Supplier Evaluation and Selection Process for Public Procurement in the Swedish Electricity industry

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Abstract

Rapidly changing business environment, increasing and fluctuating customer demand, the recent development and employment of technology are crucial reasons for companies to strive for better quality, shorter lead time and lower costs. The supplier evaluation and selection process is an increasingly important activity in the supply chain in order to enhance the company’s competitiveness by reducing the costs and simultaneously maintaining the same quality of products. The focus of this thesis is on the supplier evaluation and selection process for public procurement in Swedish electricity industry. Specifically, the work combines the literature and the empirical findings gathered from the case company Växjö Energy (VEAB) to develop a supplier evaluation and selection process for the public procurement in Swedish electricity industry.

It was concluded that the supplier evaluation and selection process for public procurement has basically four steps. The steps are 1. Identifying the needs and the sourcing method; 2. Setting the pre-requirements; 3. Supplier evaluation and 4. Supplier selection. In addition, the developed supplier evaluation tool innovatively combines the advantages of the value-added model with the advantages of AHP model. Moreover, this developed supplier evaluation and selection process would help the public procurement departments in Swedish electricity industry to improve their current practices in selecting the suppliers by highlighting the important steps and developing the evaluation model in a way that enhance its credibility to provide a more precise and reliable results.

Keywords: supplier selection, supplier evaluation, public procurement, electricity industry, supplier evaluation criteria
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1 Introduction

This chapter contains a brief introduction for the topic of this thesis. A short background is provided to present the supplier evaluation process, electricity industry within current business environment and the case company. The problem discussion paragraph is followed by and the purpose and research questions. In addition, the limitation of this paper is presented to provide a better understanding of the paper.

1.1 Background

In today’s competitive business environment, the companies attach importance to procurement since the acquisition of goods and services can influence the achievement of the company’s main goals and objectives (Prasad, et al., 2016). In addition, fierce market competition, increased customer demand and the development of recent technologies have forced companies to pursue for higher quality, improved lead time and lower production costs (Imeri, et al., 2015; Aksoy and Öztürk, 2011). These changes result in the need for a more transparent and systematic approach for supplier selection in public procurement (Boer et al., 2001). On the other hand, as suppliers are playing growing roles within the company’s supply chain, there is an increased need for more objective evaluation of supplier performance (Imeri, et al., 2015). Supplier selection is one of the most important steps in the purchasing process and this step is a basis of many proceeding activities (Weele, 2014). Most of the published articles about supplier selection have concluded that the supplier selection process includes the evaluation of different suppliers based on different criteria (Imeri, et al., 2015). Supplier evaluation is defined as a quantification process to assess the efficiency and effectiveness of supplier actions (Neely, et al., 1995). The supplier evaluation can not only be used for evaluating and motivating existing suppliers, but also be employed as tool for improvements (Imeri, et al., 2015). As pointed out by Prahinski and Benton (2004), the buyer company can develop supplier evaluation process and communicate with suppliers to address the shortcomings and build effective buyer-supplier relationship. The evaluation and selection of right suppliers may help to reduce the costs for
raw material with no effect on the quality of products which can improve the company’s competitiveness. Hence, the selection of suppliers become increasingly important when considering the new trends of global sourcing and the requirement for more close and collaborative supplier relationship with smaller number of suppliers (Ulutas, et al., 2016).

According to Ulutas, et al. (2016), the reviews of supplier evaluation and selection literature indicated that the current research focused on proposing new models to deal with the increasing complexity of decision making in supplier evaluation. However, despite the potential benefits of applying new models, there are few companies consider this approach (Erdem and Göçen, 2012). It is mainly due to the fact that the manual application of those models is usually complicated and a very time-consuming process (Erdem and Göçen, 2012). The existing studies on supplier evaluation suggest the need for the input from stakeholders to calculate and decide the weight of criteria in the process of supplier evaluation (Hashemian, et al., 2014).

Public procurement is regarded as one of the main government activities, which can account for 15% of the Gross Domestic Product (GDP) (Bergman and Lunberg, 2013). In European Union (EU), the lowest price win strategy is less used and instead, both price and quality are considered more often in the process of supplier selection to enhance the efficiency of public procurement (Bergman and Lunberg, 2013). The whole process of supplier selection and evaluation in public procurement is a complicated and highly-regulated process, ensuring fair competition while minimizing the risk of discrimination (Schapper, et al., 2006). The procurement department needs to follow rigorous and clear procedures that support the optimization of specific objectives and avoid subjective judgements on vendors (Falagario, et al. 2012). As a member of EU, the regulations of Swedish public procurement are based on the EU Public Procurement Direction (Swedish competition Authority, 2012).

About the power sector in Sweden, The Swedish Energy Agency published a report concerning the situation and the development of the sector in 2015. As stated in the report, there was a deregulation of the Swedish power market in Sweden in 1996 which was
followed by a decrease of the installed production capacity. However, after 2000, the production capacity became greater than before the deregulation with the wind power accounting for the largest portion of this increase (Swedish Energy Agency, 2015). According to Swedish Competition Agency (2012), procurement for energy sector should be conducted under law and follow the public procurement process. Each step throughout the process of public procurement is controlled by regulations to minimize the potential risk and the vendors will be selected based on mandatory and non-mandatory requirements (Lindskog, Brege and Brehmer, 2008).

There are different energy markets in Sweden such as the Swedish electricity market, the district heating market and the fossil fuel market (Swedish Energy Agency, 2015). The electricity market is to a large extent dependent on hydropower and nuclear power. For the district heating market in Sweden, the portion of district heating produced by cogeneration has increased in a steady base and it was in 2015 around 40 percent compared with 30 percent in 2003. About the fossil fuel markets in Sweden which includes oil, coal and natural gas. Oil products are used mainly in the transport sector while the coal is used mainly within industry. The natural gas in Sweden is used mostly for electricity and heat production in addition to the industrial sector (Swedish Energy Agency, 2015)

Regarding to the electricity industry, according to Ljung (2007) the power sector has many unique characteristics such as the widely fluctuating demand over any 24 hours period. Moreover, the electricity cannot be stored, therefore it is important to balance the demand with the supply continuously. The flows in transmission (and distribution) networks are hard to control and any disruption on one part can affect all other parts. The construction of a new transmission facility should be coordinated with the installation of new generating capacities and the growth of demand at the distribution system level (Ljung, 2007).

1.2 Background- Växjö Energi AB

Växjö Energi AB (VEAB) is an energy company owned by Växjö Municipality. There are two subsidiaries: Växjö Energi Elnät and Wexnet. VEAB offers products and services in
the area of electricity, district heating and district cooling for around 700 businesses and 7000 houses in Växjö and surroundings. Besides, VEAB offers broadband at several locations in Kronoberg County through the subsidiary Wexnet. VEAB has around 200 employees and three main plants. Sandvik 3 is the newest plant which produces district heating and electricity fossil free, and is powered by renewable biofuels from the forests of Småland. The company’s vision is “to be the region’s leading infrastructure player” (Växjö Energi AB, 2017) and the company’s mission is “to stimulate development in the region” (Växjö Energi AB, 2017). The central concept of VEAB is to care for the environment and contribute to the reduction in carbon dioxide emissions through long-term commitment to biofuels. Energy services are provided to help customers to implement energy-efficiency measures. The business idea is to harness enterprise and innovation to create good value services for the benefit of society which makes life more comfortable for the customers. VEAB is dedicated to providing the best service and products in the industry through committed workforce (Växjö Energi AB, 2017).

Figure 1. The process picture of power and heating

Source from Växjö Energi AB (company presentation)
Biofuel is used as a raw material. The boiler produces heat through burning the fuel. Thereby also power is produced as a byproduct. The heat is transported through pipes to the customers. Hereby, energy losses within the network are a critical part of the process.

1.2.1 Situational specifics of VEAB

VEAB is currently owned by Växjö municipality (Växjö Energi AB, 2017). Different from private sector, public sector companies as VEAB need to conduct the procurement under the regulations and law of LUF (Loorentz, Purchaser, May 03, 2017). The whole process of supplier selection and evaluation is highly regulated. As the greenest city in Europe, Växjö municipality has specific environmental policy for suppliers and products (Loorentz, Purchaser, April 21, 2017). In addition, the suppliers for VEAB’s electricity segment should fulfil technical requirements and have a certification to confirm their qualification for working within electricity sector in Sweden (Loorentz, Purchaser, April 21, 2017).

1.3 Problem discussion

Supplier evaluation in supplier selection has been extensively reviewed by researchers covering different perspectives, see for instance (Agarwal, et al., 2011; Kawa and Kocziodaj, 2015; Lenort, 2012; Purdy and Safayeni, 2000).

