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A Supplier Selection Case Study by Analitical Hierarchical Process in Textile Industry

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Abstract: In supply chain management (SCM), supplier selection is one of the most important activities. It is one of the issues that purchasing department has to face in most companies. Since purchasing process involves many qualitative and quantitative criteria, in most cases, it is hard to choose between the suppliers. In order to solve this problem it is essential to identify the important criteria for supplier selection and use an appropriate method to select the best supplier among the others. In this case study, in order to identify and select the best criteria in supplier selection for a particular textile company (Golnesar Textile Manufacturing Company), a questionnaire has been applied and asked as an interview, then Analytical Hierarchical Process (AHP) helps to choose the best supplier. Finally, Pashm Tab Company, is identified and selected as the best supplier for Golnesar textile manufacturing.

Keywords: Supply chain management, AHP, Supplier Selection, Expert Choice software, Textile Industry

1- INTRODUCTION

In today's competitive world and in this constantly growing market in order to remain alive among the rivals it is essential to work hard and launch new models and methods for developing products by improved processes while keeping the costs as low as possible. Nowadays, technology and economy has been developed and globalized. Consequently, all the firms and companies try to compete with each other and one of the most important competitive aspects has become the competition in supply chain. Coordinating the supply chain has become an opportunity to be focused on, and the main spotlight in this area is the decision making under normal conditions, which are usually defined as deterministic demand, complete information of the manufacturer about the market, and excluded operational costs from the analysis (Cao et al., 2012).

A supply chain is defined as a process in which different business sectors such as producers, suppliers, distributors and retailers work together and their goals are achieving raw materials, producing products from the raw materials and finally, delivering them to the retailers (Wang et al., 2004). During the 1990s, supply chain management was known as a new phenomenon and many producers and service providers were trying to upgrade their management methods and substitute clerical role by supply chain (Tan, 2011). In order to speed up the market, less inventory levels, lower costs and more customer satisfaction, information technology is used in supply chain management. The ultimate objectives of the supply chain management for a manufacturing company are making the proper product for the proper customer in the right amount and at the right time (Wang et al., 2004). In supply chain management (SCM), supplier selection is one of the most important activities.

One of the most difficult and important links between manufacturers and suppliers is to make a reasonable coordinators among them, which is possible by using supply chain (Chen et al., 2006).

Liu (2005) states that choosing the proper suppliers are considered a kind of herculean task for the purchasing managers Purchasing is consists of providing raw materials, suppliers, and components for the companies. In addition The activities are involved with choosing and qualifying suppliers, ranking supplier performance, negotiating contracts, timing purchases, selling terms of sale, comparing price, quality and service, analysis the value received, anticipating cost, and sometimes demand changes, specially the shape of each products and etc. (Bello, 2003). Supplier selection process is focused on three major objectives which are consist of reducing purchase risk, increasing general value to the customer, and making a close but long-term relationship between buyers and suppliers (Monczka et al., 1998).

Making a proper decision would be vital and essential because deciding too quickly can be risky and dangerous. On the other hand, decision-making postpone can mean lose opportunities. Therefore, it is vital that people make up their mind. In order to achieve this goal, what people need, is a systematic and comprehensive approach to decision making (Saaty, 1990). In many manufacturing companies, many production management philosophies are eager to increase productivity and decrease costs. Thus, supplier selection is a problem that cannot be ignored easily. Supplier selection issue is one task of purchasing department, which is one of the factors in on-time delivery of products and decrease in material costs. When talking about business, one of the most important activities is decision making. To make proper decisions, managers need reliable forecasts. Decision-making is considering the scientific criteria to choose one alternative from a number of choices (Ozkan et al., 2011). Due to reliable suppliers, the inventory costs reduce and the product quality improves (Ofori, 2000) the most important step to create a successful alliance, a company must choose the appropriate partnership (Ozkan et al., 2011). Supplier selection is defined in as the ‘‘process of finding the suppliers being able to provide the buyer with the right quality products and/or services at the right price, at the right quantities and at the right time” (Ozkan et al., 2011; Ofori, 2000) . To evaluate and select the suppliers, every company has its own specific approach. The methods they use may be based on quality, reputation of the supplier, reliability, etc. While aiming for an objective selection of the suppliers, sufficient criteria or even detailed sub-criteria should be analyzed and a proper method should be chosen to make the best decision. It is necessary to define the objectives to be solved at the beginning of each decision-making problem and in this study the objective is to choose the best supplier out of given alternatives. Hudymáčová and Benková (2010) proposed a set of criteria and sub –criteria in a general way to satisfy a large spectrum of different products, which can be subject of interest, where supplier selection is needed.

