

CHALMERS



Evaluating the Existing Suppliers' Performance and Selecting New Ones

Centraction AB Case Study

Master's Thesis within the Quality and Operations Management Program

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CHALMERS UNIVERSITY OF TECHNOLOGY
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Abstract

The purpose of this study is to develop a supplier selection and evaluation approach based on both qualitative and quantitative tools by considering the key determinants of the company. The approach will be used for evaluating the performance of existing suppliers and selecting new ones in the Centraction AB's purchasing process. Moreover, the report aims to be a guideline for management at Centraction AB about how to deal with the supplier selection and evaluation work. This purpose grouped in to one main research question; *how can the supplier selection and evaluation be done in Centraction AB* and three sub-research questions; *what kind of supplier selection and evaluation framework should be followed by Centraction AB; What are the criteria's to be considered while making supplier selection and evaluation and; and what are the relations between purchasing strategy and supplier selection-evaluation operations*. A detailed literature study, totally six supplier site visits and, totally 9 Centraction AB and supplier based personal interviews were held to collect data in order to fulfill the purpose of the study. The analytic hierarchy process (AHP) was used to evaluate the collected data.

The thesis conclude that cleanliness, reliability, flexibility, co-operation, quality, product development, warranties and claim policies, price and geographical location are the important supplier selection and evaluation criteria of Centraction AB. In addition to that a new supplier- selection and evaluation framework for Centraction AB is presented in this study. Also, the purchasing strategy of Centraction AB is associated with its supplier selection-evaluation operation and some discussions and recommendations are presented.

Key words: Supplier selection, supplier evaluation, purchasing, supplier relationship

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TABLE OF CONTENTS

1. Introduction.....	1
1.1. Background.....	1
1.2. Purpose.....	1
1.3. Company Description	2
1.4. Problem Description and Research Questions	3
1.5. Limitations of Study	4
1.6. Disposition	4
2. Methodology	6
2.1. Research Design.....	6
2.2. Research Strategy.....	6
2.3. Data Collection	6
2.3.1. Primary Data	7
2.3.2. Secondary Data	9
2.4. Validity and Reliability.....	9
3. Theory	11
3.1 Purchasing strategy	11
3.1.1 Organizational Buying Process.....	12
3.2. Supplier Selection	13
3.2.1. Supplier Selection Process	13
3.2.2. Supplier Selection Criteria	15
3.3. Supplier Performance Evaluation	16
3.3.1. Importance of Measuring.....	17
3.3.2. Selecting Performance Parameters.....	18
3.3.3. Measurement Methodologies.....	19
3.3.4. Quantitative approach to supplier evaluation.....	20
3.3.4.1. <i>Analytic Hierarchy Process (AHP)</i>	20
3.3.5. Supplier Performance Feedback	23
3.4. Supplier Relationships	24
3.4.1. Sellers' uncertainties and buyers' tactics in supplier relationships.....	26
3.4.2. Buyers' uncertainties and sellers' tactics in supplier relationships.....	27
4. Current Company Conditions	28
4.1. Purchasing Strategy of Centraction AB	28
4.3. Supplier selection and evaluation framework	29

5. Development of Selection and Evaluation Tool	31
5.1. Designing supplier selection-evaluation criteria.....	31
5.2. Evaluation of each criteria and alternatives	35
5.3. Results of the AHP model.....	41
6. Discussion and Recommendations.....	43
6.1. Discussion	43
6.1.1. Purchasing Strategy.....	43
6.1.2. Supplier selection-evaluation framework	44
6.1.2.1 Supplier selection-evaluation criteria.....	45
6.1.3. The evaluation of supplier selection and evaluation tool - Analytical Hierarchy Process (AHP).....	46
6.1.3.2. General evaluation, weaknesses and strengths of tool.....	46
6.1.3.4. Comparison of the results	48
6.1.4 Supplier Relationships	48
6.2. Recommendations.....	51
6.2.1. Short-term recommendations.....	51
6.2.2. Long-term recommendations	52
6.2.3. Future Researches	55
7. References.....	57
8. Appendix A.....	l

TABE OF TABLES

Table 1 List of conducted interviews	7
Table 2 Supplier selection criteria.....	16
Table 3 Summary of evaluation approaches	19
Table 5 pairwise comparison matrices	22
Table 6 The fundamental scale for pairwise comparisons	22
Table 7 Pairwise comparison matrices of alternatives	23
Table 8 Economic consequences of supplier relationships.....	24
Table 9 Existing Supplier selection-evaluation frame work of Centraction AB	29
Table 10 Supplier evaluation and selection criteria of Centraction AB.....	33
Table 11 Pair-wise comparisons of each criteria	36
Table 12 Pair-wise comparisons of suppliers.....	38
Table 13 AHP implemented existing framework of Centraction AB	52

TABLE OF FIGURES

Figure 1 Disposition of thesis	5
Figure 2 Impact of developments on the complexity of initial purchasing decisions	12
Figure 3 Phases of supplier selection process and tasks in supplier selection	15
Figure 4 A simple AHP hierarchies	22
Figure 5 Customer-supplier feedback process	24
Figure 6 Buyer-seller relationship.....	26
Figure 7 Basic analytic hierarchy of Centraction AB.	32
Figure 8 The weights of each criteria.....	37
Figure 9 Overall scores	41
Figure 10 Performance sensitivity diagram	41
Figure 11 Developed supplier selection and evaluation framework.....	54

1. Introduction

This chapter gives an introduction to this thesis work. It starts with, the background to why this thesis work done. This is followed by the purpose of study, company description, problem description and research questions and, delimitations of study. The chapter ended up with disposition of the thesis report.

1.1. Background

This thesis is written within the scope of the master's program Quality and Operations Management at Chalmers University of Technology in Goteborg/Sweden. The thesis work was carried out at Centraction AB Company in Sweden. As it is given by Cheraghi et al. (2004) increased competitiveness, rapidly changing market demands and quick changes on manufacturing technologies characterize today's business life. To survive in this world, every unique company is trying to find a way of cutting production and material costs without decreasing the quality of their products for being competitive and profitable. To do this, every single business activities are playing very critical role in value creation process. The purchasing process is regarded as the beginning of this value creation process. Also De Boer et al. (2001) mentions that when it comes to the share of purchasing operations on the final cost of products, it starts from 50% and rise up to 90% in some cases. Thus, a lot of companies are looking forward to find a way of decreasing the cost share of purchasing operations on the final cost of their products without decreasing quality of their product. Sonmez (2006) states that, effective, efficient and well-designed supplier selection and evaluation systems are needed to do that. Hutt and Speh (2010) add that supplier selection and evaluation activities are given as core activities in purchasing process, since supplier selection and evaluation activities have direct effects on important issues such as; customer satisfaction, quality, profitability and competitiveness of company.

Centraction AB is the one of those companies which is looking forward to have efficient, effective and well-designed supplier selection process to have better product and satisfy their customers better than other competitors. To do that, General Manager of Centraction AB; Björn Cagner asked us to deal with their supplier selection and evaluation processes in the winter of 2010. Within this context, existing purchasing, supplier selection, evaluation process were analyzed, both existing and potential supplier site visits were done and, interviews are held with both existing and potential suppliers.

1.2. Purpose

The purpose of this study is to develop a supplier selection and evaluation approach based on both qualitative and quantitative tools by considering the values of the company. The approach will be used for evaluating the performance of existing suppliers and selecting new ones in the Centraction AB's purchasing process.

Moreover, the report aims to be a guideline for management at Centraction AB about how to deal with the supplier selection and evaluation work.

1.3. Company Description

Centraction AB was founded in 2002 at Goteborg/Sweden by Björn Cagner and his wife Elisabet Cagner. Under the leadership of the founders, the company deals with designing and manufacturing of; central vacuum cleaners, mobile vacuum cleaners and various accessories at high quality and performance for both industrial and commercial usage. Centraction AB has wide range of customers such as; plastic industries, hotels, clean rooms, hospitals, construction sites as well as car, food and aircraft industries.

Centraction AB has one manufacturing facility in industrivägen area of Goteborg. The company has totally 8 workers and all of them are located in Sweden. Approximately 350 products were produced in 2010 and 70% of them were exported to more than 25 countries in worldwide (Singapore, China, Turkey, etc.). Centraction AB has 50 dealers in total. Most of them are located in Europe. Dealers are responsible for distribution of the products to customer areas and installation of the products. Centraction AB also educates the dealers to offer after sale service for their customers.

The products are grouped into four segments according to the potential usages; industrial, commercial, dust logistics and accessories;

- *Industrial segment* contains VC series, F series and Big Bag Solutions (BBS) products which are designed to be efficient, robust, longevity, easy-to-use and maintain in industrial areas.
- *Commercial segment* contains Hoteline, Comline, NonStop, LexVac and suitable VC series products which are designed to be efficient, robust, stable, silence, visual, easy-to-navigate, run continuously, low maintenance require and fit in to tight spaces in commercial areas.
- *Dust logistic segment* include Construction Site Logistics (CSL), BBS, Small Bag Solution (SBS), ME and M mobile series products which are designed to be robust, durable, easy-to-move, portative, easy-to-operate, low maintenance requirements, visual and low- energy consumption in both commercial and industrial operations.
- *Accessories segment* contains hose reels, pre separators, installation material, duct systems and cleaning accessories products for both commercial and industrial usage.

Centraction AB has a good reputation in Swedish business circles. Financially, it was certificated as AAA annually since 2003 which is the highest credit worthiness achievable by the largest Swedish credit system Soliditet. In addition to that, Centraction AB has been classified as UC Credit Rating 5 (highest credit worthiness achievable) since 2007 which means a very low probability (from 0, 03

to 0, 24) for a company to become insolvent in the following year. Moreover, the founders of Centraction AB, Björn Cagner and Elisabet Cagner have been named as “Entrepreneur of The Year 2011” in Partille. This award is given to the entrepreneur who has best environmental approach in the development of their company as well as responsible personnel policy. Also this award shows the stable and responsible development of Centraction AB as well as interest in environment and social engagement.

“Quality, innovation and reliability” are the three key words which are enough to summarize Centraction AB’s business strategy. In the light of this strategy, they aim to be competitive in the central and mobile vacuum cleaning market by producing high quality, innovative and reliable products with affordable price. Especially when it comes to innovativeness, Centraction AB regarded as the best manufacturer in the market by customers. The company is always ready to offer suitable solutions by modifying existing products or developing a new one according to their customers’ dust problem (Centraction, 2011).

Centraction AB. likes to deal with challenges which are regarded as “impossible” to deal for their competitors. Their vast knowledge and extensive experience helps them a lot while dealing with such kind of tough challenges. They look those challenges as source of innovativeness. Furthermore, Quality is a “must” for Centraction AB; they believe that if you have a good quality product, you will always sell it. But if you have a bad quality product, you will only sell it once. And, they know the importance of having quality based long lasting relations with customers that promotes new customers, positive word-of-mouth and increase the loyalty of customer. Additionally, Centraction AB will be regarded as reliable company, because of their reliable solutions to their customers’ problems. The customers can always get help from them. For the upcoming years, Centraction AB desired to sustain those specialties and aims to be; establishing the brand “Centraction” and become more widely known, double the turnover in following three years, increase the export rate to 80% and develop more innovative products according to needs of customers. (Centraction, 2011)

1.4. Problem Description and Research Questions

Finding the right product and right supplier is more important to than finding the customer for Centraction AB. Reliable and cooperative suppliers are needed in purchasing operations since the company is not manufacturing any components of their products and just do the assembly, regarding few exceptions. So that suppliers has vital importance for Centraction AB. In that point, well-designed, efficient and effective supplier selection and evaluation process is needed to give right decisions. Till now, only Björn Cagners’ experience based qualitative perspectives takes role in those kinds of selections and evaluations. But from now on, Centraction AB needed to have a proper supplier selection and evaluation approach which include both qualitative and quantitative perspective as well as to include the experiences of Björn Cagner to perform better supplier selections and evaluations in purchasing

operations. To do this, some the research questions are developed and listed as follows;

- How the supplier selection and evaluation can be done in Centraction AB?
 - What kind of supplier selection and evaluation framework should be followed by Centraction AB?
 - What are the relations between purchasing strategy and supplier selection-evaluation operations?

1.5. Limitations of Study

There are totally four limitations that need to be addressed in this study. The first one is the number of suppliers that Centraction AB have; Centraction AB has totally 60 suppliers. So, it was hard to cover all of them in this study and some selections were done by considering this limitation; the most important and critical ones were selected to analyze. The second limitation was the distance between those suppliers. Centraction AB has suppliers both from Sweden and other countries so it was limited the study to cover all of them. To overcome this limitation, only the most important critical, and nearest (which are located in Sweden) are selected to analyze. The third limitation was the time for this study. Hence, the study was limited in to 20 weeks, time becomes limitation. Fourth and last limitation was the travelling budget. There was limited travelling budget for this study so least costly travelling channels and nearer suppliers are selected in this study.

1.6. Disposition

This thesis divided in to 6 chapters (see Figure 1);

Chapter 1- Introduction: This chapter gives an introduction to this thesis work. It starts with, the background to why this thesis work done. This is followed by the purpose of study, company description, problem description and research questions and, delimitations of study. The chapter ended up with disposition of the thesis report.

Chapter 2- Methodology: This chapter the research strategy and the data collection methods are described. The research design and strategy is explained and it continues with description of data collection methods. The chapter ends with the quality assurance, including the validity and reliability of the study.

Chapter 3- Theory: This chapter provides theoretical knowledge about supplier selection process, which starts with purchasing and follows the steps of supplier selection process. It is divided into 3 groups; purchasing, supplier selection and supplier performance evaluation which includes the core parts of supplier evaluation.

Chapter 4- Current Company Conditions: This chapter explains the company vision about purchasing operations and the supplier selection, evaluation and relations. It

will give the broad information about the interviews to build up the development model that is used for supplier evaluation and selection.

Chapter 5- Designing Supplier Selection-Evaluation Parameters: This chapter describes the priorities and choices of the factors that affect supplier selection and evaluation. This Chapter combines the theoretical approaches which are given in literature with practical approaches which are driven from the experience of Centraction AB managers.

Chapter 6- Discussion and Recommendation; This chapter is divided into two section; discussion and recommendations. The discussion section includes discussions about purchasing process-strategy, supplier selection-evaluation process, the evaluation of supplier selection-evaluation tool (Analytical Hierarchy Process (AHP)), supplier relationships and limitations of study. In addition to that, discovered short-term and long-term recommendations are presented in the recommendations section of this chapter.