Regarding the supplier evaluation and selection, plenty of researches were carried out covering this topic. Supplier evaluation is considered as one of the key aspects for the creation of an efficient and successful supply chain management (Prasad, et al., 2016; Hashemian, et al., 2014). Cost savings and performance improvements that can be achieved by a proficient supplier evaluation and selection can bear a huge potential for the profitability of an organization (Imeri, et al., 2015). Supplier evaluation is not only helpful to identify cost saving potential, but also to mitigate risk and drive a continuous improvement process (Gordon, 2008). It is a very powerful tool in identifying and reducing cost of poor quality in the whole supply chain. In some industries cost of poor quality in terms of nonproductive work can make up to 50% of the total costs (Gordon, 2008). In addition, the supplier evaluation and selection process can help buying companies to decide
if the supplier base can meet the needs of current and future business and find the areas required for improvement (Prahinski and Benton, 2004). So, organizations that did not develop a proficient supplier evaluation and selection process yet may have a huge untapped potential for cost reduction and process improvement.

According to Manuwwar, et al. (2017) during a previous research conducted with Växjö Energi AB (VEAB), the manager of the business unit “power and heat” implied that they are planning to re-evaluate and improve their supplier evaluation and selection process. The business unit power and heat of VEAB is not only distributing power and heat but also generating and producing it in own facilities. Therefore, they are depending on their suppliers to deliver the processed and raw materials and services needed. Therefore, an improved supplier evaluation process coherent with up to date theoretical research, could enable VEAB to improve their supplier selection process and therefore, improve quality and lower costs. The supply chain in VEAB involves different actors and each of the actor in the supply chain plays an important role. Based on Växjö Energi AB (2017), a generic configuration of supply chain in VEAB is built (as shown in figure 2). The study object of this thesis is the relationship between VEAB and its direct suppliers.

**Figure 2. generic configuration of supply chain in VEAB**

![Source from own illustration](image-url)
A first research conducted turned out to show, that the electricity industry is one of the industries not yet covered by research in terms of supplier evaluation and selection. This first research did not deliver any results that were particularly focusing on the supplier evaluation and selection in the electricity industry. Considering the increasing significance of a proficient supplier evaluation and selection process in general and the request of VEAB to conduct an empirical study for them, this research was set up.

The research is further limited by the cooperation with the case company and the focus of their business unit power and heat. As to the fact that the industry is part of the public sector, the procurement process is highly regulated and the research is therefore limited by the applicable laws and regulation. This research will in particular emphasis the analysis and creation of a supplier evaluation and selection process for public procurement in the Swedish energy industry. The evaluation process is viewed as a part of the selection process in order to choose the right suppliers for VEAB’s business unit power and heat, specifically the electricity segment.

The objective of the work is to understand how the supplier evaluation and selection process is defined and developed, because it is important for the company since it enables the managers to better assess the efficiency and effectiveness of supplier actions.

1.3.1 The definition of researched processes

For the sake of clarifying the terms and distinguishing between the used processes in this work, a definition of these processes is needed. The three processes mainly studied in this research are procurement process, supplier selection process and supplier evaluation process.

Procurement process is considered to start with specifying the needs by the internal customer in the organization until the purchasing is made. Therefore, the supplier selection process is considered to be a part of the procurement process. Also the supplier evaluation process is treated as a part of the supplier selection process where the suppliers are
evaluated in order to be prioritized for the final supplier selection. A graphical illustration of the procurement processes can be found in figure 3.

Figure 3. Procurement processes

1.4 Purpose and research questions

The purpose of this paper is to develop a supplier evaluation and selection process for public procurement in Swedish electricity industry by selecting VEAB as case study. A supplier evaluation model will be presented to help VEAB improve their current supplier selection process. Based on the insights gathered from the previous literature studies, the following two research questions were selected to bridge the knowledge gap in this research domain.

1. How to develop a supplier evaluation and selection process for public procurement in the Swedish electricity industry?

2. How to apply the developed supplier evaluation and selection process at the case company VEAB
2 Methodology

This chapter aims to present the methods employed to answer the research question of this thesis. The methodology part of this research is introduced in detail to provide the reader with an understanding for the selection of methods and how the study is carried out. The chapter starts with a discussion about the scientific perspective and scientific approach which is followed by research design, sampling method, data collection and analysis. In the end of this chapter, the reliability, validity and the ethical consideration of this research are addressed.

2.1 Scientific perspective

In this part, an introduction of the scientific research is provided. In addition, three different scientific methods including positivism, hermeneutics and grounded theory were reviewed in order to choose a method that can be suitable for the thesis work.

According to Krishnaswami and Satyaprasad (2009) the research refers to the search for facts, answering the questions and the inquiries by finding explanations for the unknown phenomenon for the purpose of clarifying the doubtful suggestions and finding correcting the misunderstood facts. The author proceeds that the research might be made by arbitrary method (unscientific method) or by scientific method (following a systematic and logical approach for finding the facts). By using the scientific method, the disadvantages of the arbitrary method can be avoided because it is objective, precise and leads to conclusions based on verifiable facts (Krishnaswami and Satyaprasad, 2009). Furthermore, there are two different research philosophies regarding the scientific methods with respect to epistemology, which are positivism and hermeneutics (Bryman and Bell, 2011).

As stated by Bryman and Bell (2011), positivism is about testing the theories and providing tools in order to develop laws. In addition, the relation between the research and the theories denote that it is possible to collect observations if it is not affected by the pre-existing theories. Furthermore, the theoretical terms should be directly adjustable to observation in order to be considered as genuinely scientific. The authors proceed that the
researcher’s sense is the first and the most important tool, also the experiments should be
designed in order to appeal to this sense. Creswell (2014) mentioned that for the approach
to be accepted by positivism, the researcher starts with the theory, then the data can be
gathered to support or to disagree with the theory, and later an adjustment can be made
before the additional tests are made. At its extreme, the positivism asserts that only
observable and verifiable phenomena are the subject matter of science and this eliminate
the subjective or the unverifiable theories (Gillham, 2000).

Moreover, Bryman and Bell (2011) mentioned that the hermeneutics is a term that is taken
from theology. When hermeneutics is used in social science, it concerns with theory and
hermeneutics in scientific theory can be made by a process where every phase of the
research adds knowledge to the previous one, in other words, no understanding without pre-
understanding.

In addition to the scientific methods (positivism and hermeneutics) which are mentioned by
Bryman and Bell (2011), Clark (1999, pp.83) defined the grounded theory as “a qualitative
research design in which the inquirer generates a general explanation (a theory) of a process,
an action or an interaction shaped by the views of a large number of participants.” Clark
(1999) said that the purpose of the grounded theory study is to investigate and discover the
theory instead of providing only a description. During the process of the grounded theory
research, the development of the theoretical perspective can lead to an explanation for the
practices or provide a path for further research. The center part of the grounded theory
study is the data which are developed by the participants who have experience with the
process. According to Starks and Trinidad (2007) the objectives of grounded theory is to
start from a basic social process in order to develop a theory within the environments in
which it takes place. Moreover, the grounded theory investigates the “six Cs” of social
processes (causes, contexts, contingencies, consequences, covariance, and conditions) in
order to find the relationships and the patterns among the involved elements.
2.1.1 Applied scientific perspective

Since the focus of the hermeneutics method is about the interpretation of the action of human and the main focus of the thesis is on the processes of supplier evaluation and selection for public procurement in Swedish electricity industry and in the case company VEAB, hermeneutics method cannot be considered as a basis for the thesis. Furthermore, the work was planned to be based on theories and observations in order to develop a supplier evaluation and selection process. This does not match the grounded theory method where the theory is developed by a basic social process with contribution from experienced participants with the process. Therefore, it can be seen that this thesis is based on positivism since the work is about having the theoretical background as a basis of the research. After that, the supplier evaluation and selection process is detected by using the theories and the empirical findings in order to end up with a conclusion about supplier selection process for public procurement in Swedish electricity industry in general and for the case company in specific.

2.2 Scientific approach

A scientific approach is defined as “a systematic rational approach to seeking facts”, which is precise, empirical and reaches the conclusion based on veritable and accurate evidences (Krishnaswami and Satyaprasad, 2009, pp. 3). In addition, scientific approach can be designed to gather information on new facts and to test the old facts (Krishnaswami and Satyaprasad, 2009). The relationship between theory and research is one important factor in scientific approach (Bryman and Bell, 2011). According to Bryman and Bell (2011), deductive theory and inductive theory are considered as two general paradigms when considering the relationship between theory and relationship. Thus, Ghauri and Grønhaug (2005, pp.15) defined induction and deduction as “two ways of establishing what is true or false”.