In the decision-making processes, if only one criterion was used, the vendors (suppliers) selection would be so simple While in many situations, purchasers in order to make their decision, require to consider a range of criteria not just one criterion. In cases, which several criteria are used, it would be essential to verify how much each criteria affects process of decision-making (Yahya and kingman, 1999). Multi Criteria Decision Making (MCDM) techniques support the decision makers (DMs) in assessing a set of alternatives. Depends on the purchasing conditions, criteria of this situation play an important role and it is essential to weigh criteria (Dulmin and Mininno, 2003). In this Study the chosen method for MCDM is the Analytic Hierarchy Process (AHP).

1-1 Analytic Hierarchical Process (AHP)

The AHP method was first mentioned in 1980 by Saaty, and later elaborated. Since then it has been used in many applications and in different variants. Multi-criterial AHP method belongs to Multiple Criteria Decision Making tools (MCDM) (Hudymáčová et al.). Every day, people need to make different kind of decisions and their mind will be occupied with choosing the best options, which they are faced. Most of the time, these kinds of decisions can be hard to make or their complexity does not let the decision makers to make the best decision. Nowadays, it is possible to make complex decisions with mathematical models (Saaty, 1980).

AHP is a theory of measurement through pairwise comparisons and relies on the judgments of experts to derive priority scales. AHP is one of the best known and most widely used in MCDM and a decision support tool, which is used to solve complex decision problems. This method has been one of the most efficient and widely used tools, which researchers applied to solve MCDM problems in different variable areas such as political, economic, social, and management science. AHP is one of the widespread applications in decision-making process (Liu and Hai, 2005). A multi-level hierarchical structure of objectives, criteria, sub criteria, and alternatives is used in this method. And then a set of pairwise comparisons will be used to get appropriate result. These comparisons are used to obtain the weights of importance of the decision criteria. AHP ranks the alternatives of decision and when the decision maker has multiple criteria it helps to make the best decision, so it considers a powerful and flexible multi-criteria decision-making tool for dealing with complex problems where both qualitative and quantitative aspects need to be considered. In decision-making, the AHP method is identified to evaluate and resolve the supplier selection problem in choosing the optimal supplier combination in a specific company. (Yu and Jing, 2004).

Three important principles are made the AHP method. The first one is to structure the model, which the complex decision problem is structured into a hierarchy. By the use of AHP, it would be possible to arrange the goal, criteria, and alternatives in a hierarchical structure like a family tree, which has got at least three levels: goal on the top, criteria in the middle, and decision alternatives at the bottom. The second one is to make comparison between alternatives and the criteria. This pairwise judgment starts from the second level and finishes in the lowest level, which are alternatives. And the last one is the modulation of priorities. In each level, the criteria are compared pairwise according to their levels of influence and based on the specified criteria in the higher Level. In AHP, for pairwise comparisons a scale of nine levels is used as a comparison standard. The numbers show the intensity of importance it means 1 is equally important and 9 absolutely important. Table 1 shows the numerical rating for verbal judgment of preference.

Table 1: numerical rating for verbal judgment of preference

Verbal judgment of preference	**Numerical rating**
Extremely preferred	**9**
Very preferred	**7**
Strongly preferred	**5**
Moderately preferred	**3**
Equally preferred	**1**
Intermediate values between two neighboring judgments	**2,4,6,and 8**

2- LITERATURE REVIEW

In order to choose the proper supplier there are different methods, which can be used. In this paper AHP method is used to determine the best supplier. According to the literature, there are some studies, which have used AHP for

supplier selection. Some of these studies are summarized as followed:
(Liu and Hai, 2005) applied AHP to evaluate and select suppliers. Similar to Chan the authors did not apply the AHP's pairwise comparison to determine the relative importance ratings among the criteria and sub criteria. Instead, the authors used Noguchi's voting and ranking method, which allowed every manager to vote or to determine the order of criteria instead of the weights. Among all these literature two of them will be evaluated in detail:

2-1 Review of Dickson's study

As far as supplier (vendor) selection is a kind of complicated task, in decision-making process different kinds of criteria must be considered. It is necessary to mention that the focus of the scientists was on evaluation of criteria for selection and measuring the performance of suppliers. Today, Researchers have developed the evaluation and analysis processes. Zhang et al. (2003) reviewed the Dickson's (1966) study and identified a list of the most important criteria, which are used in supplier selection. At first sixty important factors were observed but this list of factors was later reduced to 23 criteria. According to the literature review, some of the most important criteria are delivery, Performance history, Warranties and claims, Production facilities, Price/Cost, Technical capacity, Financial position, Operation control, Repair service, Package ability, Management and Organization, Communication system, Reputation and position, Amount of past business, Customer service, Training aids. Among all these criteria quality is extremely important, Production facilities and capacity is considerably important. Average importance belongs to the Repair service criteria, and Training aids in consider Slight importance.