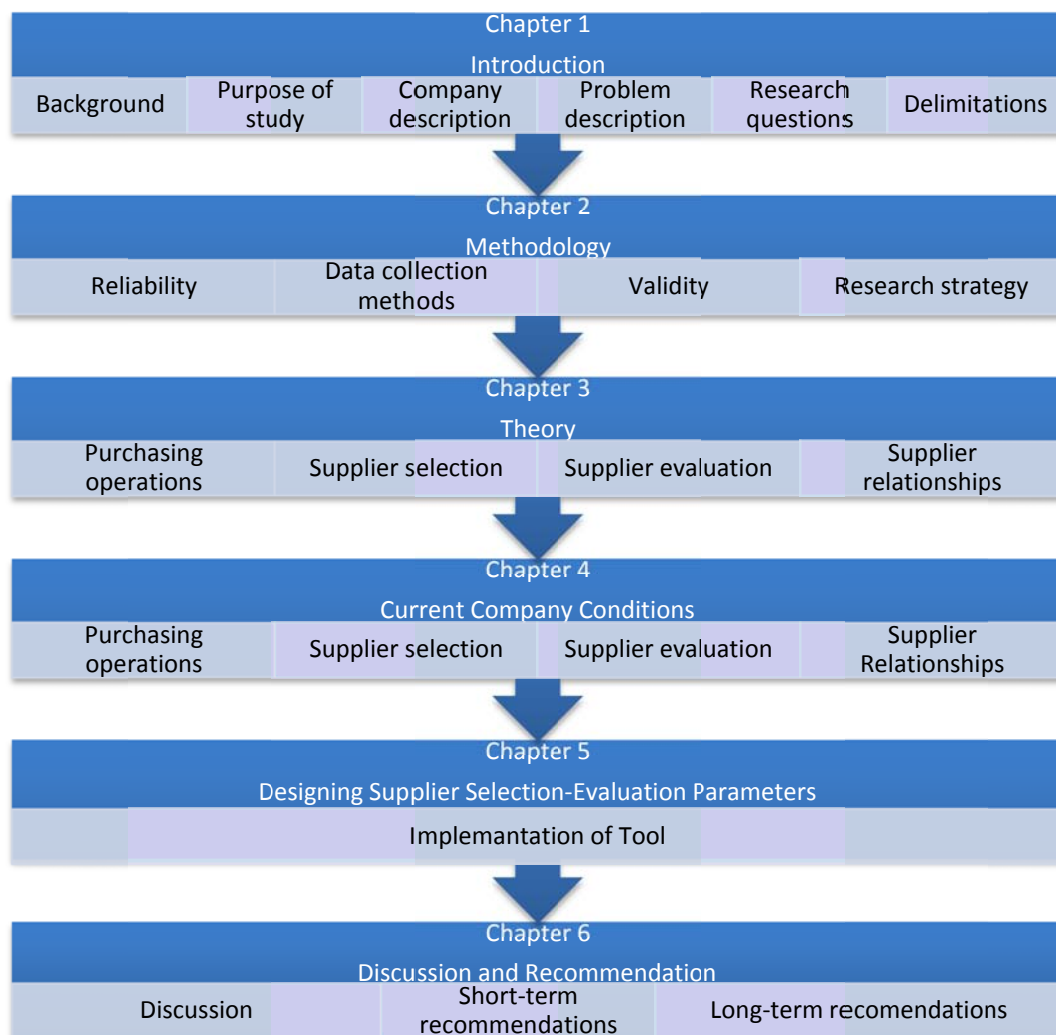


Figure 1 Disposition of thesis

2. Methodology

In this chapter the research strategy and the data collection methods are described. The research design and strategy is explained and it continues with description of data collection and data evaluation methods. The chapter ends with the quality assurance, including the validity and reliability of the study.

2.1. Research Design

Bryman and Bell (2007) propose five different research designs. The first one is experimental design, where an experiment is conducted and independent variable is manipulated to decide if it has an affect on the dependent variable. This approach is unfamiliar with our study with manipulation of the variables. The second research design is the cross sectional design consists of more than one case. In this study, the information gathered from the companies is just about one case. Thus, this research design is neither unlikely with this study. Third research design is longitudinal design, where a survey is conducted and than conducted at leaset one more time and the other research design is the comparative design, which compares two or more cases.

Case study research design is conducted, which can be with a single organization, single location, a single person, and a single event. We have worked only with Centraction and interviewed only with the general manager of Centraction AB company; Björn Cagner.

2.2. Research Strategy

It is agreed that there are two research strategies; quantitative and qualitative. Quantitative research commonly has a hypothesis considering the theory and then it is tested. The data is collected by surveys and it is quantifiable. On the other hand, qualitative research focuses on the empirical findings and covers them with the theory. It emphasizes the generation of theories where the quantitative research emphasizes testing of the theory. Qualitative and quantitative research strategies are used together in this study. In data collection, qualitative data and quantitative data are both used.

Bryman and Bell (2007), mention two different types of theory; deductive and inductive. Deductive theory mostly has a hypothesis and tests the gathered data depending on the theory. That is used for quantitative research. On the other hand, inductive theory combines theory and the analysis and generates theory. This is used for qualitative research. In this study, both qualitative and quantitative research was done, which means that both deductive and inductive data are gathered.

2.3. Data Collection

Considering the research type of this study, different data collection methods were used. Data had two categories; primary and secondary. Secondary data is the data that is gathered from the existing findings that others have experienced. On the

other hand, primary data is first gathered by the authors' observations (Guffey and Loewy, 2010). To fulfill the secondary data, literature research was done and for the primary data, interviews were done with the General Manager of Centraction AB.; Björn Cagner and both with existing and potential suppliers.

2.3.1. Primary Data

To gather the primary data, face to face interviews were conducted rather than by telephone, to have the flexibility of time. The interviews were all held in the offices of all interviewees to create a comfortable atmosphere. Interviews took between one hour and three hours. The interviews were designed as semi-structured, i.e. had some pre-determined questions. Semi-structured interviews have open-ended questions to have flexibility by asking further questions considering the predetermined list of questions (Mukherjee, 2003).

The companies that will take part in the evaluation process were discussed with the supervisor at Centraction AB and through his opinions; three companies were chosen that have different size and produce different type of products, considering the desire of taking part in the evaluation process. The first and second company was the ones that Centraction AB has close relationship and have co-operation. They are both medium-sized companies and have higher capacity compared to the third one. Before all the interviews, the reason and the main goal of the project and the interview were described. The list of interview has shown in table 1.

Table 1 List of conducted interviews

Date	Place	Interviewee	Company	Type of interview
2011/01/18	Goteborg	Björn Cagner	Centraction	Preparation
2011/02/03	Goteborg	Björn Cagner	Centraction	Data collection
2011/02/14	Markaryd	Anonymous	Supplier 1	Data collection
2011/02/14	Alingsås	Anonymous	Supplier 2	Data collection
2011/02/14	Hillerstorp	Anonymous	Supplier 3	Data collection
2011/02/21	Izmir	Anonymous	Potential supplier 1	Data collection
2011/02/25	Izmir	Anonymous	Potential supplier 1	Data collection
2011/03/01	Izmir	Anonymous	Potential supplier 2	Data collection
2011/03/17	Frankfurt	Anonymous	Potential supplier 3	Data collection
2011/03/07	Goteborg	Björn Cagner	Centraction	Preparation
2011/05/03	Goteborg	Björn Cagner	Centraction	Final meeting

The first interview with Björn Cagner was about planning the project, defining what he really wants from us and what we can do for him and it is represented as “preparation” in the table. The second interview with him was about defining and

deciding the supplier selection-evaluation criteria which took three hours after a long brainstorming. This is represented as “data collection” in the table. The other interviews with the suppliers were all data collection about their performances. In 7th of March, a meeting were held with Björn Cagner again to get some information about their current company situation and have approval on what we have done till that day.

The first three interviews were held with the existing suppliers that are located in various parts of Sweden and held with manager of Centraction AB. During the trip to the suppliers, we talked to Björn Cagner and had a chance to see his point of view deeper about his company and way of working. This gave us the opportunity to ask further complementary questions to the interviewees. The interviews were conducted through the questions regarding the performance parameters that had decided before by the manager of Centraction AB. These interviews were held mostly in English but when it is necessary, Swedish explanations were done by the manager of Centraction AB. Notes were taken during the interviews in a fast way, not to disturb or interrupt the interviewees and on the other hand, some interviews were recorded not to miss any details. The records were later listened to and analyzed. During this work period, totally three interviews were held with the existing suppliers and many discussions were held with the manager of Centraction AB every two weeks. To determine the performance parameters and to get a broad knowledge about the company, interviews were held. The interview questions are attached in appendix A.

Depending on the request of the manager of Centraction, new suppliers are searched according to the given product samples. The new suppliers which are able to produce desired products were searched through internet sources, business magazines, trade fairs, business organizations and personal business contacts. Because of long delivery times and need of high amount purchases, general manager Björn Cagner was not interested in buying from Asian low-cost-countries such as China and India. Also, European products are regarded as expensive to purchase for Centraction AB. Distinctively, Turkey is regarded as cheaper than Europe and has shorter lead times and possibility of buying low amounts by Centraction AB. So Björn Cagner asked us to find some new suppliers from Turkey. To do this, internet sources, business magazines, trade fairs, business organizations and personal business contact were searched to find out desired products at Turkey. Some potential new suppliers were detected and we agreed with them to meet and perform interviews. Björn Cagner did not attend to these meetings. The meetings were held at Turkey and, interviews were done as face-to-face, in potential new suppliers’ own offices and in Turkish. Turkish is the mother tongue of the thesis workers so it becomes an advantage for Centraction AB. Face-to-face interviews were chosen to increase the concentration and the severity. Also, the interviews were held in the potential new suppliers’ own offices for helping them to feel more relaxed. The interview questions were the same as in the

interviews conducted with the existing suppliers. They are just translated to Turkish.

Moreover, we attended the ISH2011 trade exhibition in Frankfurt, Germany with Björn Cagner to find a new supplier. A new potential supplier from Turkey was found in that exhibition. E-mails and telephone calls were used to keep in touch with those companies after arriving to Sweden. But we could not conduct an interview with this company about their performance. On the other hand, cleanliness was one of the most important criteria for Björn Cagner, which it is impossible to evaluate without visiting the company. Thus, the company has not been included in the evaluation process because of the lacking information.

A final meeting was held at Centraction AB with Björn Cagner to present the project. Also, the meeting aimed to compare the perception of him and the results of the tool, feasibility of tool and teach how to use of AHP tool. Some recommendations were also presented to him in this meeting about AHP tool and study.

2.3.2. Secondary Data

Literature research was done to get secondary data. It is mostly gathered from the articles in this study. Many online databases (Science Direct, Emerald... etc.) were searched through regarding the research questions. Books and e-books were also checked through internet and the libraries. Moreover, related previous master theses were searched through to gather information about the structure and the contents. These data is important to combine the findings of the primary data and the existing knowledge to have a reliable research. Purchasing, supplier performance evaluation, performance measurement, supplier selection, research methods were the main areas in this section.

2.4. Validity and Reliability

As Bryman and Bell (2007) mentions that validity and reliability are discussed because of the differences between the quantitative research and qualitative research. In qualitative research, trustworthiness is accepted to test the quality of the study. Trustworthiness consists of four parameters and these are parallel with the criteria of quantitative data.

- Credibility —————> internal validity;
- Transferability————> external validity;
- Dependability————> reliability;
- Confirmability————> objectivity.

In this study, empirical data was gathered to be reliable. Credibility is parallel to internal validity in qualitative researches', which means it is important that there is a match between the theory and the findings (Bryman and Bell, 2007). Depending on the interviews, it can be said that the experiences of the participants matches with the literature findings of us, which proves the credibility of this study.

Dependability is parallel to reliability, which supports the consistency of the research and the observations of the researchers. During all interviews both with suppliers and Centraction, both researchers took notes. Since this study is based on the opinions of the people, there is always a risk to misunderstand or skip the important issues during the meetings. To minimize that risk, the findings are compared to each other. If there had been a mismatch with the data, the interviewee was called and the data was checked. Moreover, in every step of the data evaluation tool, consistency test had done to prove the reliability.

Confirmability refers to the objectivity of the researchers to achieve trustworthiness. In this study, to achieve confirmability, meetings were held with supervisors to maximize the objectivity and minimize misunderstandings.

Transferability refers to external validity which means that this study can be replicated (Bryman and Bell, 2007). It is impossible to keep the social environment and the opinions of the people stable. These can be changed in a time period depending on some external factors; technology, business strategies. Thus, transferability is not a part of a qualitative study and hasn't been counted in trustworthiness of the study.

3. Theory

This chapter provides theoretical knowledge about supplier selection process, which starts with purchasing and follows the steps of supplier selection process. It is divided into 3 groups; purchasing, supplier selection and supplier performance evaluation which includes the core parts of supplier evaluation.

3.1 Purchasing strategy

Increased competitiveness, rapidly changing market demands and technological development makes difficult to continue in the long run for all businesses. Importance of every unique business activities such as purchasing, marketing, accounting and finance are increased. In addition to that, each of those business activities accepted as a ring of value chain which starts with industrial purchasing and ends with actual delivery or service to the customer. In that point, industrial purchasing plays very critical role by having direct and indirect impact on quality, customer satisfaction, profitability and market share issues (Cheraghi et al., 2004)

Purchasing is a basic part of business management and, evaluating and selecting suppliers is a major part of purchasing, both for service and manufacturing industry. Without suppliers, which match with all the demands of the buying company, it is impossible to produce low cost and high quality products. Therefore, selecting the best supplier is vital for all companies, and this is under the responsibility of purchasing department (Vokurka et al., 1996).

De Boer et al. (2001) states that share of purchasing are around 50-90% in total turnover. Purchasing process becomes a challenge to enhance long-term success in business life. Several major trends come upon to overcome this challenge such as (Cheraghi et al., 2004);

- *Outsourcing*; to focus on their core competencies, companies look for suppliers to perform its tasks such as manufacturing and services which were performed before in-house by the mother company.
- *Global sourcing*; for enhancing the advantages of lower-cost countries, companies' moves their purchasing activities from domestic to foreign suppliers.
- *Supply chain optimization*; to reduce the inventory costs such as overstocks, man and machine along the entire supply chain, companies looking forward to find suppliers which have "build to order" capability.
- *Supplier consolidation*; to enhance volume purchasing power and reducing administrative and coordination activities/costs, companies aim to work with fewer suppliers.

The decision maker has to consider all the parameters that are related with the supplied component and purchasing becomes very complex multi-criteria decision making problem. More outsourced products bring out more people and larger set of opinions. The environmental issues, government regulations, changing customer

preferences, globalization of trade and the broad image of internet affects all people and their point of view. With the effect of all these factors, the importance and complexity of purchasing increase. Figure 2 shows the complexity and the importance of purchasing decision (De Boer et al., 2001).

