



Research Paper

Factors that Influence the Supplier Selection of Manufacturing Businesses

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ABSTRACT : *The objective of this study is to find out the factors that influence businesses in manufacturing industry while selecting suppliers. The data used in the study were obtained from 80 small and medium sized enterprises in Samsun organized industrial site and small industrial areas by using face-to-face questionnaire method. KMO and Barlett's test were used to find out whether the data set used in the study was suitable for factor analysis. According to the results, KMO and Barlett's test results (0.761) show that the sample size is sufficient for factor analysis. Factor analysis gave a 4 factor structure that explained 84.48% of the total variance. The names of these factors and their rates of explaining the total variance were quality 33.08%, delivery 20.29%, price 18.72% and criteria about the supplier 12.39%, respectively. Cronbach's Alpha reliability coefficients of these four factors and their sub-components were 0.978, 0.967, 0.920 and 0.602, respectively. As a conclusion, it was found that the businesses in manufacturing industry placed great importance on the quality and delivery of the product provided by the supplier. In addition, manufacturing businesses aim to supply quality products from the supplier with the lowest cost within the same period of time in accordance with their objectives.*

Keywords - Supply chain, Supplier Selection, Manufacturing industry, SME, Factor Analysis

I. INTRODUCTION

The introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper. In today's global competition environment, whatever their scale is, an effective supply chain management is of great importance for businesses in terms of getting advantage in competition. An effective supply chain management can be provided by supplying the needed materials on time, in correct amount, in desired quality and with a suitable cost. In tough competition terms, businesses should give priority to selection of suppliers and they should follow a good supplier selection policy because the suppliers they choose will play important roles and be effective in the future of the business (Boer et al., 2001: 78).

Supplier selection is determining from whom and how much the required raw materials, semi-products and other materials will be bought (Ecer and Küçük, 2008: 357). The purpose of supplier selection is to determine suppliers with a high potential who can meet the needs of a business continually with an acceptable cost (Yang et al., 2008: 1481). The decision for supplier selection should always be based on reasonable criteria determined by businesses. Under normal circumstances, this decision is about how well the supplier can meet the criteria that influence the supply chain success such as quality, amount of product, cost, terms of delivery and service standard, which are demanded by the business (Yalçın, 2013: 23). In a sense, the criteria used in supplier selection are used in determining whether the suppliers are suitable for working with the business.

Supplier selection, which is an important decision problem for businesses, is important for small and medium sized enterprises (SMSE) which operate in manufacturing sector for the adaptation of processes. In the whole world, it can be seen that SMSEs are defined in terms of the number of staff working in businesses. According to the SMSE definition by Undersecretariat of Treasury, manufacturing businesses which have between 10 and 49 workers are accepted as small sized, while those which have between 50 and 250 workers are accepted as middle sized. SMSEs, which have an important place in the economy of countries in terms of

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their shares in industrial production and national income, have a share of 99.8% in total businesses, 74.2% share in total employment, 53.3% share in total investment and 52.8% share in total added-value (www.kobi.org.tr, 2016). Another development increasing the importance of SMSEs is the thought of mass production becoming outside the agenda and according to the new paradigm, not needing a very big capital stock, very big physical investments, very long period of time and very big employment to be able to produce lots and different types of goods with a low cost whenever needed (Karaerkek, 1992: 9). Supplier selection is extremely important for SMSEs for being able to produce suitable products for consumer expectations and to deliver these products to customers within correct time, for continuing non-stop production and for being able to prevent discontinuation (Küçük and Ecer, 2008: 436).

The objective of this study is to determine the factors effective in supplier selection of SMES which operate in manufacturing industry in Samsun by using Factor Analysis Method, which is one of the multivariate statistical analysis methods.