2-2 Review of Weber's study

Weber et al. (1991) classified all the articles, which were published since 1966. According to this classification, price, delivery, quality and production volume are the most important recognized criteria. Overall, Dickson (1966) presents 23 criteria, which will cover the majority of the criteria. Hence, for the actual industrial circumstances, Dickson's (1966) studies are very important. Weber et al. (1991) introduced ten criteria in order to choose the best suppliers, which are net price, delivery, quality, Production capability, Geographic location, Technical capability, Management and organization, Reputation and position in industry, financial position, and Performance history.

2-3 Comparison of Dickson and Weber's studies

This section covers the comparison between supplier selection criteria according to the Dickson (1966) and Weber et al. (1991) studies. As aforementioned, the result of Dickson's (1966) study was the identification of 23 different criteria. It determined that quality, delivery time and performance history were the most important factors for supplier selection. The result of Weber's studies was that, net price; delivery precision, production quality, and location were the most important selection criteria. In addition to these studies, other researchers have already concentrated on the significance of selecting the best criteria. Davidrajuh (2000) have reviewed some studies that have been done by Wilson (1998), which emphasizes the important criteria and its invariability. According to all these studies, 13 criteria were recognized as the most important criteria by some researchers, which have been summarized as follows in table 2:

Table 2: 13 most important criteria

	The most important criteria	Authors
1	**Quality**	Li et al. (1997); Yahya and Kingsman (1999); Tam and Tummala (2001); Yu and Jing (2004); Liu and Hai (2005); Weber et al. (1991); Zhang et al. (2003); Ghodsypour and O'Brien (1998), Dickson (1966)
2	**Cost**	Tam and Tummala (2001); Yu and Jing (2004); Amid et al. (2006); Li et al. (1997); Weber et al. (1991); Zhang et al. (2003); Ghodsypour and O'brien (1998), Dickson (1966)
3	**Delivery**	Yu and Jing (2004); Liu and Hai (2005); Yahya and Kingsman (1999); Dickson (1966); Weber et al. (1991)
4	**Trust**	Yu and Jing (2004)
5	**Responsiveness**	Yahya an Kingsman (1999); Li et al. (1997); Liu and Hai (2005)
6	**Financial**	Zhang et al. (2003); Liu and hai (2005; Dickson (1966); Weber et al. (1991)
7	**Management and Organization**	Zhang et al.(2003); Yahya and Kingsman (1999); Weber et al. (1991); Liu and Hai (2005); Dickson(1966)
8	**Discipline**	Liu and Hai (2005); Yahya and Kingsman (1999)
9	**Facility and Capacity**	Zhang et al. (2003); Weber et al. (1991); Liu and Hai (2005); Yahya and Kigsman (1999); Dickson(1966)
10	**Performance history**	Weber et al. (1991); Zhang et al. (2003); Dickson (1966)
11	**Environmental Performance**	Handfield et al. (2002)
12	**Technical Capability**	Tam and Tummala (2001); Liu and Hai (2005); Chen-Tung et al. (2006); Amid et al. (2006); Dickson (1966); Weber et al. (1991); Zhang et al. (2003)
13	**Warranty**	Zhang et al. (2003);Dickson (1966);

3- DISCUSSION

In this chapter the overall result of this paper will be presented. First of all, the result of case study will be explained. After that according to the designed questionnaire, the important supplier selection criteria will be discussed and identified. Finally, according to the results, the data will be classified and evaluated by expert choice software, and the best supplier will be selected which is the objective of this paper.

3-1 Questionnaires results

The questionnaire, which is used in this survey, is designed by expert choice software to evaluate the relative importance of the criteria that the experts considered most important. The

responders (experts) were asked to make a pair-wise comparison between criteria. This comparison is quantitative and the numbers, which are 1 to 9, are weight factors of each criterion. These numbers are from a standard scale, which was first introduced by Saaty (1990). In the company, two project managers R (1) and R (2) and one purchasing manager R (3) were asked to answer to the questions as responders. As far as the answers of these three responders are different, it is need to get average from their answers. In accordance with the data in table 2 and considering the results of the questionnaire, management and organization, trust, quality, cost and delivery have the highest weight averages. Figure 1 shows the hierarchy of the aforementioned criteria, and sub criteria are provided by interview. These are the input data for Expert Choice software. Expert Choice software makes pair-wise comparisons between each level of the hierarchy and chooses the best supplier.