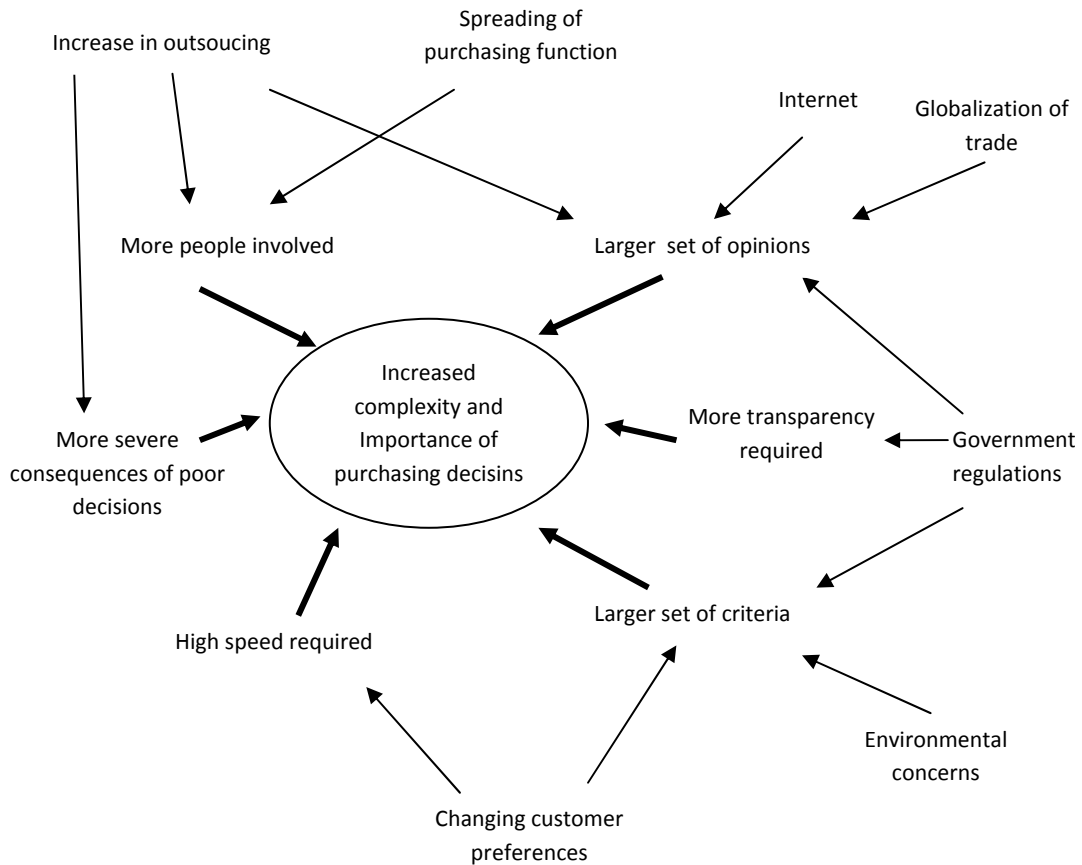


Figure 2 Impact of developments on the complexity of initial purchasing decisions (De Boer et al, 2001)

3.1.1 Organizational Buying Process

As it given in Hutt and Speh (2010), organizational buying process involves totally eight stages;

1. Problem recognition
2. General description of need
3. Product specification
4. Supplier search
5. Acquisition and analysis proposals
6. Supplier selection
7. Selection of order routine
8. Performance routine

Organizational buying process begins when someone in the organization recognizes a problem which yields potential benefits/opportunities for organization if it's solved. External (customer sales person etc.) and internal (production manager,

purchasing manager etc.) forces of an organization can be the source of a problem reorganization. Externally, sales person can be recognizing that the need of new design to capture market opportunities. Internally, production planning manager can be recognizing that the production capacity of organization is not enough to supply the customer demands (Stage 1). After that general description and detailed specification of need will be determined (Stage 2 and 3). Then, supplier search process will begin which aims to find potential candidates (Stage 4). Internet sources and catalogs can be the potential sources for finding potential candidates. Afterward, all potential candidates will be evaluated to reach the optimum one (Stage 5). This phase will be done by purchasing managers, engineers, users and other organizational members. As a result of this evaluation process the most promising supplier will be selected (Stage 6). Subsequently, agreeing on delivery guideline (Stage 7). Delivery guideline can include information such as required quantity, delivery date and frequency. Finally, Performance measurement will be done by purchasing manager. Performance measurement will help purchasing manager to give critical decisions such as continue, modify or cancel the agreement with supplier. (Hutt and Speh, 2010)

3.2. Supplier Selection

Increasing competitiveness and rapidly changing customer demands (such as; cheaper, high quality products, on-time delivery and perfect after sale services), forces companies to find a way of cutting costs. At this point, qualified and reliable suppliers are accepted as sources of costs reduction. Hereby, importance of supplier selection process is emerging. Efficient supplier selection processes is needed to survive and sustain in the market with increasing profitability of the company and market share. (Sonmez, 2006)

3.2.1. Supplier Selection Process

As it is stated by Mandal and Deshmukh (1994), supplier selection process aims to find out supplier/suppliers who is/are able to provide products and/or services at the right time, right quantity, right price and desired quality. Supplier selection process comprise from four phases; realization of need of new supplier; determination and formulation of supplier criteria; pre-qualification of potential suppliers; final supplier selection (De Boer and Wegen, (2003). In addition to that, “monitoring of selected supplier” added as fifth phase of supplier selection process by Sonmez (2006) to measure the performance of selected supplier/s.

The first phase of supplier selection process deals with realization of problem; problem will be need of new supplier or additional/more supplier or replacing existing supplier. The second phase of supplier selection process is dealing with; determination and formulation of selection criteria. Qualitative tools such as brainstorming and virtual analysis are recommended to use for the first two phase of supplier selection process. The third phase of supplier selection process deals with pre-qualification of suppliers to reduce the set of “all” supplier to a smaller number of acceptable suppliers by considering determined criteria. The fourth

phase of supplier selection process deals with selection of supplier or if it is desired more than one supplier. Quantitative tools such as case-base-reasoning, linear weighting model and artificial intelligence based models are recommended to use for the third and fourth phases of supplier selection process. (De Boer et al., 2001)

As it given by Braglia and Petroni (2000), supplier selection process include two main tasks; evaluation and assessment of attributes, criteria, or factors and, when it comes to the final selection/choice, establishment of evaluation criteria to make a comparison. In addition to that, Sonmez (2006) added some subtasks to those main tasks:

Evaluation and assessment task; decision attributes should be identified which are to be fulfilled by potential supplier's; the evaluation metrics/scales should be determined to perform a proper appropriateness measurement of potential supplier; the attributes should be weighted to determine their importance in supplier selection process; all potential suppliers should be evaluated by considering decided, scaled and weighted attributes.

Choice Task; the total score of each potential suppliers should be aggregated in both qualitative and quantitative aspects. There are two approaches to make a rational and sound choice; compensatory (linear) or non-compensatory (non-linear) approaches. In compensatory approach, weak performance on one criterion will be balanced with good performance on another criterion. On the other hand, in non-compensatory approach, weaknesses are not acceptable and they cannot be balance with good performance. In this point, final decision maker/makers should decide that weaknesses on the performance of criterion are acceptable or not.

All phases, tasks and subtasks were combined and figured in Sonmez (2006) as follows;

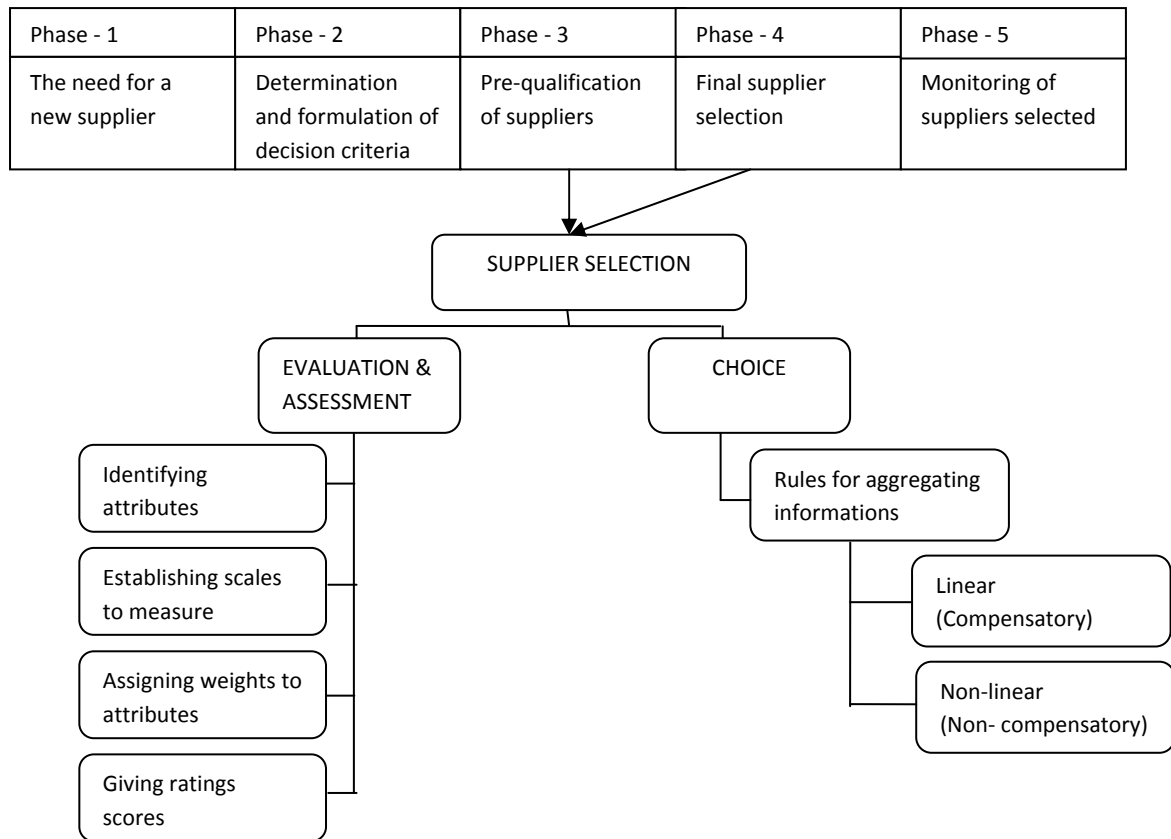


Figure 3 Phases of supplier selection process and tasks in supplier selection (Sonmez, 2006)

As it is given in both Sonmez (2006) and Gulen (2007), companies' sourcing strategy has effect on their supplier selection process. Sourcing strategy comprises some supplier selection decisions; multiple or single sourcing, minimum order quantity and frequency of delivery. If a company aims to sourcing from single source, a single supplier should be selected. On the other way around, if a company strategically aims to work with multiple sources then two or more suppliers should be selected. In this point the capabilities of suppliers effects the sourcing strategy and supplier selection process; if suppliers are not capable due to the capacity constraints to supply companies' minimum order quantity in needed frequency of delivery, then supplier selection process should ended up with more than one supplier. It was suggested in Gulen (2007) that sourcing strategies will be developed with suppliers to produce shared opportunities and alliance bound. Shared opportunities and alliance bound are needed to have sustainable, long lasting and profitable business. In addition to this, homogenous goals, mutual investment, obligation and mutual trust are needed to create shared opportunities and alliance bound.

3.2.2. Supplier Selection Criteria

Weber et al. (1991) refers to Dickson (1966) and explains Dickson's study that it was about a survey that is sent through 273 purchasing agents and managers turned up with 62.3% responses. He comes up with over 20 factors for supplier selection.

The ones that has extreme importance are; quality, delivery and performance history. Warranties and claim policies are following them. The whole supplier selection criteria are shown in table 2.

Table 2 Supplier selection criteria (Weber et al., 1991)

Number	Factors	Relative Importance
1	Quality	Extreme Importance
2	Delivery	Considerable Importance
3	Performance History	
4	Warranties and Claim Policies	
5	Production Facilities and Capacity	
6	Price	
7	Technical Capability	
8	Financial Position	
9	Procedural Compliance	Average Importance
10	Communication System	
11	Reputation and the Position in Industry	
12	Desire for Business	
13	Management and Organization	
14	Operating controls	
15	Repair Service	
16	Attitude	
17	Impression	
18	Packaging Ability	
19	Labor Relations Record	
20	Geographical Location	
21	Amount of Past Business	
22	Training Aids	
23	Reciprocal Arrangements	Slight Importance

Weber et al. (1991), reviews 74 articles considering the criteria shown in table 2, between the years 1966 and 1990. Net price, delivery and quality are discussed almost in all articles, while warranties and claim policies are not mentioned in none of the articles. He also states that many of the criteria have discussed during last five years such as communication system, impression, labor relations record, amount of past business, and reciprocal agreements; only one statement was found for desire for business, operating controls, packaging ability, training aids and only two of two authors discusses the performance history, financial position, reputation and position in industry. Besides the mentioned criteria by Dickson, 13 of the articles discuss JIT.

3.3. Supplier Performance Evaluation

With the developing technology and the changing demands of the customers it becomes more difficult to compete with the other companies. Purchasing and evaluating the performances of the suppliers are the cornerstones to be competitive (Wang, 2010). The reasons of that are; in many companies, the cost of purchased goods and services accounts for more than 60% of the cost of sold goods. Second, over 50% of all quality defects can be traced to purchase material (Gencer and Gurpinar, 2007).

Companies mostly work with suppliers to reduce product development time, improve product quality and reduce lead times. Working with a qualified supplier provides more innovative product design and flexible working conditions. To work with the best suppliers there are many factors to evaluate their performance; quality, cost, delivery and service (Zeydan et al., 2011). These evaluation parameters has trade-offs and can vary depending on the company's condition. A supplier may offer a product with a quality that is quite lower than average and have inexpensive price, while the other supplier offers higher quality products with uncertain delivery time. Here, it becomes a complex problem to select the appropriate supplier considering all criteria that can be divided into two; qualitative (service, flexibility, etc.), and quantitative (price, quality, etc.) (Bhutta and Huq, 2002). Qualitative methods explain each criterion in detail to allow them to be understood. Quantitative methods use mathematical calculations to explain the affect that arises. To have a better supplier evaluation process, quantitative and qualitative methods should be both used together separately. This will let the manager express both tangible and intangible factors that affect the evaluation process (Wang, 2010).

Supplier evaluation can be sorted into two groups; single objective models that have only one criterion for the objective function and the other criteria as constraints. The disadvantage of this model is that the company has just one criterion for supplier evaluation and that makes the supplier selection process risky. The other model is to have multi-criteria, considering all the factors that affect the evaluation process (Zeydan et al., 2011). In the supplier evaluation process, two types of information should be gathered; process based information must be gathered to learn the organizational issues (management, technology, etc.). Product-based information should also be gathered to learn supplier's output (quality, delivery performance, etc.) (Purdy and Safayeni, 2000).

According to Gordon (2008) the first step in the supplier evaluation process is to decide the supplier that the manager wants to measure. The criteria have to be decided by the manager or the decision maker. Than the evaluation methods are defined; surveys, site visits, or scorecards. Technology can also be used for supplier evaluation. There are some software (supplier relation management (SRM), major ERP vendors, etc.) that can be helpful in supplier management. These applications provides scorecard capabilities and surveys can be designed with these programs. This section presents the general steps that are needed to be considered in the supplier performance evaluation.

3.3.1. Importance of Measuring

According to (Gordon, 2008), determining what to measure and control to identify the performance of the suppliers is one of the most critical issues to have realistic results. The companies are not always having the same conditions; a success factor that is defined for a supplier can be vital for one company but have the least importance for another one. It can vary because of the priorities, size industry and

the culture of the company. The measurement factors must be meaningful and valuable for the company, means of comprehending the priorities, targets and the strategies that the company holds on. Moreover it is important to determine simple and practical factors to prevent misunderstandings and save time.