Inductive research is based on empirical observation and consists of investigation for individual case to formulate a generalized conclusion (Ghauri and Grønhaug, 2005). Therefore, an inductive research approach starts with data collection and those data are
analyzed in order to find the relations between different variables (Gray, 2009). The process of this sort of research goes from observation to theory building, since the findings can contribute to existing literature (Ghauri and Grønhaug, 2005). New theories emerge out of all the information gathered in the end of research. The inductive approach is generally associated with qualitative methods of data collection and analysis (Ghauri and Grønhaug, 2005). The researches can use open-ended questions to collect in-depth information related to the topic.

According to Bryman and Bell (2011), deductive theory is regarded as the most common perspective to view the relationship between theory and research. The researchers deduce a hypothesis based on what has been already known within the theoretical domain and translates the concepts that contained in the hypothesis into researchable terms (Bryman and Bell, 2011). For deductive approach, theories are developed in the first step through using existing literature and in the following steps concepts of the hypothesis are tested (Gummesson, 2000). Different from inductive research, Ghauri and Grønhaug (2005) stated that deductive research is based on logic and is concluded through logical reasoning. In this case, the researchers can relate the current existing theory with the empirical research. And the whole process of study starts with previous theories (Ghauri and Grønhaug, 2005).

2.2.1 Applied scientific approach

Deductive research is mainly employed to conduct this study. An inductive approach is not suitable for this research since inductive research usually starts with data collection and going from observation to theory building. However, a comprehensive literature review is needed in this research to provide basis for this research and to formulate the research question. Following the steps of deductive research, this study begins with a review of previous literature concerning supplier evaluation process and electricity industry to have a better knowledge of the existing knowledge. After translating the research question into researchable items, the empirical findings are collected in the following steps.
2.3 Research method

In theory there are two main research approaches, according to Bryman and Bell (2011), they can be classified as being either quantitative or qualitative methods. There are differences in the approach and procedure of these two research methods (Ghauri and Grønhaug, 2005). The selection of the right method depends on the purpose of the research and the research problem itself. Quantitative research is rather result oriented and emphasizes on deductive approach and the testing theory (Bryman and Bell, 2011). Whereas the qualitative research method is rather process oriented and emphasizes an inductive approach and the generation of theories and models (Bryman and Bell, 2011).

Quantitative research is often conducted by using surveys or questionnaires for data collection. The research is conducted with a previously determined sample group, then the results are generalized and provide an overview of the whole population (Creswell and Plano Clark, 2011).

Qualitative research provides a deeper insight in the topic and is therefore more suitable for researches that need to provide an understanding of complex problems, problem exploration and identification of variables and measurements (Creswell, 2007). A common form of qualitative research is to conduct semi-structured interviews, which also gives the interviewee the opportunity to share their individual experience (Creswell, 2007). So, qualitative research is the preferable option to explore the complexity of a subject even beyond the scope (Gillham, 2000).

2.3.1 Applied research methods

This research is mainly conducted relying on qualitative data. As mentioned in the problem discussion, it is very important to get a deep insight in the complexity of the electricity industry as well as into the case company VEAB. The main objective of this research is to develop a supplier evaluation and selection process, suitable for public procurement in the electricity industry and in particularly the case company VEAB. To be able to create the right fitting process for VEAB it is essential to get first hand, insight information. Therefore, it was decided to conduct semi-structured interviews at the case company to
gather primary data and have the opportunity to get a deeper insight in the individual experiences of the interviewees.

2.4 Research design

Researches can be designed in different ways. According to Bryman and Bell (2011) research design can be categorized into five different types: experimental design, cross-sectional or social survey design, longitudinal design, comparative design, and case study design.

The experimental research design type is commonly not used in business and management research. In order to conduct an experimental research, variables have to be manipulated and in the business environment most of the independent variable cannot be manipulated (Bryman and Bell, 2011). A cross-sectional design is based on the collection of various data from numerous cases, often conducted via surveys or questionnaires filled in by all participants at the same time and under the same conditions (Bryman and Bell, 2011). A longitudinal research design is mostly conducted by using questionnaires at least at two different occasions to observe and map changes in business environments (Bryman and Bell, 2011). To conduct a comparative research, more or less identical methods have to be used on at least two contrasting case to enable a direct comparison (Bryman and Bell, 2011).

Using a case study research design is applicable when researchers want to provide an in-depth elucidation of a subject. Although a case study researches can be conducted using quantitative as well as qualitative data, there is a trend of mainly using qualitative data in in-depth-case study researches (Bryman and Bell, 2011).

According to Yin (2012) a case study can either be single or multiple case studies and be designed in a holistic or embedded way. Furthermore, case studies can be regarded as either being exploratory, descriptive or explanatory (Yin, 2012). An exploratory case study rather follows intuitive paths in data collection and is often done prior to the final definition of the
study question. The purpose of a descriptive case study is to provide a complete descriptive picture in the context of the research topic. An explanatory case study is in contrast aiming to provide an insight in the cause and effect relationship of a phenomenon and is meant to elucidate how and why events happen (Yin, 2012).

2.4.1 Applied research design

Due to the nature of this research a case study research design is most suitable. An in-depth analysis of the supplier evaluation and selection processes in the electricity industry and the case company VEAB is necessary to conduct this research. Since there is no clear answer and presumption on how exactly to design the supplier evaluation and selection process for the electricity industry and VEAB, a case study design is the most suitable option. By using case study, in-depth qualitative data and information can be gathered.

Furthermore, this research is conducted as a single case study focusing on the case company VEAB and is designed in a holistic way. In the research, the company is considered as a single entity and researched according to the research question of the paper.

A descriptive approach is partially used to conduct this research. The current situation at the case company VEAB and their current supplier evaluation and selection process are shown. This research also partially has exploratory characteristics, because as much information as possible are gathered concerning the processes. A descriptive part about available theory then forms the base for the final analysis and design of a fitting supplier evaluation process.

2.5 Data collection method

Data are facts and materials that are regarded as the foundation for a research and the analysis (Krishnaswami and Satyaprasad, 2010). The process of data collection includes deciding the scope of the research and collecting information by using different methods like interviews, observations and visual materials (Creswell, 2009). Purposely selecting the participants who will help the researches to have a better understanding for the problem and
answer research question is one important step for data collection (Creswell, 2009). According to Kumar (1996), the researchers can collect information from both primary resources and secondary resources.

Ghauri and Grønhaug (2005) defined primary data as original information that are directly collected by us to address a particular study and research question. Thus, Krishnaswami and Satyaprasad (2010) stated that primary data is raw material that has not been collected by other researchers. One of the main advantages of using primary data is that primary data is collected for a particular study which means that they are most relevant to the research question (Ghauri and Grønhaug 2005). Especially in business studies, specific information with respect to attitude and opinions can only be collected through asking people who are involved in particular event (Ghauri and Grønhaug 2005). Typical methods used for collecting primary data include interviews, surveys, observations and experiments (Krishnaswami and Satyaprasad, 2010).

According to Bryman and Bell (2011) interviewing is one of the most widely used method in qualitative research. It is defined as a two-way conversation requiring face-to-face contact between an interviewer and respondents (Krishnaswami and Satyaprasad, 2010). Compared with other methods, interviews can provide researcher with in-depth information and enable them to do more to improve the quality of response (Krishnaswami and Satyaprasad, 2010). There are two main types of qualitative interviews: unstructured interview and the semi-structured interview Bryman and Bell (2011). Different from structured quantitative interview that consists of a specific set of questions, qualitative interviews are less structured with greater focus on research ideas (Bryman and Bell 2011). In qualitative research, the interviewee can be interviewed for more than one time when more information is needed (Bryman and Bell 2011). However, interviewing can take a long time and cost more money to gather information, which is one of its main limitation.

Secondary sources consist of available statistical statements and information that has already been used by other researchers in their studies (Ghauri and Grønhaug, 2005). Secondary data can not only be used to collect information for solving problems, but also to
better explain and present the research question. Most of researches start with a review of earlier research studies including books, articles, journals and online data sources from organizations and governments (Ghauri and Grønhaug, 2005). According to Krishnaswami and Satyaprasad (2010), secondary sources can be used in three different ways. First, researchers can use the data from secondary sources as reference for their study. Second, the use of secondary sources can help to test and verify the findings in the research. Third, secondary data including yearbooks, reports of government and public organization may be used as sole source of information for a project (Krishnaswami and Satyaprasad, 2010). Compared with primary data, the use of secondary data saves time and money. However, using this sort of method can’t help researchers to formulate and understand the research question. Another limitation of secondary source is that the information in secondary source can’t meet the needs of particular study (Krishnaswami and Satyaprasad, 2010). In addition, the secondary data can be outdated when considering the time lag and not as accurate as expected (Krishnaswami and Satyaprasad, 2010).