II. LITERATURE REVIEW

One of the first studies about the criteria used in supplier selection was conducted by Dickson in 1966. Dickson sent a questionnaire to 273 people who were chosen from purchasing agency and executives of National Association of Purchasing. 23 criteria were used here and the most important criteria were quality of the product, delivery on time and warranty policy (Dickson, 1966: 16-17). Many of the criteria defined by Dickson are used by manufacturing businesses in our day. The criteria to be used for supplier selection can be associated with characteristics such as the supplier's past, structure and technical capacity of the facility, financial status, organizational structure, reputation, communication skill, employer-employee relationship and location. In general, these criteria have specific weight ratios based on the quality and amount of the purchase from the supplier (Leenders et al., 2002). According to Doğruer (2005), in the supplier selection of a business, factors such as cost (raw material, semi product, and cost), quality (final product quality), service (special services such as part replacement and repair), location (transport time, cost, urgent goods and services), supplier stock policy (supplier's stocks), and flexibility (supplier's willingness and adaptation to changes) should be taken into consideration.

When studies about supplier selection are examined in literature, it can be seen that three factors come to the forefront in supplier selection: price (Levary, 2008; Katsikeas et al., 2004; Doğruer, 2005; Weber et al., 1991), quality (Öz and Baykoç, 2004; Levary, 2008; Doğruer, 2005; Chan and Chan, 2004; Chan and Kumar, 2007; Dickson, 1966; Liu and Hui, 2005; Weber et al., 1991; Pi and Low, 2006; Vonderembse and Tracey, 1999; Küçük and Ecer, 2008) and delivery (Katsikeas et al., 2004; Doğruer, 2005; Chan and Chan, 2004; Chan and Kumar, 2007; Liu and Hui, 2005; Küçük and Ecer, 2008). In addition, criteria about the supplier such as supplier's talent and capacity, supplier's image, supplier's financial structure (Küçük and Ecer, 2008; Cusumano and Takeashi, 1991), supplier's management structure and management type, warranty and insurance policies provided by the supplier, flexible payment terms of the supplier are also used in the assessment of supplier assessment.

There are a great number of approaches in literature about supplier selection. According to Sönmez (2006: 33) decision making strategies such as artificial intelligence and expert systems (neural Networks, event based inference, Bayesian network), mathematical programming (techniques based on total cost, nonlinear programming, complicated integer programming, heuristic, target programming, data envelopment), MCDM (Analytical hierarchy method, ordering methods, MAUT, linear weight point, judging modeling, judging structural modeling, categorizing modeling, fuzzy clusters), multi variable statistical analysis (structural equality model, basic key analysis, factor analysis, confidence interval approach) and other decision making tools (groups decision making, multiple method) are used in supplier selection.

There are a great number of studies with different decision making methods on different sectors for supplier selection problems. In a study by Liu and Hai (2005), AHP method criteria such as quality, flexibility, delivery and cost were used during the process of supplier selection (Liu and Hai, 2005). In their study in which they used BAHF method to measure the performances of the suppliers of businesses in automotive sub-industry, they took into consideration main criteria such as technical competency, delivery, quality, service, setting the price and innovation (Akman and Alkan, 2006: 27). As a result of the AHP method used in the supplier assessment process of a textile business to assess a great number of numerical and non-numerical criteria which conflicted each other, Öztürk et al. found criteria such as quality, cost, supply performance, technical capacity, promotion/option, financial capacity and experience/willingness (Öztürk et al., 2011: 93-112).

In a study by Jayaraman et al. (1999), which used complex integer programming method, cycle time, level of quality, production capacity and storage capacity were discussed as supplier limitations. Tracey and Tan (2001) used supplier selection criteria for the analysis of the association between another statistic technique structural equality model and suppliers' participation in product design and continuous development programs, customer satisfaction and business performance (Özdemir, 2007: 55). Albino and Garavelli (1998) realized

supplier selection with a decision support system based on neural networks (Özdemir, 2010: 60). In a study conducted by Demir (2010: 88) on a food business in manufacturing sector, one of the supplier selection ÇKKV methods, fuzzy TOPSIS method was used and the significance weights of decision criteria were found from the biggest to smallest as correct cost advantage, flexibility, terms of payment, quality, supplier reliability and delivery on time. Choi and Hartley (1996) analyzed supplier selection applications in automotive industry by using questionnaire. 23 supplier selection criteria were used in the study and as a result of factor analysis, these criteria were determined as finance, stability, association, flexibility, technological skills, service, reliability and price.

