion and these criterions are often inconsistent with the other. Hence, this technique is

an absolute solution in supplier's selection task, which includes

1) Analytical Hierarchical Process

The Analytical Hierarchic Process (AHP) is a decision-making method for prioritizing alternatives when multiples criteria and sub-criteria must be used. It is developed by Saaty in 1980. The main features of AHP method can be summarized as follow: [5]

1) Creating a hierarchy reflecting the selection problem, including the goal, the evaluation criteria and sub-criteria, and the alternatives.
2) Giving preference values to the elements of the hierarchy based on expert judgments through pair-wise comparisons. Then the overall priorities for each alternative can be calculated.
3) Checking the consistency ratio of every pair-wise comparison to check the consistency of the subjective judgments.

2) Uses & Application of AHP

As a method of measuring intangible factors, the AHP has many areas of application. Among them are:

- Conflict Resolution
- Environmental Applications
- General Resource Allocation & Optimization
- Group Decision Making
- Human Resources
- Marketing Decisions
- Medical Decision Making
- Military Applications

3) Analytic Network Process

The Analytic Network Process (ANP) is a generalization of the Analytic Hierarchy Process (AHP) and can be used to treat more sophisticated decision problem than the AHP. It was developed by Saaty in 1996.

Many decision problems cannot be built hierarchically because they involve the interaction and dependence of higher-level elements in a hierarchy on lower level elements. ANP provides a general framework to deal with decisions without making assumptions about the independence of higher-level elements from lower level elements and about the independence of the elements within a level. Therefore, ANP is represented by a network without the need to specify levels as in a hierarchy. Analytical Hierarchical Process (AHP) is a decision-making method developed for prioritizing alternatives when multiple criteria must be considered and allows the decision maker to structure complex problems in the form of a hierarchy, or a set of integrated levels. This method incorporates qualitative and quantitative criteria. The hierarchy usually consists of three different levels, which include goals, criteria and alternatives. Because AHP utilizes a ratio scale for human judgments, the alternatives weights reflect the relative importance of the criteria in achieving the goal of the hierarchy. [5]

4) Total Cost of Ownership Model

This models basically includes quantification and summarization of several costs related with the choice of vendors. It adjusts or penalizes the unit price quoted by the supplier. This methodology based on philosophy, which looks beyond the purchase price to include different purchase-related costs. [4]

5) Technique for the Performance of the Order by Match to Ideal Solution

This technique is to determine the ranking order of all suppliers and linguistic values. It uses to assess the weights and ratings of the factors. It is based on the idea that the optimal alterative has the shortest distance from the positive ideal solution and the extreme distance from the negative ideal solution. [4]

TOPSIS method was introduced for the first time by Yoon and Hwang and was appraised by surveyors and different operators. TOPSIS is a decision making technique. It is a goal based approach for finding the alternative that is closest to the ideal solution. In this method, options are graded based on ideal solution similarity. If an option is more similar to an ideal solution, it has a higher grade. Ideal solution is a solution that is the best from any aspect that does not exist practically and we try to approximate it. Basically, for measuring similarity of a design (or option) to ideal level and non-ideal, we consider distance of that design from ideal and non-ideal solution.

For supplier selection problem, composed of TOPSIS method, consists of three Steps [3]:

1) Identify the criteria to be used in the model;
2) Weigh the criteria by using expert views;
3) Evaluation of alternatives with TOPSIS and determination of the final rank; [5]

The main advantages of using TOPSIS method are:

- It is simple to use.
- It takes into account all types of criteria.
- It is rational and understandable.
- The computation processes are straight forward.
- The concept permits the pursuit of best alternatives criterion depicted in a simple mathematical calculation. [5]

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6) Multiple Attribute Utility Theory (MAUT)

This theory is also considered a linear weighting technique, which enables purchasing professionals to formulate feasible sourcing strategies and is also suitable of handling multiple conflicting attributes. This is used for international supplier choice, where the environment is more complex and risky. [4]

The MAUT proposed is also considered a linear weighting technique. The MAUT method has the advantage that it enables purchasing professionals to formulate viable sourcing strategies and is capable of handling multiple conflicting attributes. However, this method is only used for international supplier selection, where the environment is more complicated and risky. Multiple Attribute Utility Theory (MAUT), enables the decision maker to structure a complex problem in the form of a simple hierarchy and to evaluate a large number of factors associated with uncertainty Compared to multiple objective programming, MAUT

requires more data and poses less computational difficulty, which makes it advantageous. [5]

7) Outranking Methods (OM)

Outranking methods are helpful decision making tool to solve multi criteria problems. The method is partially compensatory and is competent of dealing with situations where imprecision is present. [4]

Outranking methods are useful decision tool to solve multi-criteria problems. These methods are only partially compensatory and are capable of dealing with situations in which imprecision is present. Lot of attention has been paid to outranking models, primarily in Europe. However, so far, in the purchasing literature there is no evidence of applications of outranking models in purchasing decision.

C. Mathematical Programming Models

Mathematical programming (MP) models often take for only the quantitative criteria. It allows the decision makers to think about different restrictions in choosing the best set of suppliers. Mathematical programming models are obviously ideal for solving the supplier choice difficulty since they can optimize results using single objective models and multiple objective models as well. Mathematical programming in two kinds which are: [4]

1) Multi Objective Models (MOM)

This category deals with optimization problems comprising two or more matching criteria.

2) Goal Programming (GP) Models

Goal Programming is an important tool which differs from most mathematical programming models. It provides the decision maker with adequate flexibility to set target levels on many criteria. It also obtains the best compromise solution that comes closely to each one of the specified targets.

D. Artificial Intelligence (AI) Methods:

Artificial Intelligence Methods are the system based on computer using historical data and experience. These systems deal with the complexity and uncertainty surrounded with the process of supplier selection. Two of the models are: [4]

1) CBR (Case Based Reasoning) Systems

This system falls in the category of the so called artificial intelligence (AI) approach. This system is a software-driven database which enables a decision maker with useful experience and information from similar and previous decision situations.

2) Artificial Neural Network (ANN)

This model saves money and time. The disadvantage of this model is that it demands specialized software and experts in its operation.

E. Fuzzy Logic Approach

In this approach, linguistic values are taken to assess the ratings and weights for various factors. The weights and ratings of the criteria in the problem are assessed by means of linguistic variables. One can easily construct a normalized unclear decision matrix once the decision makers' fuzzy ratings were pooled. [4]

F. Combined Approaches or Hybrid Methods

Some authors have joint decision models from many steps in the process of supplier selection. They developed a mathematical programming model and TCO. Some had incorporated AHP and LP (Linear Programming) to consider tangible and intangible factors in selecting the best suppliers. Some presented a successful model using MAUT and LP for solving the problem of supplier selection. Some has proposed a multi-criteria group approach using fuzzy TOPSIS to deal with uncertainty. [4]

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