2.5.1 Applied data collection method

In order to gather more information to answer the research question, this research has used both primary data and secondary data. The primary data is collected through semi-structured interviews with the purchaser in VEAB. Compared with other methods, interviewing can provide more in-depth and detailed information although it is costly in terms of time. Face-to face interviews have been conducted with the aim to have a better knowledge about the procurement and supplier evaluation and selection process of VEAB and highlight the main purpose of this thesis. To conduct this research, semi-interview guides that include all the necessary information related to our research problem are developed before each interview.

On the other hand, this study also uses secondary data to collect information and explain the research problems. The first step of this research is to conduct a review of the earlier research studies including books, scientific articles and journals by using the different keywords such as supplier selection, supplier evaluation, public procurement, power
industry, electricity industry, supplier evaluation criteria and so on. The secondary data are mainly used in the introduction, theory and methodology chapters.

2.6 Sampling method

Bryman and Bell (2011) mention that the sample is about selecting a part of the population for a research purpose. Moreover, the sampling process can be divided into two categories, probability and nonprobability samples. Probability sample includes four kinds of samples which are the simple random sample, the systematic sample, the stratified random sample and multi-stage cluster sampling. The authors add that nonprobability sample includes three types, convenience sampling, snowball sampling and quota sampling.

Ghauri and Grønhaug (2010) mentioned that sampling is a way to collect information from a portion of a larger group, which refers to something about this larger group. Furthermore, there are two reasons why to choose a sample rather than taking all units. First the sake of reducing the cost of including all units, second, the time of including all elements often be long.

2.6.1 Applied sampling method

As mentioned in problem discussion part, the topic is assigned by the case company and the samples for the work has been given by the manager of the business unit “power and heat”. The needed sample for the work includes the appropriate participants to provide the right and relevant information for the work. Since the procurement department of VEAB only has two employees, the population of this research is two. As to the fact that the procurement department consist just of two employees, the interviews were conducted with the executing purchase of VEAB. Both of the employees are involved in all activities of the procurement department and therefore the purchaser is able and capable to provide all information required to conduct this research. Regarding the participants and the source of the information, the purchaser from the procurement department has been chosen to participate in the interviews. The reason for the selection lies behind her ability to provide the needed information since she has direct relations and interactions with the suppliers.
2.7 Analysis method

According to Yin (2014) case study analyses can be conducted following one of five analytical techniques he identified. Explanation building is a technique most suitable for explanatory case study, where the data is used to build an explanation about the case. The time-series analysis is applicable for studies that track the change of variable over time. The logic model can be seen as a form of pattern matching, but the inherent sequential stages and dependencies distinguish the two techniques clearly. The cross-case synthesis is only applicable for multiple case studies and prerequisites a research consisting of at least two cases (Yin 2014).

One of the most desirable analytical techniques to apply for a case study research is the pattern matching technique. Using the pattern matching techniques is done by creating patterns based on empirical findings and match/compare them with predicted patterns (Yin, 2014). Pattern matching is suitable for case studies that include variables that represent single data points and therefore not have the needed variance to satisfy statistical needs (Yin, 2014).

2.7.1 Applied analysis method

Due to the structure of this research, the pattern matching techniques shows to be the most suitable analytic technique. This research is based around a theoretical research to identify a suitable and effective supplier evaluation and selection processes, fitting the needs of public procurement in the Swedish electricity industry. The findings of the theoretical research are used to develop a desirable model for the electricity industry. Furthermore, this process is used as a pattern to compare and match with the findings of the empirical research. Matching the predicted, theoretical pattern to the pattern identified through empirical research enable the researchers to create an accurately fitting supplier evaluation and selection process for public procurement in the Swedish electricity industry and the case company.
2.8 Scientific credibility

In business and management studies, reliability and validity are two of the most prominent criteria to assess and establish the quality of research (Bryman and Bell 2011).

2.8.1 Reliability

According to Bryman and Bell (2011), reliability is established to answer the question of whether the results and outcomes of the studies can be repeated by a later researcher who employs the same techniques. In addition, the reliability of research indicates whether the approach is coherent across different concepts and projects (Creswell, 2013). Several methods can be used in studies to ensure the internal reliability of a research (Creswell, 2013). For example, Yin (2014) stated that researchers who employ qualitative research need to record the process of their case studies in detail and document as many steps as possible to enhance the reliability. Thus, Gibbs (2007) suggested the researchers to check the transcripts to avoid obvious mistakes during the process of data collection.

2.8.2 Validity

The validity of a research is concerned with the question of whether the results are true and represent the ability of researchers to use the methods (Saunders, et al., 2007). Internal validity is regarded as the strength of qualitative researches as it is used to decide whether the findings of the study are consistent to the opinions of the interviewees or participants (Creswell, 2000). To ensure the validity of the research, the authors need to make sure that they interview the right person who can provide reliable information (Saunders, et al., 2007). Thus, both the primary data and secondary data that get used as the foundation of the research should be accurate and clear. However, considering qualitative research usually use case studies and small samples, which makes it difficult for the findings of the research to be “generalized across social settings” (Bryman and Bell, 2011, pp. 400).

2.8.3 Applied reliability and Validity

When it comes to reliability, the research uses face-to-face interview to ensure the quality of research and mitigate the misinterpretation of the questions. In addition, the process of a case study for VEAB is recorded in detail to enhance the reliability of research. Before
conducting the interview with the VEAB, the questions are sent to the interviewee. The participant is informed about the information needed for the research and the interview structure.

This thesis has a high level of validity since interviews are conducted with a buyer in VEAB. The manager of the heating and power department arrange the interview and the participant was assigned, because she is the right person who can provide accurate and up to date knowledge about the procurement at VEAB. On the other hand, since the study object of this research is the power plant company that manufactures products and services in the area of electricity and district heating, this research can only provide useful information and techniques for future studies within the research domains. In addition, the information of this research is gathered only from VEAB and there is no contact with the suppliers, which minimize the ability to include the supplier perspective in this work.

2.9 Ethical considerations

In every research involving human-participants, possible ethical issues should be considered. The relationship between the researchers and the participants are most sensitive in the research process in business environments (Ghauri and Grønhaug, 2005). The consideration of ethical issues should take place before initiating the data collection and involving the participants of the research. It is essential to ensure that the privacy of the participants is not be invaded or violated (Creswell, 2014).

According to Ghauri and Grønhaug (2005) there are eight main ethical issues that have to be considered regarding the researcher-participant relationship; Preserving participant’s autonomy; exposing participants to mental stress; asking participants questions detrimental to their self-interest, use of special equipment and techniques e.g. tape recorders, video or other equipment; involving participants in research without their consent; use of deception; use of coercion to get information; deprive participants of their rights, e.g., of self-determination.
Furthermore, it is important to address the issue of confidentiality in advance to know which data can be published and if the anonymity of the participants should be preserved by not revealing their identity and other personnel information (Ghauri and Grønhaug, 2005).

2.9.1 Applied ethical consideration

According to the fact that this research is dependent on in-depth and first-hand information of employees of the case company, the consideration of ethical issues was of major importance. The case company was involved in the design of the research and was continuously kept informed about any changes and the progress of the work. The interviewee was informed about the research and its purpose in detail before the data collection took place. So, the possible ethical issues identified by Ghauri and Grønhaug (2005) were considered by the researchers and clarified with the participant in advance. Moreover, the interviewee has to grant her permission before sensitive data like names, position, confidential data etc. are published together with the result of the research.
2.10 Summary of Research Methods

Table 1 presents the summary of the methods employed in this research to provide a clear view of how this study is carried out.

Table 1. Summary of research methods

<table>
<thead>
<tr>
<th>Scientific Perspective</th>
<th>Positivism</th>
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<tr>
<td>Scientific Approach</td>
<td>Deduction</td>
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<td>Research Method</td>
<td>Qualitative</td>
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<td>Research Design</td>
<td>Case Study</td>
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<td>Data Collection Method</td>
<td>Primary and Secondary data</td>
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<td>Sampling Method</td>
<td>Determined by the case company</td>
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<td>Analysis Method</td>
<td>Pattern Matching</td>
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<td>Ethical Considerations</td>
<td>Company involvement</td>
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<td></td>
<td>Continuous information exchange</td>
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<td>Request permissions in advance</td>
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<table>
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<tr>
<th>Scientific Credibility</th>
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<tr>
<td>Reliability</td>
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<tr>
<td>Face to face interviews</td>
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<tr>
<td>Questions sent to Interviewee beforehand</td>
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<tr>
<td>Interview audio-recorded</td>
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<tr>
<td>Validity</td>
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<tr>
<td>Participants are selected by VEAB itself</td>
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<td>Specific focus on electricity power plant</td>
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</table>
3 Theory Review

This chapter describes the theories on which this research is based on. A comprehensive literature review is conducted in order to fulfill the purpose of the study and present the most important aspects concerning supplier selection process and supplier evaluation. In the beginning of this chapter, specific situation of Swedish electricity industry, public procurement and the conditions of Swedish electricity industry are described. Then, supplier selection criteria and popular models for supplier evaluation are reviewed for the development of supplier evaluation model. Finally, a conceptual framework is created to provide a general view of theoretic processes.