3.3.2. Selecting Performance Parameters

Cheraghi et al. (2004) reviews 113 articles, including the 74 articles reviewed by Weber, and found out that there are a few more criteria that have not mentioned before. The new significant criteria are, consistency, long-term relationship, reliability and flexibility, and the others are; process improvement, product development, inventory costs, quality standards, integrity, professionalism, and research. According to the authors; warranties and claim policies, amount of past business, desire for business and training aids become ineffective. Here are the most important parameters that the authors agreed (Gordon (2008), Sarkar and Mohapatra (2006), Weber et al. (1991), Weber and Current (1993), Krause (1999), Amin et al. (2011)):

3.3.3.1. Quality

Quality is a major criteria for supplier selection because it affects the end products (De Boer et al. 1998) and used by many authors with different supplier selection methods (Bhattacharya et al. (2010), Sarkar and Mohapatra, (2006), Amin et al. (2011)). Cheraghi et al. (2004) defines quality criteria for supplier selection as satisfying the customers by meeting their expectations. The major parameters to guarantee the sales are quality, delivery and price. Customers can be satisfied by receiving the product at the right time and at a price level that reflects value for the money. Thus, these three parameters are linked to each other. Gordon (2008), and explained as “quality is a cost driver”. In the case that quality is lacking, it causes many rework and customer dissatisfaction. He also adds that the performance of the suppliers affects the company’s responsiveness to its customers. Therefore, every company has to trust their suppliers’ quality and delivery time.

3.3.3.2. Price

Identifying all the cost factors will definitely help companies to manage supply chain. This can be firstly done by getting a better price from the suppliers (Gordon, 2008). Sarkar and Mohapatra (2006) separates the criteria into two groups; capability factors and performance factors and put the price into the performance factors since it can affect the company financially.

3.3.3.3. Delivery

The delivery delays or the quality problems of the supplied products can financially cost more than expected and cause production problems. In such a situation, the buyer company will search for another supplier that can have worse quality (Krause, 1999). This will directly affect the satisfaction of the customer and decrease the reputation of the company in the market. In supply chain, the supplier company can also have a supplier which makes all the relations more complex and

increase the importance of the deliveries. Once that chain breaks it effects all production in the companies. The main goal of the buyer company is to reduce the cost and minimize the risk by having a closer supplier (Chen et al., 2006).

3.3.3.4. Technology

Technical capability becomes more and more important to keep the buyer company and the supplier to work together. The buyer company concerns both the technology that the supplier has now, and that they would have in the future. It is important to have a reliable supplier that will keep contributing to the design of the products and catch the new technology (Cheraghi et al. 2004). One of the main objectives of the buyer company is to minimize the risk in new product development, increase the innovative ideas, and have the best practices and competence (Gordon, 2008).

3.3.3. Measurement Methodologies

Gordon (2008) presents many methods to collect and monitor the data that is used for evaluating the suppliers. To get both qualitative and quantitative feedback it is very important to use the appropriate methods. Hard copies can be sent through mail or in an electronic way or telephone surveys can be another alternative. Table 3 includes the challenges of the common methods to avoid possible problems. It is important to find the appropriate person at the supplier, arrange a telephone meeting with an appropriate person, finding time to implement the survey, ensuring that the survey is understood in a correct way.

Table 3 Summary of evaluation approaches (Gordon, 2008)

Method	Challenges
Paper questionnaires (mailed or e-mailed documents)	<ul style="list-style-type: none"> • Hard to construct sound information-gathering instruments • Requires knowledge of what to measure • Difficult to deploy • Suppliers procrastinate filling out
Site visits	<ul style="list-style-type: none"> • Resource intense for both customer and supplier • Requires trained personnel • Can be inconsistent
Third-party information	<ul style="list-style-type: none"> • May not be accurate • May be difficult to determine what to react to

Basu (2001) mentions the success of the measurement depends on the effectiveness of the monitoring systems and discusses three different aspects; data collection, validation and reporting. In local and global system it is emphasized to use ERP systems to have a better monitoring system. A well designed spreadsheet model can also be used for a site-centric monitoring system.

3.3.4. Quantitative approach to supplier evaluation

A review of multi-criteria decision making approaches is done by Xo et al. (2010) and they proposed DEA, Mathematical Programming, Analytic Hierarchy Process, Analytic Network Process, Case-based Reasoning, Fuzzy Set Theory, Integrated AHP Approaches, Integrated Fuzzy Approaches. Many authors proposed analytic hierarchy process (Yu and Tsai (2008), Xia and Wu (2007), Liu and Hai (2005), Handfield et al. (2002)). Zeydan et al.(2011), used fuzzy AHP for the determination of the criteria weights and than the authors used fuzzy TOPSIS(Technique for Order Preference by Similarity to Ideal Solution) for the qualitative evaluation. For quantitative evaluation they used used DEA(Data Envelopment Analysis). Bhattacharya et al. (2010) integrated analytic hierarchy process with quality function deployment. Araz and Ozkarahan (2007), intoruduced PROMETHEE methodology to rank the suppliers depending on their performances. Gencer and Gurpinar (2007), proposed analytic network process(ANP) in supplier selection in an electronic company.

To evaluate the gathered data, as qualitative tool, brainstorming was chosen and Analytic Hierarchy Process was chosen as a quantitative method. AHP is explained in the following section.

3.3.4.1. Analytic Hierarchy Process (AHP)

AHP is first introduced by Saaty in 1971-1975, during his education that these comparisons indicate the preferences and the feelings of the decision maker (Saaty, 1987). It is a general approach that expresses and ranks the decisions by prioritizing the judgments on a numeric scale. It is mostly used in multi-objective; multi-criteria and multiparty decisions (Saaty, 2008) and became popular during the last 20 years. Tahriri et al. (2008) reviews 150 articles that have used AHP and their distribution over the years and, an increasing trend on its usage is observed in past years.

AHP makes pair-wise comparisons considering the decision-making environment and can be used for both qualitative and quantitative criteria (Yu and Tsai, 2008). AHP has been used in many different situations such as (Saaty, 1983):

- Priority setting
- Alternative (policy) generation
- Selection of the best alternative
- Determination of requirements
- Prediction
- Measuring performance
- Designing a system
- Planning
- Conflict resolution
- Optimization as a forward projection-back-ward idealization process
- System with feedback
- Relation to fuzzy sets

The analytic hierarchy process is an effective approach that can be used in multi-criteria decision making environment. It is more appropriate to use than some other tools such as total cost of ownership, to use in the situations when both qualitative and quantitative criteria are considered (Bhutta and Huq, 2002). Some other tools were discussed in Tahriri et al. (2008) and, the advantages as well as the disadvantages of AHP were presented as follows;

Advantages of AHP;

AHP method is able to structure the complex, multi-personal, multi attributed, and multi periodical problem in to a hierarchy. Also, AHP is simple to use and easily understandable. Moreover, AHP is good at relating the distinct factors such as; attributes, sub attributes and alternatives in to each other that facilitates communicate the problem with solution. Furthermore, AHP gives consistent result by testing their consistency ratio (if the consistency ratio $> 0,1$ the result is regarded as inconsistent and wrong).

Disadvantages of AHP;

One of the main disadvantages of AHP is that if a new alternative would be added to the calculations, the ranking that were done before will be changed automatically. Thus, all ranking should be done from the beginning considering the new alternative which will cause waste of time. Secondly, the comparisons of alternatives can be ambiguous because of the question that is asked to the decision maker. There may be some issues that cannot be expressed just with the question how much A is better than B. Moreover, the scale of AHP is not enough to express all the comparisons properly. It limits the comparisons just with 9 levels and sometimes full outcome cannot fit to this scale. Apart from these, it is difficult for people to express their feelings as criteria or they can have different perceptions on the same verbal issues. That can also cause problems during the comparisons and have importance since AHP is just tied up to the comparisons.

According to (Saaty, 1983), it is used to have a hierarchical scale in any complex and multi- criteria problems. It is based on three stages:

1. The first step is to define the problem considering all details. Then, put all elements in a hierarchy. The highest part is the main objective, where the lowest part is the alternatives that contribute to the goal through the intermediate criteria. The intermediate part of the hierarchy covers the goal and the alternatives. Representing them in a hierarchy is an effective way to visualize and define the problem and its components to deal with the complexity.

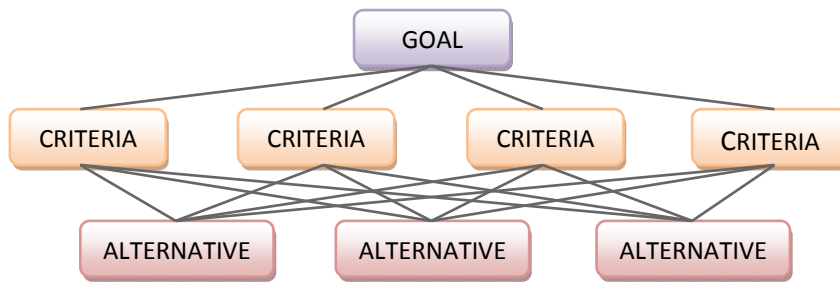


Figure 4 A simple AHP hierarchies

2. After establishing the hierarchy, the second step is to evaluate each set of criteria in pairs and the pairwise comparison matrices is constructed; see table 5. The matrix illustrates two aspects; dominating and dominated.

Table 4 pairwise comparison matrices

	Criteria A	Criteria B	Criteria C	Criteria D
Criteria A				
Criteria B				
Criteria C				
Criteria D				

In the matrix, criteria A is compared in the column on the left with the criteria B, criteria C and criteria D. This is repeated for all the criteria in the column in the left. To make the judgments all matrix is filled, and numbers are assigned from 1-9. A scale is used shown in table 6. These numbers are just approximations and sometimes translation of the feelings. A test of consistency is done to have the validity.

Table 5 The fundamental scale for pairwise comparisons (Saaty, 1983)

Intensive of Relative Importance	Definition	Explanation
1	Equal Importance	To activities contribute equally to the objective
3	Moderate	Experience and judgment another slightly favor one activity over
5	Essential or Strong	Experience or judgment strongly favors one activity over another
7	Importance demonstrated	An activity is strongly favored and its dominance is demonstrated in practice
9	Extreme (Absolute)	The evidence favoring one activity over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values	When compromise is needed

3. After the pairwise comparison of each criteria, the priorities are established for the alternatives and an overall weighting for each criteria is calculated as shown in table 7.

Table 6 Pairwise comparison matrices of alternatives

	Alternative A	Alternative B	Alternative C
Alternative A			
Alternative B			
Alternative C			

This is priority comparison is repeated for all criteria. Then the necessary calculations are done or a computer program is used and the best alternative is obtained depending on the criteria that the decision maker was decided before.

In this study, Expert Choice software was used for AHP application to measure the performance of supplier's, pair-wise comparison of alternatives, prioritizing/weighting the criteria, sensitivity analysis and selecting the best alternative/supplier. According to Ishizaka and Labib (2009), Expert Choice software is the leading software for AHP applications.

Expert choice is a software program that was developed for making quick, efficient and effective multi-criteria decision making and also presenting graphical representation of results. Also, Expert Choice software is designed to help users to overcome the limits of human mind and synthesizing the gathered qualitative and quantitative data. It gives lean and understandable results. It is using in many decisions support and process management operations to; structure and measure the decision processes, to determine strategic priorities, communicate and harmonized the priorities -decisions and, enable move forward quickly and confidently. (Expert Choice, 2011)

3.3.5. Supplier Performance Feedback

According to Gordon (2008), it is beneficial to give performance feedback after all deliveries about expectations and requirements to the evaluated supplier. This will be beneficial for such kind of issues; to increase the performance of suppliers', overcome misunderstandings, develop trust, build cooperation. Otherwise, it would be a barrier between two companies and possible to cause some problems for both parties. Supplier performance feedback can be given by considering the supplier selection and evaluation criteria's. The feedback should be between buyer and supplier, in both two ways. Figure 5 illustrates the supplier-customer relationship considering the performance feedback. For example, it can be a phone call to supplier after noticing good service and/or new improvements, it will show that you are aware of their affords to improve. It can also be about a problem that will rise in last delivery. In that case, it is good to discuss together with suppliers and trying to find way to solve and prevent it.

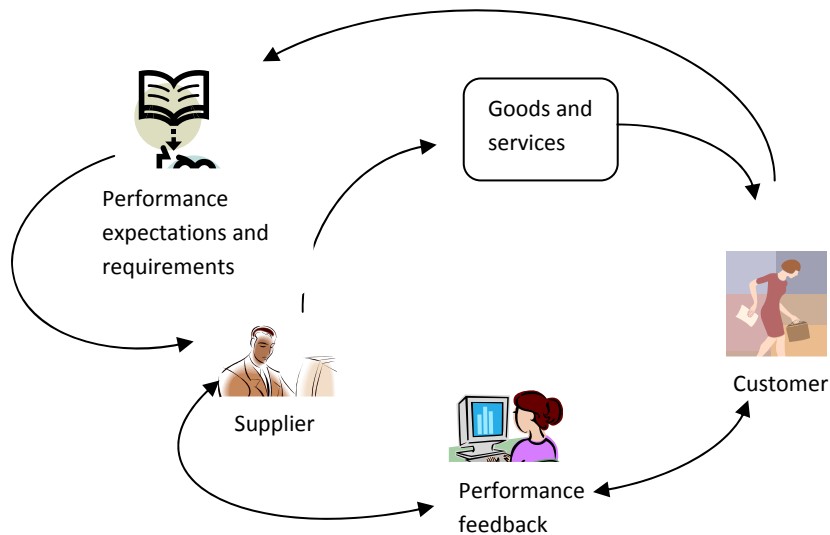


Figure 5 Customer-supplier feedback process (Gordon, 2008)

3.4. Supplier Relationships

Supplier relations becomes more important the companies. Arm's length relation with suppliers which aims to avoid dependency and keep prices down was recommended before. But now, it is replaced with close relations which are aiming to making the most of supplier relationships. Moreover, partnership is needed to enhance the benefits of supplier relations. On the other hand, developing partnership is a costly activity for purchasing companies. So, it was suggested that to develop partnership between limited numbers of suppliers which are selected by considering the economic importance of supplier, continuity of the relationship and purchasing strategy of the purchasing company. Also, some relations are regarded as important because of the volume of business they represent and their potential effects on future of the company when it comes to technical development, product quality and performance. (Gadde and Snehota, 2000)

As it is given in Gadde and Snehota (2000), making the good use of suppliers is a complex task because of its hard assessment of economic consequences when it comes to range of products/services supplied and people involved and, having limited control over supplier because suppliers have their own logic in customer relations. In order to develop effective and efficient relationships, it is important to understand the economic consequences (costs and benefits) of high supplier involved relations (see Table 8).

Table 7 Economic consequences of supplier relationships (Gadde and Snehota, 2000)

Relationship costs	Relationship benefits
Direct procurement costs	Costs benefits
Direct transection costs	Revenue benefits
Relationship handling cost	
Supply handling costs	

As it is given in Gadde and Snehota (2000), direct procurement costs are obviously the costs that are easily identify and measure from the supplier invoice. Also, every purchasing operation is associated with other costs such as transportation, goods handling and ordering which are regarded as direct transaction costs. These costs can be harder to identify and measure. Moreover, some supplier relations are requiring more continuous interaction for sustain and handle the relationships. Those kind of continuous interactions, add costs to supplier relations which is regarded as; relationship handling cost. Furthermore, supply handling costs are the structural and common costs for purchasing companies such as, whole, communication, warehousing operations and process adaptation. On the other hand, there are some economic benefits of supplier relations which are harder to asses and clearly presented in purchasing company accounts. Cost benefits are regarded as the operational cost savings which are driven from supplier collaborations. In addition to that, revenue benefits are the benefits that are increasing the income of buyer companies. Improvement in product quality or performance can be the sources of the revenue benefits by increasing the competitiveness of buying company. The supply strategy should be aiming to balance various costs and benefits supplier relations.