4- CONCLUSION

Since the 1980s, supplier selection has attracted the interest of many researchers. In this study, identification of the important criteria for supplier selection was the main contribution. The criteria are trust, quality, cost, Delivery, and management and organization. After that all the data were analyzed by AHP method to identify and evaluate the supplier selection. The results showed that this method will help the decision-makers to examine the strengths and weaknesses of suppliers by comparing them with proper criteria, sub-criteria. It is necessary to mention that, the proposed AHP method is strongly effective in decision making. With the use of Expert Choice software, the results can be transferred to a spreadsheet for easy computations and it is easier to identify and evaluate supplier to arrive to a consensus decision.

In supplier selection, based on quality and quantity criteria, selection of the best and proper supplier is a kind of difficult task. By using the AHP technique, the buyers have the capability to analyze the data to get the ideal decision. In order to upgrade the results, the method of Fuzzy Analytic hierarchy process (FAHP) can also be applied. This method helps the user to make accurate decision based on the incomplete and ambiguous data.

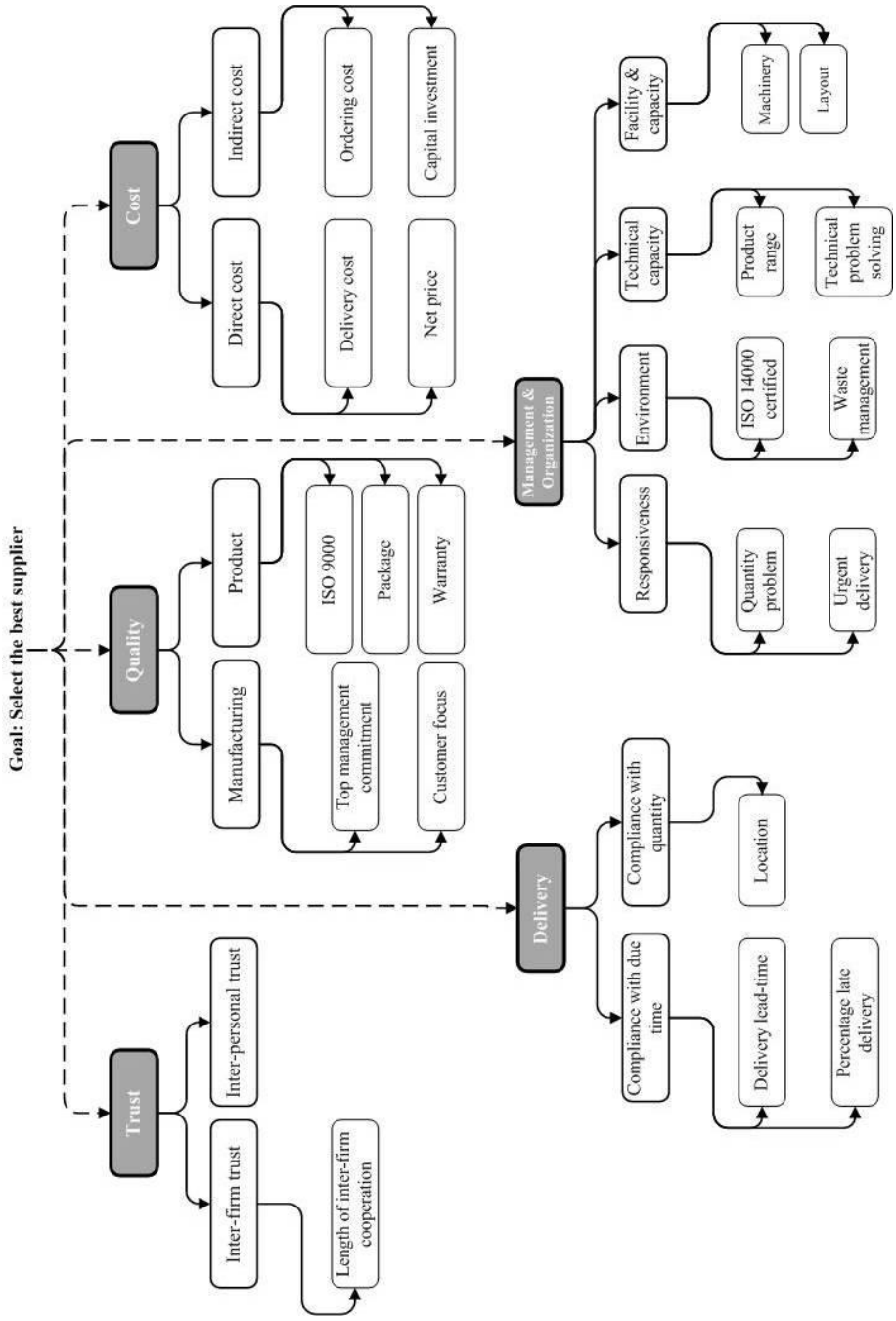

Figure 1: hierarchy of the criteria

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