3.1 Swedish electricity industry

The electricity industry is regarded as the most dominant sector in the domain of energy sector (Oberndorfer, 2009). As mentioned in Swedish Energy Agency (2015), electricity is the major form of energy in Sweden and the amount of electricity use was 125 TWh in 2013, which accounted for around one third of the total energy use. The electricity sector is usually owned by private organization or the government and subjected to the regulations in terms of price (Joskow, 2003). The supply process of electricity power includes power generation, transmission, distribution and retail (Joskow, 2003). Power generation refers to the process of producing electricity by transferring other types of energy such as coal-fired power and hydropower (Qin, et al., 2011). The production of electricity power in Sweden is largely dependent on nuclear power and hydropower and the use of wind power as well as biofuel is increasing significantly in recent years (Swedish Energy Agenc, 2015). The amount of electricity use is growing steadily from 1971 to the beginning of 1990s and has remained stable in the last decade (Swedish Energy Agency, 2015). The total electricity use in Figure 4 is divided into three categories including business electricity, domestic electricity and electric heating.
3.2 Public Procurement

Public procurement is regarded as one of the main functions of government in order to purchase the needed goods and services (Thai, 2001). According to Schapper, et al. (2006, pp.2) the procurement in public sector is “inherently a political sensitive activity”, which involves large amounts of money that are spent every year and even influence national economy. The research of Thai and Grimm (2000) indicated that the government purchasing expenditure can account for around 20 percent of the total gross domestic product (GDP). Considering the importance of public procurement, government entities, policy makers and public procurement practitioners have taken a large effort for the improvement and reform of procurement process (Thai, 2001). In most cases, the selection of suppliers in public procurement is a complicated and time-consuming process in consideration of both price and other qualitative factors (Falagario, et al., 2012).

The major political considerations within the context of public procurement are on the “principles of transparency, equity and fair dealing” (Schapper, et al., 2006, pp. 5). Different
from the procurement in private sector, each step throughout the process of public procurement is controlled by the regulations in order to minimize the potential risk from undue influence under the circumstance of discretion and to ensure fair dealing (Schapper, et al., 2006). The government policies aim to encourage the candidate suppliers to compete in the bidding process (Falagario, et al., 2012). Thus, the selection and evaluation of vendors must be conducted under rigorous and clear procedures without subjective judgement, which means that each supplier should be treated equally (Falagario, et al., 2012). However, the defect of highly regulated control for procurement process lacks flexibility and results in less weight for efficiency and performance (Schapper, et al., 2006). On the other hand, in the past few years, the increased awareness of environmental issues has made great impact on the government public purchasing practices and regulations including the movements towards deregulation (Thai, 2001).

According to Lindskog, Brege and Brehmer (2008) the whole process of purchasing in public sector can be divided into ten steps and the starting point of formal purchasing process is the development of RFP (request for proposal) (as shown in figure 5). The development of RFP can be regarded as the core procedure in the public purchasing, which includes the structuring of mandatory and non-mandatory requirements for the candidate suppliers and criteria for the evaluation (Lindskog, Brege and Brehmer, 2008). The public procurement agencies need to provide clear and detailed RFP document on public website, then the firms can download the documents online and submit their applications (Leipold, et al., 2004). In step seven (evaluation of tenders), vendors who do not conform to the mandatory requirements will be rejected and the rest vendors will be evaluated in terms of prices and non-mandatory requirements (Lindskog, Brege and Brehmer, 2008). All the information including prices and other qualitative information won’t be released to public until the suppliers are chosen by procurement officer (Qiao and Cummings, 2003).
Sweden has joined European Union in 1955 and its purchasing procedures in public sector are closely related to the laws of EU (Warra, 2008). In Sweden, public procurement is regulated by Swedish Public Procurement Act (LOU), which is to a large extent based on the EU Public Procurement Direction that promote the principle of free movements of goods and services in the EU regions (Swedish competition Authority, 2012). Following the Swedish procurement rules, the contracting authorities also conform to the obligation which is prescribed by EU laws (Swedish competition Authority, 2012). Contracting authorities refer to the parties who follow the purchasing procedures in the LOU (Swedish competition Authority, 2012). Act on Procurement within the Water, Energy, Transport and Postal Services Sectors (LUF) is another law that applies to the public procurement in the utilities sector including “Water, Transport, Energy and Postal service sectors” (Swedish competition Authority, 2012, pp. 4). Under certain situations the contracting authorities can conduct the procurement under both LOU and LUF, which is decided upon the subject matter of the contact (Swedish competition Authority, 2012).
3.2.1 Pre-requirements

The request of proposal can be regarded as the information base that provides suppliers with the information required for candidate suppliers before the procurement (Swedish competition Authority, 2012). It includes the following requirements for the suppliers:

1. Supplier’s economic condition and professional ability
2. Specification or description for the assignment (e.g. technical ability)
3. The basis for the supplier evaluation (e.g. the lowest price or the most economically advantageous tender)
4. The commercial conditions and terms during the period of agreement (e.g. payment)
5. The administrative regulations for the process of procurement (e.g. award procedure, the deadline for the tenders) (Swedish competition Authority, 2012)

There is an information portal concerning purchasing in public sector and the website is maintained by Swedish National Financial Management Authority which functions as information database for different agreements (Bof and Previtali, 2010). And this information portal is open to the national authorities, government entities and municipalities (Bof and Previtali, 2010).

3.3 Supplier selection

Sollish and Semanik (2006) mentioned that the suppliers are essential for the organization to provide the needed resources in order to achieve satisfactory results. Once the suppliers are chosen to be a part of well-managed supply chain, it will have a lasting effect on the competitiveness of the whole supply chain (Choi and Hartley, 1996). Sollish and Semanik (2010) further pointed out that the supply risk management is a complicated business activity and it is a fundamental factor in supplier selection. In addition, an appropriate supplier selection must be conducted systematically by using the most objective criteria that the company is able to develop. According to Choi and Hartley (1996) selecting the supplier based on the potential for a long-term relationship has a high rate which means it is very important for the firm. Furthermore, developing long-term and close supplier relationship are now critical for procurement decisions. Moreover, concerning the relationship between
the supplier and the buyer, the supplier’s main goal is to reach the desired returns with a maximized chance of being selected. While the buyer’s main goal is to find a proper supplier selection process that can reach the right information in the right details to be able to choose between the competing suppliers (Seshadri, 2005).

However, Handfield, et al. (2009) argued that there is no certain ways for supplier selection and according to that, the organizations can use a variety of many different methods. Moreover, the level of the needed effort for the supplier selection depends on the importance of the required goods or service.

3.3.1 Supplier selection process

According to Sollish and Semanik (2006) supplier selection process is one of the critical organizational activities that is managed by the procurement department. Therefore, the purchasing manager should develop and use an effective process for finding the qualified suppliers to award the business. Handfield, et al., (2009) said that the process can be an intensive effort requiring a major commitment of resources. Furthermore, as shown in figure 6, according to Handfield, et al. (2009) the supplier evaluation and selection process consists of seven steps which are:

1- Recognizing the need for supplier selection: The process can be initiated based on the anticipation of a future purchase requirement. Here, the engineering staff might have some preliminary specifications on the type of the needed materials, processes or services. However, the specifications have no specific details but these specifications are enough to initiate the process for finding a potential source of supply.

2- Identifying the key sourcing requirements: Understanding the importance of the needed requirements is essential for the purchaser, and these requirements might vary from an item to item.

3- Determining the sourcing strategy: That includes for instance, domestic versus foreign suppliers, single versus multiple supply sources, short term versus long term purchase contracts.

4- Identifying the potential supply sources: This step is dependent on different sources of information.
5- Reducing the suppliers’ number in selection pool: Purchasing staff often use an in-depth evaluation of all possible suppliers in order to narrow the number to a small list which will be used for an in-depth formal evaluation.

6- Determining the method of supplier evaluation and selection: The method will be applied on the remained supplier after the first cut in the former step. The evaluation and selection can be conducted using many methods including evaluating the supplier provided information, using a list of preferred suppliers or carrying out a site visit.

7- Selecting the supplier and reaching an agreement: It is the last step of the evaluation and selection process.

**Figure 6. Supplier evaluation and selection process**

1. Recognize the need for supplier selection.
2. Identify key sourcing requirements.
3. Determine sourcing strategy.
4. Identify potential supply sources.
5. Limit suppliers in selection pool.
7. Select supplier and reach agreement.

*Source from Handfield, et al. (2009)*

In addition, Weele (2014) indicated that the supplier selection process is a part of the purchasing process that is initiated with a market research after defining and specifying the functional or the technical specification. Moreover, the process contains several steps (as shown in figure 7).