It was agreed on the importance and merits of “partnership posture” in supplier relationships. Also, partnership based supplier relations are regarded as the main sources of future competitive advantage. Strategic partnership aims to offer long-term relationship, mutual trust, co-operation and wide-scope relationships. As a concept “partnership” is a little bit confusing, it sometimes confused with “close” relationship which is not really offer much help. “Closeness” means the degree of integration in partnership concept of supplier relations. There are three degrees dimensions of involvement; coordination of activities where the activities are more or less tightly coordinated; adaptations of resources where the resources are more or less specifically adapted to the requirements of the counterpart; and interactions among individuals where the individuals are interact more or less intensely. Some supplier relationships can be getting high score on all three dimensions; it means high involvement in supplier relations. High-involvement in supplier relationships are regarded as costly because of coordination, adaptation and interaction entail costs but lead to achieve cost benefits and revenue benefits. On the other hand, some supplier relationships are getting high in one of those supplier dimensions that mean lower involvement in supplier relations. Low-involvement supplier relationships are potentially cost effective and require lower relationships handling costs but higher direct procurement costs and transaction costs. It was suggested to use variety of supplier involvement degrees in supplier relationships, rather than having “one-size-fit-all strategy”. To do this, the supplier segmentation is recommended to use to make right allocation of resources. The segmentation of suppliers can be done by considering three characteristic of supplier relations; monetary volume of business in the relationship; continuity of the relationship over time; whether or not the supplier relationship is used as a single source. Also, high-

involvement approach is suitable for supplier relations which are aiming to have long-term relationships and coinciding with single sourcing. Besides, low-involvement approach is suitable for supplier relationships which aim to have small volumes, short-term and multiple sourcing. (Gadde and Snehota, 2000)

3.4.1. Sellers' uncertainties and buyers' tactics in supplier relationships

Sellers bring their uncertainties in to their customer relationships which are hard to overcome by themselves. On the other hand, buyers have their own uncertainties and sellers have different tactics to overcome these problems. It can be seen in figure 6;

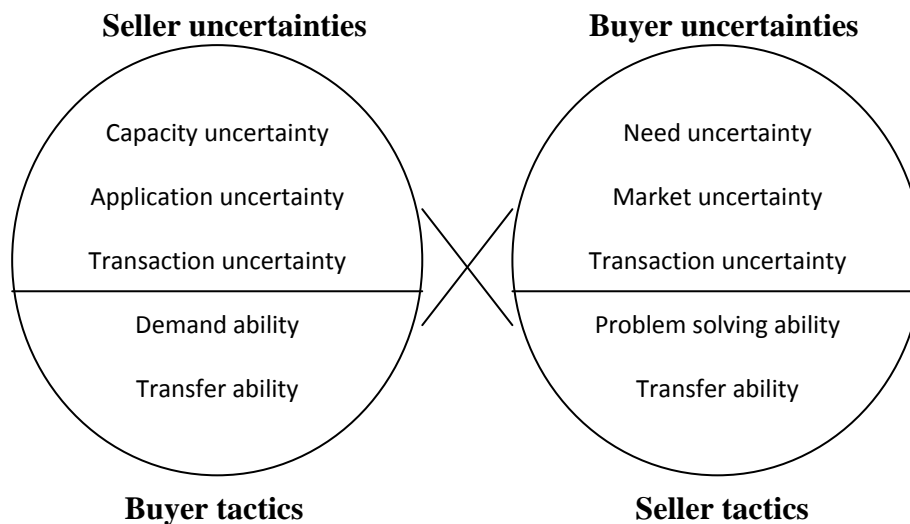


Figure 6 Buyer-seller relationship (Ford et al., 1998)

As it is given in Ford et al. (1998), sellers have totally three uncertainties; *capacity uncertainty*; *application uncertainty*; *transaction uncertainty*. Firstly, capacity uncertainty means that the amount of the product that is going to be sold in coming year is often uncertain where the selling company tries to keep some buyers close and get some orders. Secondly, application uncertainty means that with the change of requirements of customers, the way of using the products are changing in a fast way. Thirdly, transaction uncertainty means that the risk of that the customer may not buy what he/she orders. It is often difficult to trust to the customers whether they pay not. On the other hand, buyers have own tactics to help their suppliers to overcome their customer relationship uncertainties. According to Ford et al. (1998), buyers have totally three tactics; *manipulation of uncertainties*; *demand ability*; *transfer ability*. Manipulation of uncertainties aims to take some actions to reduce the seller's capacity uncertainty, application uncertainty, and transaction uncertainty. Demand ability aims to reduce the capacity uncertainty and application uncertainty of suppliers' by giving certain amount of products and explain the way of use of the product that he/she will buy. By the help of transfer ability, customer can build trust and reliability by paying the bills on time and reduce transaction uncertainty.

3.4.2. Buyers' uncertainties and sellers' tactics in supplier relationships

Buyers bring their uncertainties in to their supplier relationships which are hard to overcome by themselves. As it is given in Ford et al. (1998), buyers have totally three uncertainties; *need uncertainty*; *market uncertainty*; *transaction uncertainty*. Firstly, the need uncertainty means that it can be difficult to express their requirements for a buyer, when technology is considered and if the company is new. Secondly, market uncertainty means that Buyer Company can confuse what to choose because of the large variety in the market. Thirdly, Transaction uncertainty means that the risk of that the seller may not deliver what the buyer orders. It is often difficult to trust to a seller about the quality or price of the product. On the other hand, sellers have own tactics to help their customers to overcome their seller relationship uncertainties. According to Ford et al. (1998), sellers have totally three tactics; *manipulation of uncertainties*; *problem solving ability*; *transfer ability*. Manipulation of uncertainties includes the actions that the selling company takes to reduce the buyer's need uncertainty, market uncertainty, and transaction uncertainty. By the help of problem solving ability, the seller can reduce the need uncertainty and market uncertainty by providing solutions of what to buy. Also, transfer ability helps seller to build trust and reliability by delivering products on time and reduce transaction uncertainty.

4. Current Company Conditions

This chapter explains the company vision about purchasing operations and the supplier selection, evaluation and relations. It will give the broad information about the interviews to build up the development model that is used for supplier evaluation and selection.

4.1. Purchasing Strategy of Centraction AB

Finding the right product and right supplier is more important than finding the customer for Centraction AB. General Manager (GM) of Centraction AB Björn Cagner believes that, if a company has a good product, there is always a customer who buys it. Centraction AB builds its purchasing strategy on those philosophies.

Reliable and cooperative suppliers are needed since Centraction AB is not manufacturing any components of their products and just do the assembly, regarding few exceptions. The GM is very pleased to have some of those reliable and cooperative suppliers. There are some examples of those suppliers that Björn Cagner has been working more than 30 years and having the advantages of this reliable and cooperative environment. In those kinds of situations, there is no limit of cooperation in the product development and flexibility issues for both parties.

They also reflect the advantages of cooperation and reliable relations with their suppliers to their customers. According to the manager of Centraction AB, central vacuum cleaner is sold as a problem solution and totally different from a product that they directly buy and sell. When they offer a solution to their customers, they must rely on their suppliers a lot. This can be explained by the importance of the delivery time, and required product development.

Centraction AB has global sourcing strategy which means that Centraction AB is aiming to buy from other foreign countries as well as its home country; Sweden to take the advantage of lower cost countries. In order to this global sourcing strategy, Centraction AB has a lot of suppliers from all around the world. It increases the complexity of purchasing operations by bringing additional factors such as; people, culture and environment governmental regulations. In Centraction AB, purchasing operations are managed by general manager Björn Cagner and Elisabeth Cagner as part time and there is no purchasing department and any other purchasing staff. That makes hard to deal the complexity of purchasing operations.

In total, the company has approximately 60 suppliers and almost everyone of them are active. There are 5 really active in Sweden, ad regular ones are around 20. Supplied parts can be grouped into two; special and standard parts. For standard parts, they look very much on the price and secondly reliability, that they'll get the quality that they want and on the right time. For the special parts (vacuum pump, and electrical parts, etc.) they have to find the right supplier. Here it is more important to have reliable suppliers, than cheap ones. For the special parts that are designed by Centraction AB., they are more depended on the co-operation more

than price. It is more important to get the right components that match with Centraction AB.'s quality.

As a result of up mentioned conditions, Centraction AB managers build a purchasing strategy which aims to; keep stocks for some special components (especially if they are purchasing from foreign countries), preferring to have more than one supplier and if it is possible and profitable buying from Sweden.

4.3. Supplier selection and evaluation framework

Supplier selection and evaluation are the two of the most important steps in Centraction AB's organizational buying process. Centraction AB is a company that is looking for possible improvements on its' buying process to increase its quality, innovativeness, customer satisfaction level and competitiveness by making right supplier selections and evaluation.

Centraction AB has its own framework for supplier selection and evaluation operations. The company's supplier selection and evaluation framework can be presented as follows; realization of need; determination of need; searching for new supplier; detecting potential suppliers; ordering samples, testing the samples and price comparison with other ones; site visits and evaluation (only qualitative methods); selection of supplier (or more than one supplier if it is needed) with using qualitative methods; record the performance. This framework can be seen in table 9 as follows;

Table 8 Existing Supplier selection-evaluation frame work of Centraction AB

Phases	Actions
Phase-1	Realization of need
Phase-2	Determination of need
Phase-3	Searching for new supplier
Phase-4	Detecting potential suppliers
Phase-5	Sample Ordering-Testing-Price comparison
Phase-6	Site visits and evaluation
Phase-7	Selection of Supplier
Phase-8	Performance recording

Centraction AB searches their suppliers more on internet and visit business exhibitions to find suppliers. They not only search for new components or suppliers, but also search for existing parts to compare price, quality etc. Starting a business with a supplier can also vary depending on the product type (special/standard). Centraction AB Company always tries to have an alternative and they are not afraid of changing the existing suppliers. When they want to change the supplier, first they find the other one and then they stop working with the

existing supplier. Centraction AB does not have a systematical supplier performance feedback procedure. Centraction AB is preferred to record the problems and, if they face it again, they give feedback or change the supplier. Changing supplier had happened before because of the standards that were not matching with Centraction AB. The company changes their suppliers when the suppliers cannot do what Centraction AB wants them to do, or they do not do what Centraction AB wants them to do, or because of the quality problems. All supplier selection and evaluation activities are managed by Bjorn Cagner and Elisabet Cagner.

Managers' of Centraction AB do not have any formulated supplier selection-evaluation criteria while making supplier selections and/or evaluations. Beside this, they prefer face to face talking and taking notes about any kind of problem for evaluation. All the problems that they have faced with a supplier are written down by both Centraction AB. and the supplier. They check and compare it every year to find the reason of the problems to prevent the possible ones. He tries to visit every customer once a year. He travels about 80 days in a year depending on the projects. Even communicating by phone is easier and quicker, he always prefers to talk face to face and visit suppliers. According to him, it is much easier to solve a problem face to face, than through e-mails. On the other hand, they get an idea of how they produce, and see the possible changes that can be done for the ordered parts.

5. Development of Selection and Evaluation Tool

This chapter combines the theoretical approaches which are given in literature with practical approaches which are driven from the experience of Centraction AB managers.

Based on the theory above, supplier selection and evaluation is combined with one tool that includes the steps of selection and evaluation that is mentioned. AHP, which is a very popular tool for supplier management, was chosen and applied. The advantage of AHP is that it can solve the complex and multi attribute problems and rank the alternatives by comparisons. The priorities are defined and the performance of alternatives is described in a hierarchy from lowest to highest (Liu and Hai, 2005). Besides the existing suppliers, two new suppliers were added to the calculations to see their position in the evaluation which will affect the decision on making business with these companies.

5.1. Designing supplier selection-evaluation criteria

Authors have different priorities and choices of the factors that affect supplier selection and evaluation as it's mentioned in the theory. Considering all these criteria, an interview had done with the manager of Centraction AB. The interview was based on totally 36 criteria that are mentioned by Cheraghi et al (2004) and Weber et al. (1991). Brainstorming was used as a qualitative tool and every single criterion had been discussed due to the strategy of the company. The analytic hierarchy can be seen in figure 6 for this study. All three existing suppliers and first two potential suppliers are counted for the calculations. The last potential supplier, which is represented as "potential supplier 3" has not been counted because of the lacking information about their performance.

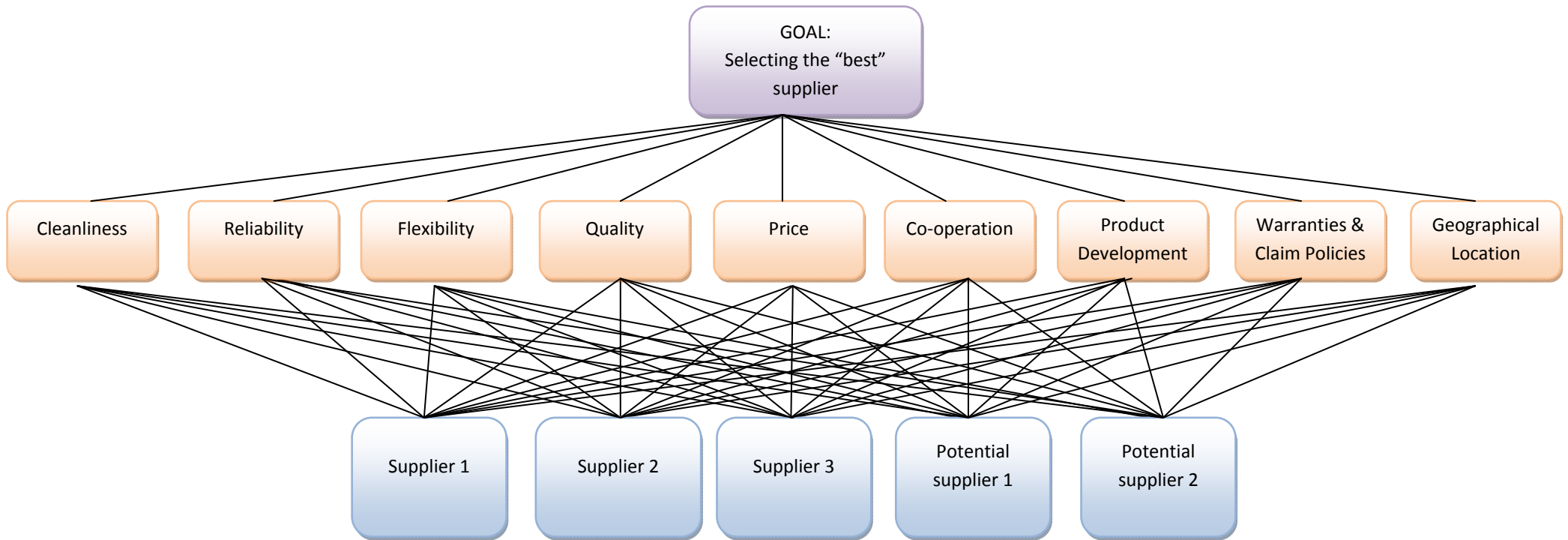


Figure 7 Basic analytic hierarchy of Centraction AB.