III. MATERIAL AND METHOD

This study examined the factors effective in supplier selection of SMSEs operating in manufacturing industry sector in Samsun organized industrial site (OIS) and small industrial areas (SIA). According to the data of Samsun Chamber of Commerce, there are a total of 700 manufacturing businesses in Samsun (micro, small sized and large), 133 of which are in OIS and 567 of which are in SIA. In line with the purposes of the study, the businesses included in the study were small and middle sized. In order to limit the research area, firms which had been operating at least for 5 years were chosen. Within this context, the universe of the study included 266 businesses. 80 businesses, which are the 30% of these 266 businesses, were chosen with simple random sampling method (Akın 1998; Güleş 1999; Güleş and Çağlıyan 2002). Face-to-face questionnaire method was applied on the owners or managers of these chosen businesses in April 2016.

The questionnaire used in the study consists of two parts. The first part contains general questions about the businesses participating in the study. In the second part, there are 19 expressions with 7-Likert type in order to find out the supplier selection criteria of SMSEs. The supplier selection criteria in the questionnaire form prepared in line with the purposes of the study made use of the commonly used criteria in supplier selection as a result of the related literature review. These criteria were: quality of the product, delivery in correct amount, being affordable, delivery with package, certificate of the supplier, quality of service, talents of the supplier, solving the quality problem, type of payment, stable quality, delivery on time, amount of faultless product, quality of production, option time, financial structure of the supplier, flexibility of the supplier, reliability, supplier's past and innovation. The expressions made from these criteria were presented to 80 SMSEs manufacturing in OIS and SIA through a questionnaire and each business was asked to assess these criteria according to their own priorities in 7-likert type scale. The 7-likert scale expressions used in the study were: strongly disagree (1), disagree (2), partly disagree (3), undecided (4), partly agree (5), agree (6) and strongly agree (7).

Factor analysis was made to determine the structural validity of 7 likert type scale prepared. Factor analysis is a technique which aims to find out and explore few unrelated and conceptually significant new variables (factors) by bringing together related variables (Büyüköztürk, 2010: 123). Before factor analysis, it should be found out whether factor analysis can be conducted. To do this, Kaiser-Meyer-Olkin (KMO) test should be applied to test the sufficiency of the data obtained from the existing sample and Bartlett test should be applied to test the normality of distribution in the universe (Pallant, 2005: 174; Büyüköztürk, 2010: 126; Tavşanlı, 2010: 50-51).

KMO tests whether partial correlations are small and whether the distribution is sufficient for factor analysis. KMO value can be between 0 and 1, it is interpreted as normal between 0.5 and 0.7, as good between 0.7 and 0.8, as very good between 0.8 and 0.9 and as perfect when it is over 0.9 (Field, 2005). This study used Kaiser- Meyer-Olkin and Barlett test to test the sample sufficiency (Kaiser, 1974).

The expressions which were formed to determine the factors that influenced supplier selection were assessed through factor analysis. The data obtained were analyzed through SPSS 20.0 statistic package program. Later, reliability analysis was conducted on these factors and their sub-components and the test's reliability was shown.

IV. RESULTS OF THE STUDY

Figure 1 gives the distribution of the businesses in Samsun which participated in the study in terms of the sectors they operated in. As can be seen in Figure 1, in the field work, which was conducted with firms operating in a wide range and in different sectors, most observed sectors were food (23%), furniture (12%) and medical (11%) sectors.