1- Determining the method of subcontracting and here the most important thing is to decide on whether to choose a turnkey (performing the whole assignment) or partial subcontracting besides the pricing method before awarding the work.
2- Setting the preliminary qualification of the potential suppliers and drawing up the bidders’ list.

3- The preparation of the request for quotation and analysis of the received bids.

4- The selection of the supplier, which is the most important step in the purchasing process and a basis for many other activities. In certain situations, the number of the approved suppliers available is not enough; hence, a thorough supply market research should be conducted for finding new suppliers. According to Weele (2014) when the quotations are received from the potential suppliers, a preliminary technical and commercial evaluation should be done by the purchasing department in order to weigh the technical, logistics, quality, financial and legal aspects. In addition, the offered price can be compared between the suppliers but the more important is to look at the total cost of ownership instead of at the prices itself.

**Figure 7. Supplier selection process**

Source from Weele (2014)
3.3.2 Supplier Evaluation

Supply chain consists of a network that has a goal of using the available resources in a best possible way. Therefore, the focus should be on the inter-organizational operations instead of the firm operations (Imeri, et al., 2015). The authors further proceeded that in nowadays business environment, companies are facing a strong competition which leads them to give more attention to improve quality, reduce the cost and improve the lead-time. For this reason, companies need to be more open to change and to be very efficient in meeting the market needs. Pearson and Ellram (1995) mentioned that the suppliers directly affect the price, quality, delivery reliability and availability of the products which means a direct impact on customer satisfaction.

Supplier evaluation is one of the most important activities that is done by the procurement department (Imeri, et al., 2015). According to Pearson & Ellram (1995), the idea of supplier evaluation is about assessing the performance of the suppliers basing generally on the organization’s experience in doing business with that supplier. The goal of supplier evaluation is to minimize the supply risk and to improve the overall value to the buyer (Handfield, et al., 2009). Moreover, supplier evaluation might be implemented as a tool to find the areas that need to be improved (Imeri, et al., 2015). The authors further proceeded that the supplier evaluation process should be conducted for motivating and initiating corrective actions for the existing suppliers, not only for selecting new suppliers. Narasimhan, Talluri and Mendez (2001) pointed out that the evaluation process is usually done by a group work where the important attributes can be decided. However, even it is easy to some extent to decide the important attributes, reaching a consensus about the first few attributes of performance are hard to reach. According to Araz and Ozkarahan (2007) the supplier practices (managerial, quality and financial, etc.) and the supplier capabilities (co-design capabilities, cost reduction capabilities, technical skills, etc.) should be considered when conducting the supplier evaluation.

Moreover, it was noticed that the evaluation of the suppliers is critical for improving the overall quality, better all-around service, improving the delivery performance, relationships and then reducing the costs (Imeri, et al., 2015).
On the other hand, selecting a wrong supplier could be a reason for deteriorating the whole supply chain’s operational and financial situation because in today’s competitive environment, having an appropriate supplier base is critical for producing low cost and high quality products (Araz and Ozkarahan, 2007). Moreover, supplier evaluation process is a time consuming activity, therefore, it is necessary to have clear objectives in order to create value for the evaluating company (Imeri, et al., 2015). The author added that there is no need for evaluating all of the existing suppliers since the resources are often limited. For this reason, the suppliers that would benefit the company the most should be evaluated.

3.3.3 Supplier evaluation criteria

Potential suppliers for the organizations are usually evaluated by the purchasers and categorized by the purchasers’ selection criteria with assigned weights (Handfield, et al., 2009). Buyers should implement an evaluation process in order to make sure that all aspects of the organization's needs are considered. Hence, within the evaluating process, the buyer should review three criteria in order to reach a decision about awarding the contract to a certain supplier, and these criteria are: responsiveness, capability, and competitive value (Seshadri, 2005).

According to Handfield, et al. (2009), there are three main criteria that are used to evaluate the suppliers which are the cost or price, the quality and the delivery. On the other hand, there would be a need for a detailed supplier evaluation and an in-depth analysis of the capability of the suppliers for critical items. The authors have mentioned a wide range of criteria to be considered by the purchasers when evaluating and selecting the suppliers, for instance, management capability and their ability for running the business besides employee capabilities (highly trained, stable, motivated, etc.), cost structure (in-depth understanding of a supplier’s total costs), total quality performance, process and technological capability, environment regulation compliance and financial stability. Choi & Hartley (1996) pointed out that the price, quality and delivery performance have been considered as important variables in the supply chain, however, during the years, there has been a switch from the price to the cost perspective. In addition, the author mentioned that customer satisfaction
and the performance of the firm were affected in a positive way when evaluating the suppliers regularly regarding the quality, reliability and product performance.

Moreover, Imeri, et al. (2015) conducted a survey including 80 companies and the conclusion have shown that the most important supplier evaluation criteria is the attitude of the supplier towards the customer, supplier delivery, followed by the quality of the product and the product net price. Handfield, et al. (2009) argued that the needed criteria are different from purchaser to purchaser, whereas the consistent delivery besides short lead times is preferred for those who operate with Just-in-time production system. The supplier's processes and the technological advancement, or the emphasis on research and development are preferred for those who work with high-technology industry. Based on the work of Chen (2011), Tahriri, et al. (2008), Kannan and Tan (2002), Liu, et al. (2000) and Min (2003), important criteria for supplier evaluation and selection was summarized in Table 2. Thus, Table 2 demonstrated the priority order of those important supplier evaluation criteria from each article. In addition, Table 2 will be used for further analysis in chapter 5.1.3 to find the common criteria in the table.

Table 2. Important criteria for supplier evaluation from literature.

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<tbody>
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<td>1 Quality</td>
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<td>Quality level</td>
<td>Quality level</td>
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<td>2 Delivery on time</td>
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<td>Service level</td>
<td>Delivery</td>
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<td>3 Historical performance</td>
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<td>On time delivery</td>
<td>Historical performance</td>
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<tr>
<td>4 Guarantee &amp; compensation</td>
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<td>Responsiveness</td>
<td>Warranty &amp; claim</td>
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<td>5 Equipment &amp; capability</td>
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<td>Flexibility</td>
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<td>6 Price</td>
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<td>Correct quantity</td>
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<td>7 Technical capability</td>
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<td>Price / Cost</td>
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<td>8 Financial situation</td>
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<td>Communication sys</td>
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<td>9 Procedure &amp; legality</td>
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<td>Certification</td>
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<td>10 Communication system</td>
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<td>Information sharing</td>
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3.4 Supplier evaluation models

Supplier evaluation models can commonly be categorized as weighted-point models, cost ratio models, dimensional analysis models and categorical models (Teng and Jaramillo, 2005).

The categorical method is a rather simple model that does not require expensive technology preparation for its implementation. It allows the division of the performance of a supplier into different categories. So, the monitoring of the single product categories is enabled and simplified. Furthermore, for each defined criteria either the grade good, neutral or unsatisfactory is assigned and then a total rate is calculated for every supplier (Ghodsypour and O’Brien, 1998). The creation, usage and the success of this model depend on the experiences, personal judgment and memory of the leading buyer (Humphreys, et al., 1998).

The weighted-point model is considered to be the most basic supplier evaluation model. This model depends on the estimation of weights for performances variables as well as on a good understanding of common performance levels of the industry. Due to its simplicity, flexibility and effectiveness in decision making, it is considered as one of the most popular models (Humphreys, et al., 1998).

The cost ratio model stresses a high influence on the operation costs of a buyer and is less used, due to its complexity (Kemp, 2002). The decision making process in this model is mainly based on two factors, the supplier’s price and the internal operating cost of the buyer (including quality, delivery and other service elements). The internal costs get converted into a cost ratio in regards to the total value of the purchase. After adjusting the selling price considering the internal cost ratio, the supplier with the lowest adjusted costs is selected (Humphreys, et al., 1998).

Dimensional analysis models are responding to disadvantages of the other models mentioned. It was developed by Willis, et al. (1993) and combines multiple criteria into a unified entity for every supplier. A vendor performance index is calculated for each supplier according to a standard benchmark performance against the supplier’s performance. The
evaluation is based on vendor performance index, which is based on the weight and the relative importance of each criterion.

A literature review conducted by HO, Xu and Dey (2010) depicts an overview of the available research concerning multi criteria decision making (MCDM) approaches. The overview provided by this research listed the MCDM’s according to their popularity among researchers. It showed that Data Envelopment Analysis (DEA) received the most attention from researches in the years from 2000 to 2008 and according to the authors this method has a high robustness. The Mathematical programming method turned out to be the second most popular method. Nevertheless, both of these methods do not support the processing of qualitative data and criteria and therefore do not fit the requirement of this case study. The third most popular method is the Analytical Hierarchy Process (AHP) which also supports the processing of qualitative data in criteria.