After the discussion and identification of the criteria that affects supplier selection and evaluation of the company, the manager was asked to compare these criteria and rank them in an order that goes from least important to most important. Here, number 5 represents the most important criteria, where number 1 represents the least important criteria. Lists of factors and their weights were developed according to manager's point of view as shown in table 10.

Table 9 Supplier evaluation and selection criteria of Centraction AB.

Factor	Ranking Rate
Cleanliness	5
Reliability	5
Flexibility	5
Co-operation	5
Quality	4
Product development	4
Warranties and claim policies	3
Price	3
Geographical location	3

As it is shown in the table, reliability and flexibility are very important for Centraction AB as they are two major factors of the purchasing strategy of the company. Since the company doesn't manufacture the components of the central vacuum cleaner, they must rely on their suppliers to prevent the possible problems that can occur during the assembly. Reliability comprise the delivery time for Centraction AB. The company arranges all the assembly operations depending on the delivery times of the components from suppliers. Thus, the reliability of the suppliers is extremely important.

To continue a better production flow, company sometimes demands urgent or new design parts. Centraction AB expresses flexibility as to have a supplier that is able to produce different parts that matches with the standards of Centraction AB whenever it is needed. This is an important factor to be chosen as a supplier to provide solutions and be innovative.

One of the factors that are listed in table 10 is the cleanliness, that hasn't been mentioned by any of authors that were reviewed. Cleanliness is other important criteria that affect supplier relations for Centraction AB. Cleanliness can be explained as not having any dust or dirt on working environment of the suppliers, i.e. the floor and the shelves. According to the company, cleanliness of the company gives the idea about the working style and working conditions of the suppliers. It signifies the respect of the supplier that they have to their job. On the other hand, cleanliness also includes the dust or dirt on the delivered components, which can affect the working conditions. Björn Cagner visits every supplier and checks whether the floors and the shelves are dusty.

Four different criteria, that is mentioned by Weber et al. (1991), (communication, desire for business, impression and attitude) are summed up in just one criteria and named as “co-operation” depending on the discussion with the manager of Centraction AB. Cheraghi et al. (2004) discusses these factors and list the factor “desire for business” as it is not important anymore. Distinctively from this article, desire for business is important for Centraction AB. It is decided that these four criteria are connected to each other and one can be affected by another in the business. According to the manager, the communication between supplier and the buyer company will absolutely affects the business that they have been doing together. It is difficult to work with a company that doesn’t help to increase the sincerity which will decrease the desire for business.

Product development is extremely important for the company due to the technology that continues developing. It is sometimes possible that suppliers offer a new type of product that the buyer company is unfamiliar to or vice versa. That increases the awareness and the opportunity to create better products. Moreover, that is one of the possibilities that increases innovativeness and develop both buyer and seller.

Quality is explained as delivering the products that meets with Centraction AB’s requirements. This can be divided into inspections and measurements that the supplier follows during the production. The final product must be in the form that is required. It is not important to receive components with a higher quality than expected for the company but it will cause problems if they receive low quality products. Apart from these, quality is tied to cleanliness of the firm where Centraction AB is not satisfied with the dirty or dusty received components as a customer. Cleanliness also affects the quality of the products during its usage.

Geographical location becomes more and more important nowadays for the company because of the transportation cost that is a big part of the total cost. The manager believes in that it is absolutely better to have closer suppliers that are easier to visit and communicate. That is one of the reason for Centraction AB that they don’t import so often from China.

Price is tied to co-operation and reliability criteria. In other words, Centraction AB continues to work with the suppliers that they have close co-operation with and they rely on, even if there are cheaper suppliers compared to these ones. Having cheaper suppliers are absolutely more preferable but on the other hand, it is meaningless to have a cheap supplier if Centraction AB cannot rely on them and if they deliver late or dirty components. Thus, price is less important than the other criteria.

Björn Cagner believes in that it is always better to have a supplier that provides solutions when they face with any problem rather than having a supplier that starts discussing which side is responsible of the problem. It is preferable to have suppliers that provide solutions and produce defect free components. The solutions

can be to change the defective products as soon as possible without any charge to the buyer company.

Cheraghi et al. (2004), states that cultural difference is important in their article. In this study, the manager of the company thinks that cultural differences are not important but very interesting. He also adds that working with other countries and cultures are so common now and help to find the best components that buyer companies are looking for.

5. 2. Evaluation of each criteria and alternatives

As it is mentioned in the method section, a software program was used to have a easier calculations and more reliable results. After identification of all criteria, that affects the supplier selection of Centraction AB., these criteria were defined in the software program. Pair-wise coparisons were done for each criteria that defines the importance order of them. The table is shown is table 11:

Table 10 Pair-wise comparisons of each criteria

	Cleanliness	Reliability	Flexibility	Co-operation.	Quality	Product development	Price	Warranties& claim policies	Geographical location
Cleanliness	1	1	1	1	3	3	5	5	5
Reliability		1	1	1	3	3	5	5	5
Flexibility			1	1	3	3	5	5	5
Co-operation				1	3	3	5	5	5
Quality					1	3	3	3	3
Product dev.						1	3	3	3
Price							1	1	1
Warranties and claim policies								1	1
Geographical location									1

In table 11 the prioritization of each criteria is indicated and ranked by pair-wise comparisons. Pair-wise comparison were done by deciding which criteria is important with respect to ranking the suppliers. Cleanliness, reliability, flexibility and co-operation are the most important factors for the company, while quality and product development follow them in the second place. Price, warranties and claim policies and geographical location are the the less important then the others. To visualize the results and indicate the weights of these crieteria, see figure 8. The software calculates the inconsistency of each decision an it is accepted to be consistant if the ratio is lower than 0,1, which it is 0,01 in that calculation and proves the consistancy.

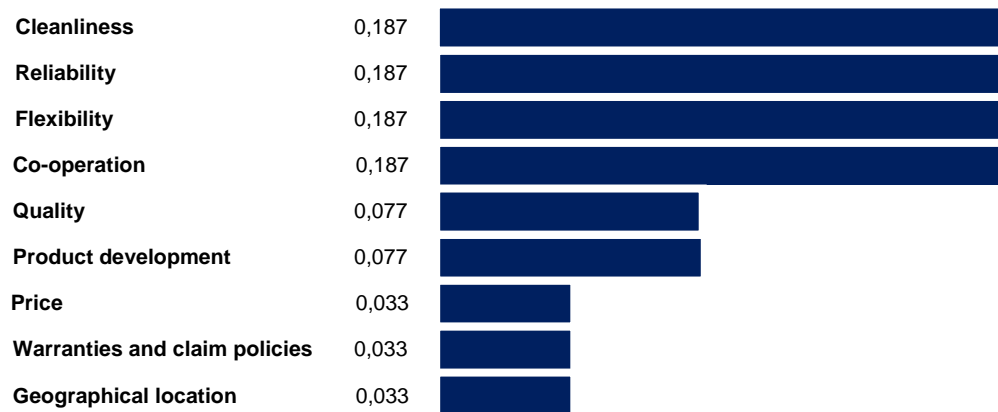


Figure 8 The weights of each criteria

Once the pair-wise comparisons done for each criteria, the comparisons were done for all suppliers for each criteria that is shown in table 12. These comparisons were done in the software program and exact copies were taken from the the program to see more visualized results. In the first table, supplier 1 is compared versus to supplier 2, supplier 3, potential supplier 1 and potential supplier 2, with respect to cleanliness. The one that is higher to the other with respect to cleanliness got a higher grade, according to the scale given in the theory by Saaty (1983). If any supplier in the row has greater value over any supplier in the coloumn, it is represented by black colour. If any supplier in the column has greater value over any supplier in the row, it is represented by red colour. For each objective, the same comparisons were done between the suppliers.

Table 11 Pair-wise comparisons of suppliers

Supplier 1					
Cleanliness					
Supplier 2					
	Supplier 1	Supplier 2	Supplier 3	P. Supp. 1	P. Supp. 2
Supplier 1		1,0	7,0	5,0	3,0
Supplier 2			7,0	5,0	3,0
Supplier 3				3,0	5,0
Potential supplier 1					3,0
Potential supplier 2		Incon: 0,03			

- Extreme
- Very strong
- Strong
- Moderate
- Equal
- Moderate
- Strong
- Very strong
- Extreme

Supplier 1					
Reliability					
Supplier 2					
	Supplier 1	Supplier 2	Supplier 3	P. Supp. 1	P. Supp. 2
Supplier 1		3,0	5,0	9,0	5,0
Supplier 2			3,0	7,0	3,0
Supplier 3				5,0	1,0
Potential supplier 1					5,0
Potential supplier 2		Incon: 0,04			

- Extreme
- Very strong
- Strong
- Moderate
- Equal
- Moderate
- Strong
- Very strong
- Extreme

Supplier 1					
Flexibility					
Supplier 2					
	Supplier 1	Supplier 2	Supplier 3	P. Supp. 1	P. Supp. 2
Supplier 1		1,0	5,0	5,0	3,0
Supplier 2			5,0	5,0	3,0
Supplier 3				1,0	3,0
Potential supplier 1					3,0
Potential supplier 2		Incon: 0,01			

- Extreme
- Very strong
- Strong
- Moderate
- Equal
- Moderate
- Strong
- Very strong
- Extreme

Supplier 1					
Co-operation					
Supplier 2					
	Supplier 1	Supplier 2	Supplier 3	P. Supp. 1	P. Supp. 2
Supplier 1		1,0	7,0	5,0	3,0
Supplier 2			7,0	5,0	3,0
Supplier 3				3,0	5,0
Potential supplier 1					3,0
Potential supplier 2		Incon: 0,03			

- Extreme
- Very strong
- Strong
- Moderate
- Equal
- Moderate
- Strong
- Very strong
- Extreme

Supplier 1					
Quality					
Supplier 2					
	Supplier 1	Supplier 2	Supplier 3	P. Supp. 1	P. Supp. 2
Supplier 1		3,0	3,0	1,0	1,0
Supplier 2			5,0	3,0	3,0
Supplier 3				3,0	3,0
Potential supplier 1					1,0
Potential supplier 2		Incon: 0,01			

- Extreme
- Very strong
- Strong
- Moderate
- Equal
- Moderate
- Strong
- Very strong
- Extreme

Supplier 1					
Product Development					
Supplier 2					
	Supplier 1	Supplier 2	Supplier 3	P. Supp. 1	P. Supp. 2
Supplier 1		1,0	7,0	5,0	3,0
Supplier 2			7,0	5,0	3,0
Supplier 3				3,0	5,0
Potential supplier 1					3,0
Potential supplier 2		Incon: 0,03			

- Extreme
- Very strong
- Strong
- Moderate
- Equal
- Moderate
- Strong
- Very strong
- Extreme

Supplier 1					
Warranties and Claim Policies					
Supplier 2					
	Supplier 1	Supplier 2	Supplier 3	P. Supp. 1	P. Supp. 2
Supplier 1		1,0	3,0	3,0	5,0
Supplier 2			3,0	3,0	5,0
Supplier 3				1,0	3,0
Potential supplier 1					3,0
Potential supplier 1		Incon: 0,01			

- Extreme
- Very strong
- Strong
- Moderate
- Equal
- Moderate
- Strong
- Very strong
- Extreme

Supplier 1					
Price					
Supplier 2					
	Supplier 1	Supplier 2	Supplier 3	P. Supp. 1	P. Supp. 2
Supplier 1		1,0	5,0	3,0	3,0
Supplier 2			5,0	3,0	3,0
Supplier 3				7,0	3,0
Potential supplier 1					5,0
Potential supplier 2		Incon: 0,03			

- Extreme
- Very strong
- Strong
- Moderate
- Equal
- Moderate
- Strong
- Very strong
- Extreme

Supplier 1					
Geographical location					
Supplier 2					
	Supplier 1	Supplier 2	Supplier 3	P. Supp. 1	P. Supp. 2
Supplier 1		1,0	3,0	1,0	1,0
Supplier 2			3,0	1,0	1,0
Supplier 3				3,0	3,0
Potential supplier 1					1,0
Potential supplier 2		Incon: 0,03			

- Extreme
- Very strong
- Strong
- Moderate
- Equal
- Moderate
- Strong
- Very strong
- Extreme

5.3. Results of the AHP model

After the pair-wise comparisons of all criteria and alternatives, the results can be seen automatically from the software. The weights of the alternatives are shown in figure 9. According to the results, supplier 1 has the best performance and supplier 3 has the worst performance with respect to the criteria that had been decided before with the manager of Centraction AB.

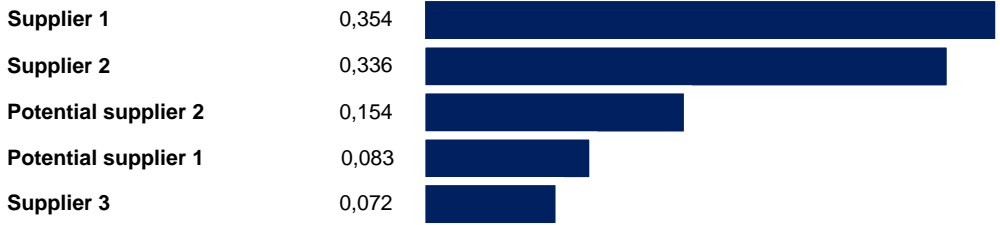


Figure 9 Overall scores

In figure 10 the criteria lies on the x axis and their importance can be seen from the y axis, where cleanliness, reliability, flexibility and co-operation are the most important criteria for the company. The alternatives are in the right side of the figure and each of them has different colors to have a more visualized view, which also makes it easier to see their weights and make comparisons. This diagram gives the opportunity for the readers to see the difference performance levels of each supplier for each criteria.