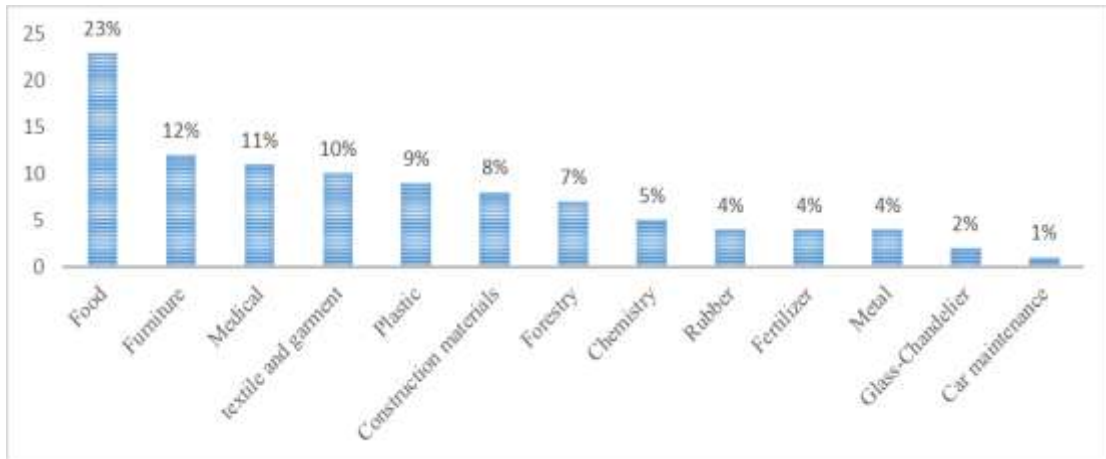


Figure 1. Sectors of the businesses

When the businesses' years of operation were analyzed, it was found that 45% had been operating for between 31 and 40 years. This rate was followed by businesses that had been operating for more than 41 years with a rate of 25% (Figure 2). 52% of the businesses that participated in the study were found to be limited companies (Figure 3).

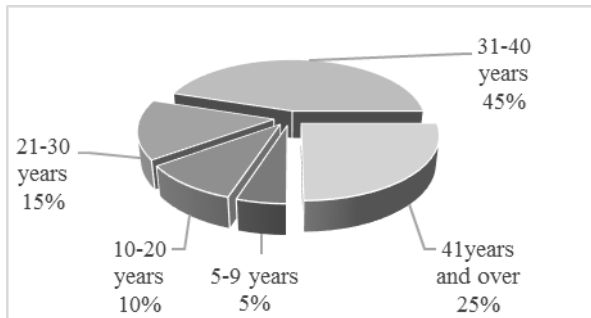


Figure 2. Businesses' years of operation

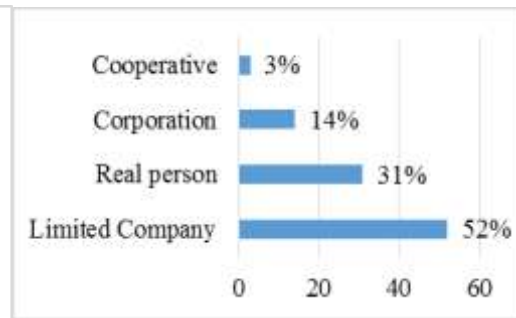


Figure 3. Types of businesses

When the capital structures of the businesses were analyzed, it was found that a large part of them (70%) were national capitals, 20% were family companies and 10% were foreign capitals (Figure 4). In terms of their area of operation, it was found that 45% of the businesses that participated in the study operated only within the country, 37% operated only abroad and 18% operated both within the country and abroad. When the businesses operating both within the country and abroad and the businesses operating only abroad are considered together, it can be seen that 55% of the businesses compete in international market (Figure 5). The importance that businesses which want to sell goods and services in international markets place on supplier selection during the supply chain process is important in terms of increasing competitiveness. When the number of workers in businesses is considered, it can be seen that 45% of the businesses were small sized with 10-49 workers, while 55% were middle sized with 50-249 workers.