3.4.1 Analytical hierarchy process

The analytical hierarchy process is considered to be one of the most popular multi-criteria decisions making tools and found as a widespread application method to determine supplier selection priorities (Liu and Hai, 2005; Omkarprasad and Kumar, 2006). AHP enables companies and their procurement departments to evaluate suppliers and to create a ranking order to support the supplier selection and decision making process. Lee (2001) even proposes the usage of AHP as a base for a supplier selection and management system (SSMS). The AHP model is highly dependent on the judgment of individual professionals, groups and their experience. A multi-level hierarchical structure is built and judgments are needed to derive and determine priorities for each attribute of the model (Bruno, et al. 2012). The determined priorities allow the weighting of the chosen attributes and therefore the creation of a supplier score to facilitate a ranking order to support the decision making process.

According to Bruno, et Al. (2012), Teng and Jaramillo (2005) and Tahriri, et al. (2008), the methodology of an AHP typically consists of the following five steps:
First the problem has to be structured into a hierarchy according to the goal of the process and attributes have to be distributed and categorized. According to Teng and Jaramillo (2005) each category of attributes is referred to as a cluster. Clusters consist of several attributes that later on can be compared to each other in order to identify priorities and their influence on the overall evaluation and its category’s performance. Saaty (1990) pointed out that deciding and setting important attributes are the most creative part in AHP analysis. The layout of an AHP is shown in figure 8, including commonly used attributes and clusters as an example.

Figure 8. AHP layout

The second step is to establish a comparative judgment. The aim of this step is to identify the relative importance of single attributes to the overall goal. In order to identify the relative importance of each cluster, characteristic and attribute, the elements of each hierarchical level are compared to each other. The common way of comparison is to compare the elements pair-wise and establish a pair-wise comparison matrix (Benyoucef, et al., 2003). A pair-wise comparison is used to make comparison between criteria and then a
total of \( n(n-1) \) judgements will be required (Benyoucef, et al., 2003). An example of pair-wise comparison is shown in table 3. And Table 4 shows the calculation of normalized weights for each level of hierarchy. Therefore, each element gets pair-wise compared individually to all other elements of the same hierarchical level and cluster, according to their importance to the overall goal. So, the metrics establishes the relative importance of each individual element compared to the other elements.

Table 3. Example of pair-wise comparison

<table>
<thead>
<tr>
<th>Criteria for Supplier selection</th>
<th>Cost</th>
<th>Lead time</th>
<th>Order quantity</th>
<th>Service level</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>0.40</td>
</tr>
<tr>
<td>Lead time</td>
<td>1/3</td>
<td>1</td>
<td>1/3</td>
<td>1</td>
<td>0.13</td>
</tr>
<tr>
<td>Order quantity</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1/2</td>
<td>0.26</td>
</tr>
<tr>
<td>Service level</td>
<td>1/3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Source from Benyoucef, et al. (2003)

Table 4. Example of criteria weighting

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Geometric mean</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>((1x3x1x3)^{(1/4)}) = 1.73205</td>
<td>0.40</td>
</tr>
<tr>
<td>Lead-time</td>
<td>((1/3x1x1/3x1)^{(1/4)}) = 0.57735</td>
<td>0.13</td>
</tr>
<tr>
<td>Order quantity</td>
<td>((1x3x1x1/2)^{(1/4)}) = 1.10668</td>
<td>0.26</td>
</tr>
<tr>
<td>Service level</td>
<td>((1/3x1x2x1)^{(1/4)}) = 0.90360</td>
<td>0.21</td>
</tr>
<tr>
<td>TOTAL SUM</td>
<td>= 4.31968</td>
<td></td>
</tr>
</tbody>
</table>

Source from Benyoucef, et al. (2003)

Although many scales can be used for quantifying the judgement or preference for all the criteria and sub-criteria, nine-point scale shown in table 5 is regarded as the most standard usage for AHP analysis (Benyoucef, et al., 2003). This measurement scale indicates the level of importance of each criterion from extremely preferred to equally preferred and the rating of 2,4,6 and 8 is regarded as intermediate value between two adjacent judgements (Benyoucef, et al., 2003)
Table 5 Measurement scales

<table>
<thead>
<tr>
<th>Verbal judgment or preference</th>
<th>Numerical rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely preferred</td>
<td>9</td>
</tr>
<tr>
<td>Very strongly preferred</td>
<td>7</td>
</tr>
<tr>
<td>Strongly preferred</td>
<td>5</td>
</tr>
<tr>
<td>Moderately preferred</td>
<td>3</td>
</tr>
<tr>
<td>Equally preferred</td>
<td>1</td>
</tr>
<tr>
<td>Intermediate values between</td>
<td>2, 4, 6, and 8</td>
</tr>
<tr>
<td>two adjacent judgments (when</td>
<td></td>
</tr>
<tr>
<td>compromise is needed)</td>
<td></td>
</tr>
</tbody>
</table>

Source from Benyoucef, et al. (2003)

During the third step the weights of the attributes are calculated based on the data that was gathered by the comparative judgment and the pair-wise comparison of the attributes. The weights for each attribute have to be assigned according to the priority that was previously determined for it. This step is required to enable the calculation of a global score for each supplier, containing the cores and weight of all assigned attributes.

The fourth step is to check and verify the consistency of the pair-wised comparison and the weights of the attributes. According to Tahriri, et al. (2008), the consistency check is one of vital step of AHP analysis, which can be used to eliminate the potential inconsistency in criteria weighting. To determine the acceptance of priority weighting, a computation formula called consistency ratio (CR) can be used (as shown below) (Saaty, 1980).

\[
CR = \frac{\text{Consistency Index (CI)}}{\text{Random Consistency Index (RI)}}
\]  
(1.1)

And Consistency index (CI) can be calculated through the following formula.

\[
\text{CI} = \frac{\lambda-n}{n-1}
\]  
(1.2)

Where n refer to number of criteria. And the random consistency index (RI) for different size of matrix can be found in Satty’s table (shown in table 6). The work of Satty (1980) indicated that CR equals 0.10 is acceptable and if the value is lower than the acceptable value, the priority weighting is consistent. On the contrary, if the CR value is higher than the acceptable value, the results of weighting are inconsistent.
The fifth and final step of the AHP model is to calculate the global score for each supplier. Considering all clusters and attributes, it is possible to calculate a global score for each supplier. The global scores can then be used to establish a ranking order and provides a simple overview to determine the most suitable option and supplier.

The outcome of the AHP model is to provide a simple ranking and overview, that allows the comparison of several alternatives based on multiple criteria. The use of AHP is highly dependent on the judgment of experts and is capable of considering qualitative and quantitative data. One drawback is that AHP is not useful for the consideration of binary attributes that require either a yes or no answer (Handfield, Walton, Sroufe and Melnyk, 2002).

### 3.4.2 Total Cost (TC) / Total Cost of Ownership (TCO)

The total ownership approach evaluates suppliers not only based on the price they offer, but it also takes additionally other costs related to the purchase into account, which are often neglected by other approaches (Bhutta and Huq, 2002). If a company wants to apply TCO it is crucial that they are able to identify and determine additional costs. The costs range from the actual purchase price to the final disposition of goods or services and moreover also includes cost like order placement, research and qualification of suppliers (Ellram, 1995).

The actual costs related to the purchase form the base for the total cost approach and it additionally allows the user to replace further non-monetary issues by assigned cost factors. First the organization has to determine the factors that are crucial for the decision making and supplier selection. Following each identified factor is translated into a cost component and added into a price formula. Afterwards, the purchase prices offered by the suppliers will be added a debit (or credit) for each factor according to the supplier’s performance. Finally, the supplier with the lowest overalls cost, including the assigned cost of non-
monetary factors, gets selected. Organizations planning to implement this approach, often struggle during the translation and valuation of non-monetary factor into costs (Bhutta and Huq, 2002).

The total cost approach is a simple tool that provides a consistent supplier evaluation. It supports to determine supplier performance expectations and enable a good and quick comparability of suppliers. The performance expectations are clarified not only for the buyer but also the suppliers. The tool provides a better focus on the cost topic and the priorities regarding the desired supplier performance (Bhutta and Huq, 2002).

3.4.3 Discrete Choice Analysis (DCA)

The discrete choice analysis is a method used for the quantification of relative weights of attributes when the actual supplier selection is carried out. DCA is also known as an effective methodology for the analysis of choices in a complex decision making process. It is especially useful, when identifying the relative weights of attributes for decision maker, so that they can decide on tradeoffs while choosing alternative from a set of alternative (Verma and Pullman, 1998).