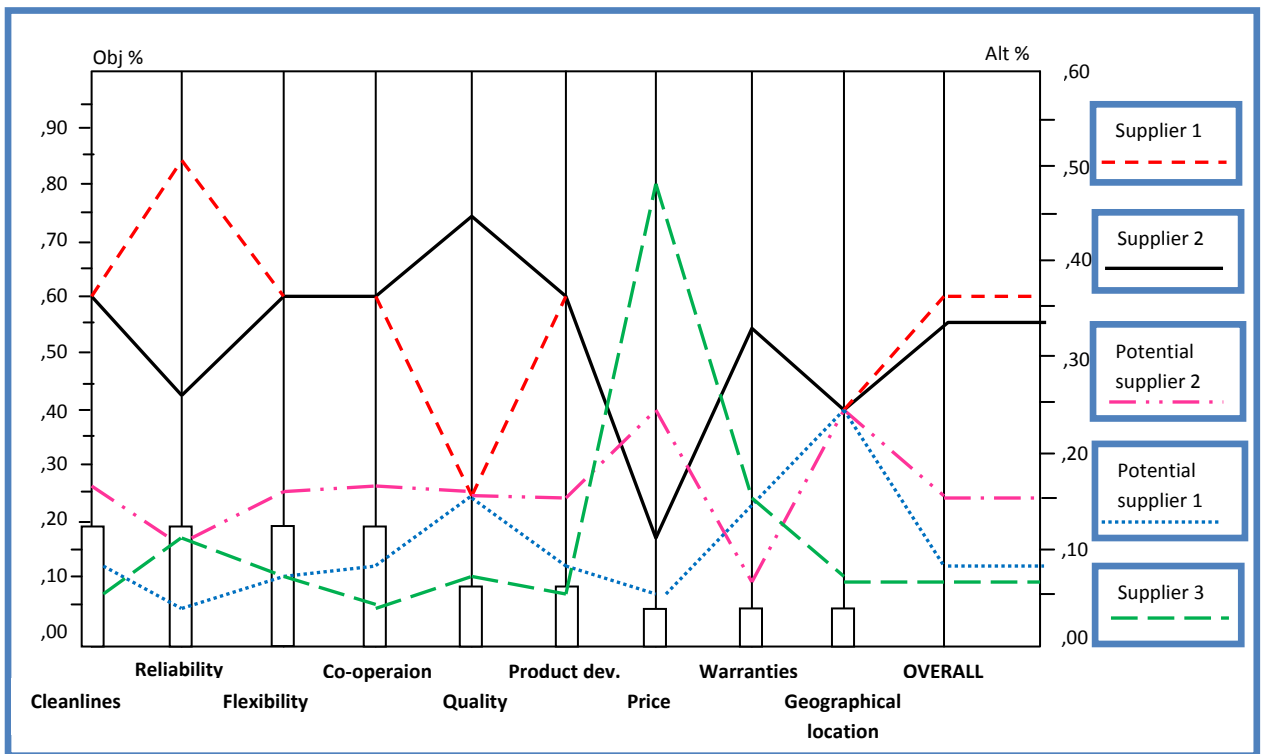


Figure 10 Performance sensitivity diagram

In the table it can obviously be seen that the suppliers have specific benefits when they are treated individually. For the price criteria for instance, supplier 3 offers the cheapest price compared to others. But when all criteria are considered, supplier 3 has the lowest performance. As it was mentioned before, it is not enough for Centraction when a company fulfills just one or two criteria, such as supplier 3.

When quality is considered; although supplier 2 has the same performance level on the quality dimension as the potential supplier 1 and the potential supplier 2, its overall performance score is higher than them. This difference is just because that it has higher performance on other criteria such as; cleanliness; reliability, flexibility, and co-operation

6. Discussion and Recommendations

This chapter divided in to two section; discussion and recommendations. The discussion section includes discussions about purchasing process-strategy, supplier selection-evaluation process, the evaluation of supplier selection-evaluation tool (Analytical Hierarchy Process (AHP)) and limitations of study. In addition to that, discovered short-term and long-term recommendations are presented in the recommendations section of this chapter.

6.1. Discussion

Discussion section is divided into three sections; buying process-strategy, supplier selection-evaluation process, the evaluation of supplier selection-evaluation tool (AHP) and limitations of study. The comparisons can be found in this chapter between Current company situation, theory and development of selection and evaluation tool.

6.1.1. Purchasing Strategy

According to Cheraghi et al. (2004), Vokura et al. (1996) and De Boer et al. (2001), purchasing operations are playing very important role in today's competitive business life. Purchasing operations have direct and indirect impact on quality, customer satisfaction, and profitability and market share issues. Suppliers are accepted as critical actors in these purchasing operations. Suppliers make it possible to produce lower cost and higher quality products by fulfilling the demand of purchasing company. For Centraction AB, finding the right supplier is more important than finding customers. According to general manager Björn Cagner, if a company has a good product, there is always a customer who buys it and, reliable and cooperative suppliers are needed to have good product. Centraction AB builds its purchasing strategy on those philosophies. It is good to see that Centraction AB aware of the importance of suppliers in purchasing operations.

Centraction AB is not manufacturing any components of their products and just do the assembly, with a few exceptions. Thus, suppliers are of vital importance for Centraction AB to continue production without any disturbances. As it is mentioned in Cheraghi et al. (2004), many trends are mentioned to overcome this challenge; outsourcing; global sourcing; supply chain optimization and supplier consolidation. Centraction AB has been outsourcing to many other companies, and also has suppliers from different countries which means global sourcing in theory. We think that it is an opportunity for Centraction AB to utilize the advantages of lower-cost companies. But, Centraction AB has total 60 suppliers and only general manager Bjorn Cagner and Elisabet Cagner deal with this large number of suppliers as part time. As it is given in De Boer et al. (2001), more outsourced products bring out more factors such as people, larger set of opinions, environmental issues and different government regulations, with the effect of all these factors complexity of purchasing operations are increase. In that case, Centraction AB has highly complex purchasing operations, and it can be hard to deal with this complexity with this number of work force. To handle with that complexity, Centraction AB builds

a purchasing strategy which aims; to keep stocks for some special components (especially if they are purchasing from foreign countries), preferring to have more than one supplier and if it is possible and profitable buying from Sweden. It was discussed that, Centraction AB's purchasing strategy has some pros and cons;

- Theoretically, it is not good to keep stock because it adds inventory cost and also it means tie up capital. But in reality, Centraction AB will need some safety stocks because it is purchasing from foreign countries and some of them are far from Sweden. Also, delivery times are long and it is not profitable to buy few. In that case, it is good to keep stock as less as possible to not to tie up capital and having lower inventory cost.
- It is good to have more than one supplier to enhance flexibility and not to face with any disturbances in production. On the other hand; it will increase the supplier management complexity and, as it mentioned before, Centraction AB is sensitive in complexity case because of limited work force. In this situation, working with less problematic and experienced suppliers will reduce the supplier management complexity of Centraction AB.
- By considering cultural, environmental and governmental aspects, it is advantageous to buy from suppliers which are located in Sweden for Centraction AB. Also, it will reduce the supplier management complexity which is good for Centraction AB. In this case, the cost advantages and profitability will be considered and compared frequently with the global price to be competitive in global market.

Further, purchasing strategy topic related short-term and long-term recommendations are presented in section 6.2.

6.1.2. Supplier selection-evaluation framework

As it is given in Hutt and Speh (2010) and Vokurka et al. (1996), supplier selection and evaluation are the two of the major steps in organizational buying process both for manufacturing and service industries. They are playing very critical role for companies by affecting their performance on quality, innovativeness, customer satisfaction, profitability and competitiveness issues. Also, Centraction AB is a company that is looking for possible improvements on its' buying process to increase its quality, innovativeness, customer satisfaction level and competitiveness by making right supplier selections and evaluations.

As it is stated by Mandal and Deshmukh (1994), supplier selection process aims to identify supplier/suppliers who is/are able to provide products and/or services at the right time, right quantity, right price and desired quality. The supplier evaluation process aims to evaluate the selected and/or potential supplier's performance according to evaluation parameters. A supplier selection frame work was presented in De Boer and Wegen (2003) which is comprise from four phases; realization of need of new supplier; determination and formulation of supplier criteria; pre-

qualification of potential suppliers; final supplier selection. After that, some modifications were done on this framework; “monitoring of selected supplier” is added as fifth phase by Sonmez (2006). Right after that, supplier evaluation starts with selecting the suppliers that the manager wants to measure. Then the evaluation criteria are defined with utilizing surveys, site visits, or scorecards. Quantitative and Quantitative tools can be used to evaluate which are available at sections 3.2.1 and 3.3.4. Moreover, Gordon (2008) states that it is beneficial to give performance feedback after all deliveries about expectations and requirements to the evaluated supplier. This will be beneficial for such kind of issues; to increase the performance of suppliers’, overcome misunderstandings, develop trust, build cooperation. Also, it was suggested in Vokurka et al. (1996), Purchasing department and held supplier selection and evaluation issues.

Distinctively from theory, Centraction AB is following its own framework for supplier selection and evaluation operations. It has some similarities and differences from theoretical framework. Centraction AB’s supplier selection and evaluation framework can be present as follows; realization of need; determination of need; searching for new supplier; detecting potential suppliers; ordering samples; testing the samples and price comparison with other ones; site visits and evaluation (only qualitative methods); selection of supplier (or more than one supplier if it is needed) with using qualitative methods; record the performance. Centraction AB does not have a systematical supplier performance feedback procedure. Centraction AB has preferred to record the problems and, if they face it again, they give feedback or change the supplier as mentioned in detail in chapter 4.3.

It is discussed that the combination of theoretical supplier selection-evaluation framework and, Centraction AB’s own supplier selection-evaluation framework will give better results. Theoretical framework has the advantages of using supplier selection-evaluation criteria and, both combination of qualitative and quantitative tools. So it will give more consistent results. On the other hand, Centraction AB’s framework has the advantages of site visits and sample testing that gives better understanding about supplier’s organizational culture, technical abilities and working procedure as well as the product specifications. Finally, a new supplier selection and evaluation framework is developed by combining the theoretical suggested and existing Centraction AB based supplier selection and evaluation framework. It is presented in section 6.2.

6.1.2.1 Supplier selection-evaluation criteria

Supplier selection-evaluation criteria are playing very important role in supplier selection and evaluation processes by directly affecting the end result. It is suggested both in Sonmez (2006) and De Boer and Wegen (2003) to use supplier selections-evaluation criteria while making supplier selection and evaluation for purchasing operations. Totally 23 criteria are presented in Weber et al. (1991) and also, given in table 2. Those criteria can be used in selection and evaluation process of companies. Centraction AB does not have any specific selection-evaluation

process as it was mentioned before. During the meetings, theoretical findings were discussed with Björn Cagner and agreed on some of the criteria mentioned in theory. Some of them were eliminated considering the company values. Finally, Centraction AB based supplier selection-evaluation criteria list was developed and prioritized and used in study (see table 10). Formulated supplier selection-evaluation criteria approach adds value to this study and it will have promising results for Centraction AB.

6.1.3. The evaluation of supplier selection and evaluation tool - Analytical Hierarchy Process (AHP)

Detailed discussions about AHP tool is presented in this section. It includes discussions about Selection process tool, general evaluation of tool, features of tool, disadvantages and advantages of tool, feasibility of tool, and reality test of tool results.

6.1.3.1. Selection of supplier evaluation and selection tool

When it was discussed with the manager of Centraction AB. about their suppliers, it was obvious that this study would be about multi-criteria decision making because of the large amount of suppliers they have. Outsourcing brings more amounts of people and larger set of criteria as mentioned by De Boer et al. (2001).

The selection of supplier selection and evaluation tool was done by considering the practical view of Centraction AB managers and literature that has given in chapter 3. First, both the suppliers that will be evaluated and selected are decided by the manager of Centraction AB. After that, brainstorming was done to define the selection and evaluation criteria. Afterwards, both potential and existing suppliers were visited and necessary data was collected. To interpret collected data, the AHP method was chosen. The selection of tool was done by considering the use of tool in literature and in similar cases. Some other tools (which are given in section 3.3.4) were also considered according to their disadvantages and advantages, features and limitations. Finally, AHP was selected tool for this study.

6.1.3.2. General evaluation, weaknesses and strengths of tool

As it is given in Saaty (2008), AHP is a general approach that expresses and ranks the decisions by prioritizing the judgments on a numeric scale. It is mostly used in multi-objective, multi-criteria and multiparty decisions (Saaty T. L., 2008). It makes pair-wise comparisons considering the decision-making environment and can be used for both qualitative and quantitative criteria (Yu et al. 2008).

During the comparisons that were done with the manager of Centraction AB, one of the advantages of the tool was that its easily understandable way of collecting data, as it was also mentioned in the theory section. Building the hierarchy can be done with just defining the supplier selection criteria and the suppliers that were going to be evaluated. Moreover, by doing pair-wise comparisons between all the suppliers, the performance level of each alternative could be seen clearly, without any disturbance.

The interface of Expert Choice software is very visual. The results are presented in different and reasonable colors in computer screen. So, the results are easily understood and interpret by users. On the other hand the Expert Choice software's this visual advantage get lost in black and white printing and the results become hard to understood and interpret for users. The colorful signs/lines look same in black and white printing because they share the same sign/line structure. Hence, the printing operations mostly held by black and white printer, some developments are needed on Expert Choice software to make it also visual in black and white printing.

The comparisons were tested by the consistency test that is automatically done by the software program. This proves the reliability and the validity of the tool and in this study, all comparisons' consistency were under the limits which means that they are consistent.

In AHP, it is a disadvantage to rank between verbal criteria (Tahiari et al. 2008). In this study it was difficult to define the criteria especially the fuzzy ones such as cooperation, which the manager defines as the attitude, impression, communication and desire for business. On the other hand, cleanliness is another criteria that had been identified. These two criteria are based on the perception of the manager, and vary between individuals. In this study, all criteria were based on the opinions of Bjorn Cagner.

Luckily, there haven't been any criteria or alternative added after the comparison, which would create a disturbance that will end with starting to rank all criteria and alternatives from the beginning. Even if it is much easier to get results by the software, it would still be time consuming to add new alternative or criteria.

6.1.3.3. Feasibility of Tool

As it is stated in Bhutta and Hug (2002), AHP is an effective approach that can be used in multi-criteria decision making environment. In this study it is also used for multi-criteria decision making; supplier selection and evaluation. Every step of the tool was implemented with the coordination of the researchers and Centraction AB managers. It follows those steps in given order; determination of potential and existing suppliers; determination of criteria; data collection by making supplier visits and interviews; data structuring and evaluating with AHP; final selection and evaluation results; interpretation of results. Implementation of AHP plays very critical role in this process and it is based on the capabilities of the managers on identifying the right criteria. As it was given in theory, AHP is not a complex tool to use and Centraction AB managers are capable to use of the tool, so that this risk turns in to an advantage. Moreover, implementation of tool was done without facing any serious problem. And, it was the proof of the tools feasibility.

6.1.3.4. Comparison of the results

According to the result of the tool the performances of potential and existing supplier's can be listed starting from the highest performance to the lowest as follows;

1. Supplier 1
2. Supplier 2
3. Potential supplier 2
4. Potential supplier 1
5. Supplier 3

Supplier 1 was presented as best compared to others. On the on the hand supplier 3 was presented as worst by AHP. The managers are informed about each step of AHP; the especially in pair-wise comparisons. After the ranking, the reality test of results was done by the participation of Centraction AB managers and researchers. The tool was found logical to be implemented. Long discussions were held and the perception of Björn Cagner were compared with AHP ones. As a result of this process, it was observed that the AHP results were match with his opinions which creates a consistency.

6.1.4 Supplier Relationships

As it is discussed in Gadde and Snehota (2000), the arm's and length relationships trend which aims to avoid dependency and price down, is changing over to close relationships trend which is aiming the making the most of supplier and enhancing the benefits of partnership. Partnership based supplier relations are regarded as the main sources for the future competitive advantages by offering benefits of long-term relations, mutual trust and wide-scope supplier relationships. Also, Centraction AB is seeking for close relationships to enhance the benefits of partnership and making the most of suppliers. Especially when it comes to enhancing the reliability, flexibility and co-operation which are the highest ranked supplier selection and evaluation criteria for Centraction AB, the importance of partnership and making the most of supplier approaches of supplier relationships are increased. By building on the benefits of close relations, Centraction AB can more easily have more reliable, flexible and co-operation focused suppliers. On the other hand, developing and sustaining the partnership is regarded as a costly activity for purchasing companies by Gadde and Snehota (2000). So, it was suggested to develop partnership between limited numbers of suppliers which are selected by considering the economic importance of the supplier, continuity of the business relationships and the purchasing strategy of the purchasing company. Especially, Centraction AB will gain benefits because of their highly complex purchasing operations and limited workforce by limiting the number of suppliers to develop strategic partnership. In addition to this, the partnership concept is sometimes being confused with close relations (which are not really offering much

help). “Closeness” means degree of integration in supplier relationships. The level of integration is also a strategic decision for buyer companies. High-involvement in supplier relationships is regarded as costly when the coordination, adaptation and interaction costs are considered. But, high-involvement also has some benefits such as cost and revenue benefits. So, there is a conflict between high-involvement costs and benefits that makes it a strategic decision. That point, a supplier segmentation approach will help the integration decision. The segmentation of suppliers can be done by considering three characteristics of supplier relations; monetary volume of business in the relationship; continuity of the relationship over time; whether or not the supplier relationship is used as a single source. A segmentation approach will also help Centraction AB, deciding on the degree of supplier integration.