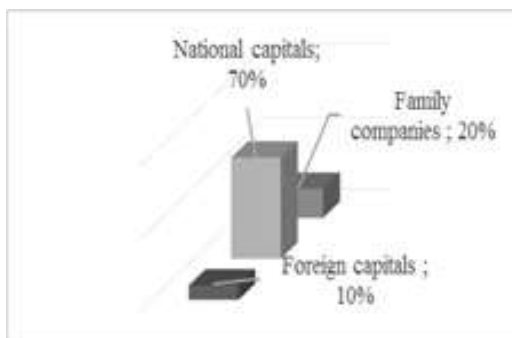


Figure 4. Capital structure of businesses

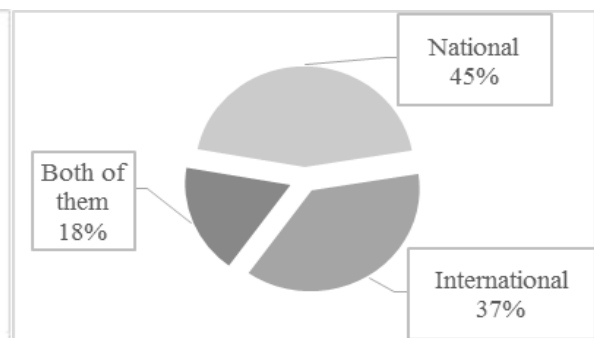


Figure 5. Markets of the businesses

First, factor analysis was applied on 19 expressions to find out the factors that influenced supplier selection. In the first factor analysis, the number of factors was not limited and 7 factors were found with and eigenvalue of bigger than 1.00. As a result of factor analysis, 5 items which gave high load values in more than one factor were taken out of the scale and the analysis was remade. In this study, factor loading cut-off value was accepted as 0.30. While there are different techniques that can be used to find out factor structures, Principal Component Analysis is the most frequent used one in literature (Klainbaum, et al., 1987; Zeller and Karmines, 1978).

KMO and Bartlett test values as a result of the analysis remade show that the sample size and the data obtained are suitable and sufficient for analysis (Table 1).

Table 1: KMO and Bartlett's Test Values

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.761
Bartlett's Test of Sphericity	Approx. Chi-Square	1622.256
	Df	91
	Sig.	.000

As a result of this factor analysis, Varimax rotation technique was used and a structure of 4 factors and 14 sub-components was obtained (Figure 6).