According to Gadde and Snehota (2000), making the good use of suppliers is a complex task in supplier relationships because of its’ economic consequences (relationship costs-relationship benefits, see section 3.4). Relationship costs can be summarized as follows; direction costs -obvious costs which are easy to measure from the supplier invoices-; relationship handling costs –costs to sustain and handle the relationships-; supply handling costs –structural and common costs- .On the other hand, cost benefits –operational cost savings- and revenue benefits – increasing income of buyer companies- are regarded as the cost benefits of supplier relationships. Centraction AB will gain benefits if they consider these economic consequences. Also, the supply strategy of the buyer companies plays a very critical role to find the balance between relationship costs and relationship benefits.

According to Ford et al. (1998), both sellers and buyers bring their own uncertainties and tactics in to their supplier-customer relationships. Shortly, sellers have totally three uncertainties; capacity uncertainties –amount of product is going to be sold in upcoming year-; application uncertainty –the way of using the product by the supplier-; transaction uncertainty –risk of customer not buying the product- . To help their suppliers, customers have totally three tactics; manipulation of uncertainties –sharing forecasts about upcoming year etc.-; demand ability-explain the way of use the product-; transfer ability -make agreement to buy product or give bank guarantee about payment- . So, Centraction AB will gain benefits by being aware of its’ suppliers uncertainties and help them to overcome those uncertainties by using customer tactics. Also, Centraction AB will have long-term relations, increased mutual trust and wider-scope in its supplier relationships that will lead them to have more reliable, flexible and co-operating suppliers and a positive word-of-mouth in the market. Moreover, buyers have their own uncertainties in their supplier relationships; need uncertainty –do buyers really need this product or not-; market uncertainties –is the market going to demand this product or not-; transaction uncertainties –supplier is going to deliver on time or not- . To help their customers, suppliers have their own tactics; manipulations of uncertainties –provide market forecast for buyer-; problem solving ability – provide solutions of what to buy-; transfer ability –make some contract about on time deliveries-. Suppliers will

help Centraction AB to overcome its uncertainties by using their tactics. Without those uncertainties, Centraction AB can be more competitive, efficient and effective in the market.

6.2. Recommendations

Based on the analysis and discussions, some recommendations are developed and presented in this section. The recommendations are divided into two parts; short-term recommendations and long-term recommendations.

6.2.1. Short-term recommendations

Sustain the supplier based business approach;

Centraction AB is one of those companies which recognize the importance of the suppliers in purchasing operations. And, the managers of Centraction AB aim to develop themselves and the company to have a better supplier selection and evaluation approach to increase their possibility of finding better suppliers and making right evaluations. By doing that they are aiming to be more reliable suppliers for their own customers, increase customer satisfaction levels and having a positive word-of-mouth between existing customers in order to attract new ones. Also, Centraction AB will have an improved competitive position in the market, increase its' innovativeness and profitability. It is recommended to build a supplier feedback system that report the good and bad performance results to the both suppliers and Centraction AB managers.

Re-position someone from inside or hire someone from outside to purchaser position;

Centraction AB is working with 60 suppliers on Global base so it has highly complex purchasing operations. General Manager Björn Cagner and Elisabet Cagner are dealing with the management of those complex business operations, on part time basis, besides their other responsibilities. It is reducing both their organizational efficiency and, effectiveness of purchasing operations. So, it is recommended to re-structure Centraction AB's organizational structure and open a position for a purchasing staff and to re-position someone from Centraction AB in to that position or hire someone from outside of the company.

Take care about purchasing strategy related issues;

Centraction AB has a purchasing strategy which aims; to keep stocks for some special components (especially if they are purchasing from foreign countries), preferring to have more than one supplier and if it is possible and profitable buying from Sweden. In this point, some recommendations are presented as follows; keep as limited safety stock as possible to not to tie up capital and having less inventory cost; work with less problematic and experienced suppliers; the cost advantages and profitability will be considered while sourcing from Sweden and compared frequently with the global price to be competitive in global market.

Implement AHP in the existing supplier selection-evaluation framework;

In the short time period it will be hard to change the existing supplier selection and evaluation framework. On the other hand, the need of a supplier selection and

evaluation tool is obvious. So, an implementation of supplier selection and evaluation tool is recommended to existing supplier selection-evaluation framework. AHP tool is analyzed in this study for this purpose as supplier selection-evaluation tool and it gives promising results. So, the AHP tool is recommended to be used in the existing framework. Table 13 is presented to give an idea about which phases are possible to use AHP tool;

Table 12 AHP implemented existing framework of Centraction AB

Phases	Actions
Phase-1	Realization of need
Phase-2	Determination of need
Phase-3	Searching for new supplier
Phase-4	Detecting potential suppliers
Phase-5	Ordering-Testing samples-Price comparison
Phase-6	<i>Site visits and evaluation- AHP implementation</i>
Phase-7	<i>Selection of Supplier-AHP implementation</i>
Phase-8	Performance recording

As a result of AHP applications in this study, it is recommended to continue working with Supplier 1 and Supplier 2. On the other hand Supplier 3 is not sufficient for Centraction AB so it is good to change it with new ones. Also, Potential Supplier 2 is seems ok when it is compared with Potential Supplier 1 and Supplier 2 so it will add value to Centraction AB.

Enhance the benefits of partnership based supplier relationships

As it is discussed in section 6.1, a partnership and integration approach is leading to long-term, reliable, flexible, co-operative and trustful supplier relationships. But, to enhance cost benefits of a partnership approach, it is recommended to build partnership and highly integrate with a limited number of suppliers. Also it is recommended to make supplier segmentation by considering the economic importance of the supplier, continuity of the business relationships and the purchasing strategy of Centraction AB. In addition to that, it is recommended to buyers to use tactics to reduce the sellers' uncertainties and sellers can use tactics to reduce buyers' uncertainties.

6.2.2. Long-term recommendations

Discussion section based discovered long-term recommendations are presented as follows;

Build purchasing department

A purchasing department with well-educated staff is recommended for Centraction AB to having better supplier selections and evaluations for more reaching competitive position in the market, increasing the profitability, innovativeness and product quality as well as the customer satisfaction levels. Moreover, it will reduce the complexity of purchasing operations by increasing management control over purchasing operations.

Reduce the purchasing complexity

As it was mentioned in previous sections, Centraction AB has very complex purchasing operations because of its global outsourcing strategy, limited work force and large number of working supplier. It was suggested to use the AHP tool to eliminate some of suppliers and/or substituting insufficient ones with the better ones by using AHP tool. This will reduce the complexity of the purchasing operations by reducing the number of suppliers or substituting insufficient ones with better ones. The AHP tool was recommended to be used while making recommended eliminations and substitution processes to have consistent results.

Change the Supplier selection and evaluation framework

As it is discussed in section 6.1, a combination of the theoretical supplier selection-evaluation framework and Centraction AB's own supplier selection-evaluation framework is recommended to have a better result. The theoretical supplier selection-evaluation framework has the advantage of using supplier selection-evaluation criteria and, a combination of qualitative and quantitative tools. So it will give more consistent results. On the other hand, Centraction AB's framework has the advantage of site visits and sample testing that gives better understanding about supplier's organizational culture, technical abilities and working procedure as well as the product specifications. Finally, a new supplier selection and evaluation framework is developed by combining the theoretically suggested and the existing Centraction AB based supplier selection and evaluation framework. It is presented in Figure 11 as follows;

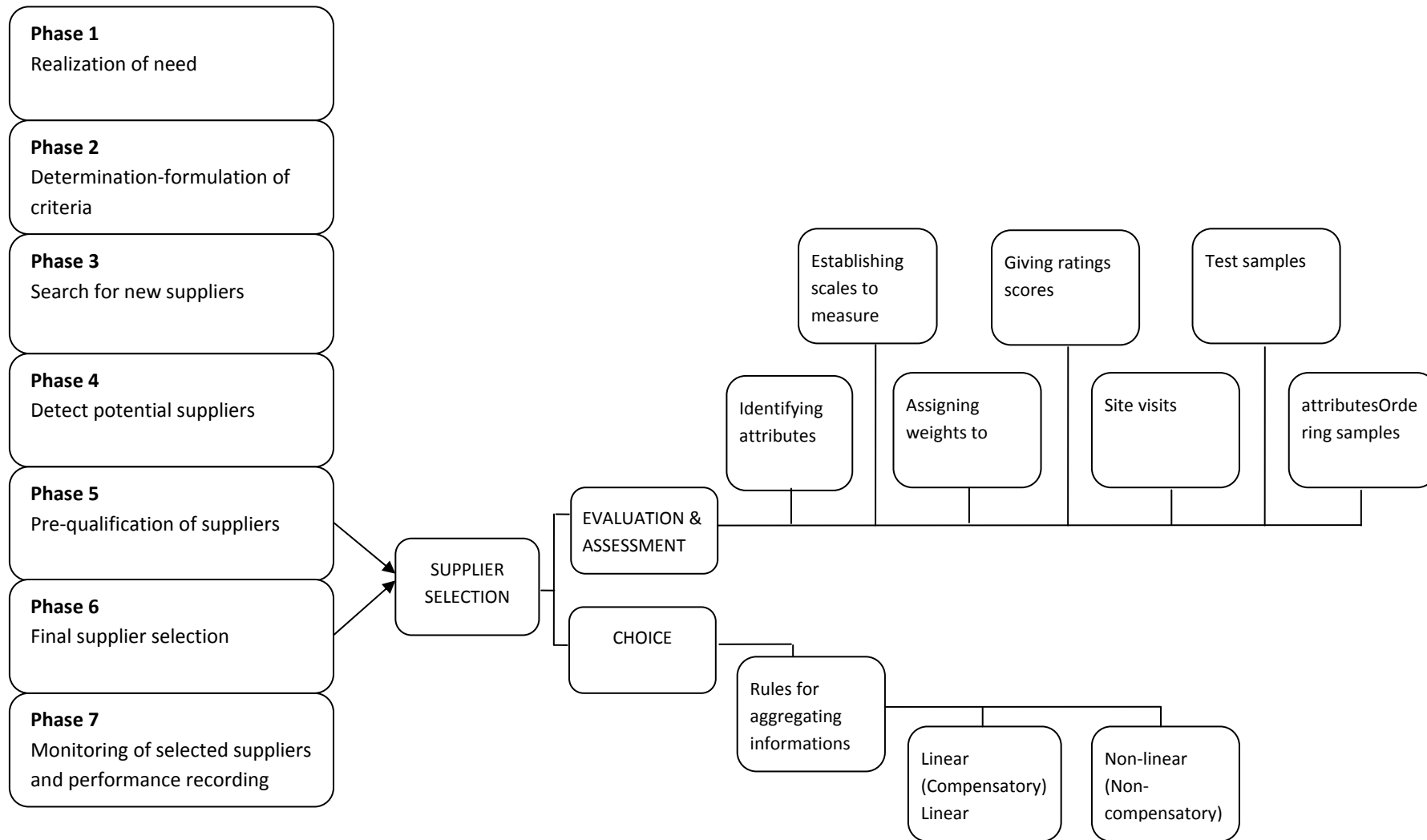


Figure 11 Developed supplier selection and evaluation framework

The new recommended supplier selection and evaluation framework can be described as follows;

In the first phase of the framework, the realization of problem activities can be performed; problem will be need of new supplier or additional/more supplier or replacing existing supplier. The second phase of the framework is dealing with; the determination and formulation of selection criteria. Qualitative tools such as brainstorming and virtual analysis are recommended to be used for the first two phase of supplier selection process. The third phase of deals with the searching for new suppliers. The fourth phase of the framework deals with the detection of potential suppliers. The fifth phase of the framework is dealing with pre-qualification of suppliers to reduce the set of “all” supplier to a smaller number of acceptable suppliers by considering determined criteria. The sixth phase of supplier selection process deals with selection of a supplier or if it is desired more than one supplier. A quantitative tool such as the AHP is recommended to be used for the third and fourth phases of supplier selection process.

The new framework will include two main tasks; evaluation and assessment of attributes, criteria, or factors and, when it comes to the final selection/choice, establishment of evaluation criteria to make a comparison. In addition to that, these two tasks will include number of subtasks:

Evaluation and assessment task; decision attributes should be identified which are to be fulfilled by potential supplier’s; the evaluation metrics/scales should be determined to perform a proper appropriateness measurement of potential suppliers; the attributes should be weighted to determine their importance in the supplier selection process; all potential suppliers should be evaluated by considering decided, scaled and weighted attributes. Than site visits can be performed to see the supplier’s organizational culture, technical abilities and working procedure. After all, samples of products can be ordered from suppliers. Then, some sample test will be performed to check the product specification.

Choice Task; the total score of each potential suppliers and/or existing suppliers should be aggregated in both qualitative and quantitative aspects. There are two approaches to make a rational and sound choice; compensatory (linear) or non-compensatory (non-linear) approaches. In compensatory approach, weak performance on one criterion will be balanced with good performance on another criterion. On the other hand, in non-compensatory approach, weaknesses are not acceptable and they cannot be balance with good performance. In this point, final decision maker/makers should decide that weaknesses on the performance of criterion are acceptable or not.

6.2.3. Future Research

There were some limitations in this study such as time, money and geographical distances between suppliers and Centraction AB. Thus, this study is focusing on only one point; supplier selection and evaluation. There is a possibility to extend

this study by making some future research. The relationship between suppliers and buyers can be examined and the supplier's opinions can be gathered about their customers. Gathering the suppliers point of view would provide a better working atmosphere and for both sides and increase the partnership between the companies.

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8. Appendix A

1. Can your customers rely on you and your deliveries that you are supposed to send?
2. Do you have flexibility on producing new components; changing the size of the components, deliver urgent demands?
3. Do you allow your customers to visit your company so often?
 - Do you have a strong communication with your customers?
 - Do you accept all demands that comes from a new customer even if you do not have any desire for business?
 - Do you believe the first impression on you customers and take decision on that opinion?
 - Do you consider your customers' attitudes during your business?
4. Do you make inspections and measurements during the production?
5. Do you have an innovative R&D department?
 - Do you accept new drawings that you haven't produce before?
6. Can you elaborate on your price? How do you see you price level compared to your competitors?
7. How do you see your geographical location?
 - Is this company located close to the customers, to highways, to airport, to railway or to the harbor?
8. Do you have any warranties? What is your first focus when you face with a problem with your customers?