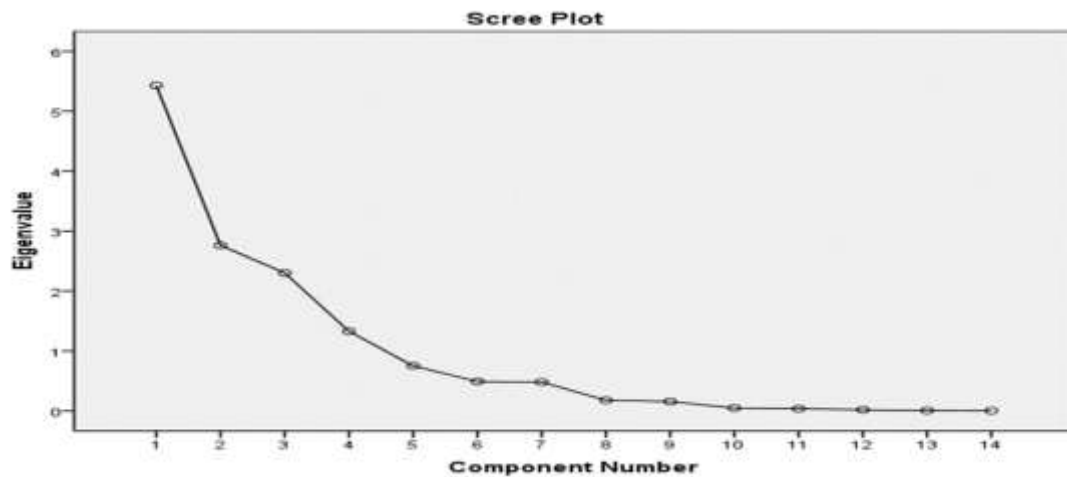


Figure 6 .Eigenvalue scree plot

These four factors obtained explain the 84.479% of the total variance. The first of these factors was named as “Quality” and quality factor was found to explain 33.08% of the total variance. The subcomponents and factor loadings of the quality factor were determined as quality of the product (0.982), amount of faultless product (0.979), solving the quality problem (0.965), quality of production (0.960) and stable quality (0.848). The second factor was named as “delivery” and delivery factor was found to explain 20.29% of the total variance. The subcomponents and factor loadings of the delivery factor were determined as delivery on time (0.970), delivery in correct amount (0.965), and delivery in package (0.910). The third factor was named as “price” and price factor was found to explain 18.72% of the total variance. The subcomponents and factor loadings of the price factor were determined as affordability (0.958), type of payment (0.920) and option time (0.836). The last factor effective in supplier selection was named as “criteria about the supplier” and this factor was found to explain 12.39% of the total variance. The subcomponents and factor loadings of the factor of criteria about the supplier were found as financial structure of the supplier (0.782), talents of the supplier (0.766) and certificate of the supplier (0.689) (Table 2).

Table 2. Results of EFA

Factors and items	Factor loading	Eigen values	Variance Explained %	Cronbach's Alpha
F1:Quality				
In my supplier selection, quality of the product is important	0.982	38.803	33.077	0.978
The amount of faultless product influences my supplier selection	0.979			

When I have a problem with quality, my supplier's solving this problem influences my supplier choice	0.965			
Quality of the product is important in my supplier selection	0.960			
My supplier's not decreasing the level of quality is an important factor in my supplier selection	0.848			
F2: Delivery				
Delivery on time is important in my supplier selection	0.970	19.738	20.294	0.967
Delivery in correct amount is very important in my supplier selection	0.965			
Delivery in package is my priority in my supplier selection	0.910			
F3: Price				
I care about affordability in my supplier selection	0.958	16.447	18.719	0.920
Type of payment is an important factor in my supplier selection	0.920			
Option time is a reason for preference in my supplier selection	0.836			
F4: Criteria about supplier				
My supplier's financial structure is important in my supplier selection	0.782	9.492	12.389	0.602
The talents of my supplier is my priority in my selection	0.766			
I pay attention to my supplier's having a certificate in my supplier selection	0.689			

*Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 5 iterations.

After the factors that influenced supplier selection were found, reliability analyses were conducted on these factors separately. Cronbach's Alpha reliability coefficients of these four factors and their subcomponents were as follows: quality 0.978, delivery 0.967, price 0.920 and criteria about the supplier 0.602. The reliability analyses conducted showed that the factors that influenced supplier selection were reliable.

V. CONCLUSION

Whatever their sizes, all businesses basically try to catch competitive advantage and thus to maximize their profit. Supplier selection and sustainable building relationships with the selected suppliers, which is one of the inputs of having competitive advantage for SMSEs, plays a very important role in catching this advantage. The importance placed on supplier selection in SMSEs enables building long term relationships with suppliers which are not dependent on only the cost of the supplied product and these relationships affect the competitive power of the business positively in the long run.

Various methods are used in supplier selection and one of these methods is factor analysis. Factor analysis is a useful method that aims to measure variables that measure the same structure by bringing them together and explaining them with few numbers of factors. The study was conducted on SMSEs which operate in manufacturing industry in OIS and SIA in Samsun. The criteria used in supplier selection in literature were analyzed and 19 items were created to find out the factors that may be effective in supplier selection of SMSEs. Administrators were asked to assess these criteria in the 7-likert type scale according to their level of priority in terms of suppliers and the data obtained were assessed in SPSS 20.0 statistic package program by factor analysis.

In the study, 4 factors and 14 subcomponents of these factors were found that influenced the supplier selection of SMSEs. The four factors obtained explain the 84.479% of the total variance. These factors are quality, delivery, price and criteria about the supplier. Subcomponents of quality are quality of the product, amount of faultless products, solving the problem of quality, quality of production and stable quality. Delivery subcomponents are delivery on time, correct amount of delivery and delivery in package. Price subcomponents are affordability, type of payment and option time. Subcomponents of the factor related with the supplier are the financial structure of the supplier, talents of the supplier and certificate of the supplier.

Basic criteria list can be prepared for the assessment of suppliers to find the right suppliers, to develop healthy supplier relationships and to create a long term working system because wrong supplier selection can cause important financial and operational losses. The features looked for in a supplier should include level of meeting the needs, understanding the needs of the business and the presenting solutions that can solve the problems.

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