DCA establishes several levels (commonly two to three) of performance characteristics of supplier to support the buyers in their supplier selection process. The suppliers are evaluated by making tradeoffs between the levels of performance characteristics. The buyer is required to identify the most important criteria to base his final supplier assessment on. Following, the chosen criteria are split up into different levels. Figure 9 shows an example of chosen criteria and their corresponding levels of supplier performance.

**Figure 9. DCA supplier performance levels**

<table>
<thead>
<tr>
<th><strong>Cost:</strong></th>
<th><strong>Quality:</strong></th>
<th><strong>On time delivery:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 5% above target price</td>
<td>1. Poor</td>
<td>1. Few times</td>
</tr>
<tr>
<td>2. Approx. Target price</td>
<td>2. God</td>
<td>2. Most time</td>
</tr>
<tr>
<td>3. 5% below target price</td>
<td>3. Excellent</td>
<td>3. Almost always</td>
</tr>
</tbody>
</table>

Source from own illustration derived from Verma and Pullman (1998)
When the criteria and supplier performance levels are established, the buyer has to rank the criteria according to the importance for the organization. The evaluation of suppliers then takes place by the means of the chosen criteria and their levels. Based on a comparison of the evaluation of the suppliers the buyer is enabled to identify and choose a preferred supplier.

Verma and Pullman (1998) said that another way of applying DCA is by appointing design codes (e.g. -1 and +1) to the method, to represent the different level. Suppliers get evaluated on the chosen criteria and a design code gets assigned to each criteria. Then the suppliers are getting pair-wise compared, a good overview is provided to get an impression about the strength and weaknesses of the suppliers. Furthermore, the authors describe the ideal number of criteria to be around four and to be measured by two or more levels. The following figure 10 depicts a pair-wise comparison of two suppliers.

**Figure 10. DCA design code table**

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Supplier 1</th>
<th>Supplier 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Higher than competitors (+1)</td>
<td>Lower than competitors (-1)</td>
</tr>
<tr>
<td>Quality</td>
<td>Meets minimum requirements (-1)</td>
<td>Exceeds requirements (+1)</td>
</tr>
<tr>
<td>On-time delivery</td>
<td>Always (+1)</td>
<td>Occasionally late (-1)</td>
</tr>
</tbody>
</table>

Source from own illustration derived from Verma and Pullman (1998)
3.5 Conceptual supplier selection and evaluation process for public procurement in the Swedish electricity industry

According to Weele (2014) the supplier selection process is a part of the purchasing process that is initiated with a market research after defining and specifying the functional or the technical specification and ended with supplier selection. After comparing the mentioned supplier selection processes according to Handfield, et al. (2009) and Weele (2014), it can be seen that some main points can be taken as common steps in supplier selection process. In addition, the public procurement characteristics are taken into account for finding the mentioned steps, for instance, the step ‘Identifying the potential supply sources’ mentioned by Handfield, et al. (2009) is not needed in public procurement since all potential suppliers can apply. Therefore, the concluded steps are summarized as the following:

1- Identifying the needs and the sourcing method.
2- Setting the pre-requirements for the suppliers: Public procurement is different from private sector and each step throughout the procurement process should be controlled by the regulations in order to ensure the fair dealing and to minimize the potential risk from undue influence under the circumstance of discretion (Schapper, et al., 2006). Therefore, setting the pre-requirements is a critical step in the supplier selection process in public procurement. The supplier cannot proceed to the following steps if they do not prove to work in accordance with the public procurement regulations.
3- Supplier evaluation: This step includes the choice of appropriate criteria for supplier evaluation. The criteria can vary depending on the subject of purchase. In addition, assigning weights to the chosen criteria according to their importance to the purchase and the importance of the weighting of criteria in the supplier evaluation process also vary depending on the specifics of the purchase.
4- Supplier selection: Choosing the supplier with the best score after conducting the evaluation. By following a supplier selection process including these four steps, it can be assured that all necessary data is considered and all suppliers are evaluated on the same base. A visualization of these steps can be seen in figure 11.
Figure 11. Conceptual supplier selection and evaluation process for public procurement in Swedish electricity industry

<table>
<thead>
<tr>
<th>Process steps</th>
<th>Specification and regulations to follow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: Identifying the needs and the sourcing method</td>
<td>PP</td>
</tr>
<tr>
<td>Step 2: Setting the pre-requirements</td>
<td>PP (LOU) &amp; SEI (LUF)</td>
</tr>
<tr>
<td>Step 3: Supplier evaluation</td>
<td>PP &amp; SEI</td>
</tr>
<tr>
<td>Step 4: Supplier selection</td>
<td>PP</td>
</tr>
</tbody>
</table>

PP = Public Procurement  
SEI = Swedish electricity industry

Source from own illustration
4 Empirical findings

This chapter will provide a detailed empirical description of the investigated case company VEAB. It begins with a short introduction of the purchasing department in VEAB, followed by a description of the public procurement process. Then, the information about supplier selection process and VEAB electricity segment will also be presented.

4.1 Purchasing department in VEAB

Loorentz, Purchaser (April 21, 2017), and the manager, Patrick Gross, are the only two purchasers in the purchasing department in VEAB. Loorentz, Purchaser (April 21, 2017), pointed out that they don’t purchase products and services directly. They only purchase agreements, then the internal customers in the company order base on these agreements. Loorentz, Purchaser (April 21, 2017), added that they don’t really have strategy for the purchasing department since they have to follow the law in every step of procurement.

4.2 Public Procurement process at VEAB

Every procurement process at VEAB begins by an employee or department contacting the purchasing department and expressing their demand for a purchase (Loorentz, Purchaser, April 21, 2017). The purchasing department then has to clarify the exact needs and specifications. According to Loorentz, Purchaser (April 21, 2017), the specifications and the estimated total value of the purchase VEAB has to follow specific rules set for public procurement.

Loorentz, Purchaser (April 21, 2017), pointed out that the total value of the purchase during the whole contract period is decisive to determine how to publish the request and which suppliers are enabled to apply. If the budget is estimated to be less than 900,000 SEK the purchasing department is free to contact suppliers of their own choice. If the budget is estimated to be higher than 900,000 SEK a request for proposal has to be published and all Swedish suppliers are entitled to participate and submit their proposal. In case the total
budget is greater than 3.800.000 SEK the request for proposal has to be published and all European supplier are entitled to participate (Loorentz, Purchaser, April 21, 2017).

The request for proposal has to be a complete document containing all information related to it (Loorentz, Purchaser, April 21, 2017). It states all details about the demand, all requirements the supplier have to fulfill, the contract terms as well as the criteria on which upon the final supplier selection takes place.

Loorentz, Purchaser (April 21, 2017), added that the request for proposal gets published for a previously determined time period on an online platform called Tendsign, which is maintained by the company Visma. All suppliers can request access to this website and search on it for request of proposals (Loorentz, Purchaser, April 21, 2017). The whole procurement process of VEAB is finally executed via this online platform, because it provides total transparency to the suppliers and therefore fulfills the legal obligations of public procurement. All communication between any potential supplier and VEAB has to be carried out using Tendsign, so that all suppliers can follow the conversation and have the same information (Loorentz, Purchaser, April 21, 2017).

After the time period set for the request for proposal is over, VEAB has to evaluate and select a supplier according to the criteria published on Tendsign. In some cases, VEAB can withdraw their request, for example if there is not enough competition and just one supplier leaves an offer (Loorentz, Purchaser, April 21, 2017).

Tendsign also has to be used for all communication between the potential suppliers and VEAB (Loorentz, Purchaser, April 21, 2017). If questions arise they have to be asked publicly on the platform and also be answered there, so that all other potential suppliers are able to follow the conversation. Doing so it is secured that all potential supplier have the same information and none of them can get an advantage by contacting the VEAB to receive additional data (Loorentz, Purchaser, April 21, 2017).

According to Loorentz, Purchaser (April 21, 2017), if a supplier is selected, VEAB has to inform the other participants about the result. If requested by any participant, VEAB has to
show clearly how the final selection was taken and what it was based on. Because of this it is important to work very detailed during the creation of the request for proposal and include all information including the exact criteria for the final supplier selection (Loorentz, Purchaser, April 21, 2017). In addition, VEAB has to base their supplier selection on the criteria that were mentioned in the request for proposal that means that supplier relations cannot be taken into account. So, even if VEAB has a preferred supplier, this preference cannot influence their decision making. Thus, in some cases even unfavorable suppliers that show the best performance in the predetermined criteria and therefore have to be chosen (Loorentz, Purchaser, April 21, 2017).

With the chosen supplier a frame-contract will get signed, commonly with a period of three years (Loorentz, Purchaser, April 21, 2017). Due to recent changes in public procurement regulation, it is possible to sign contracts with durations up to seven years. Loorentz, Purchaser (April 21, 2017), mentioned that VEAB prefers to use contract durations between three and four years, so that they are not tied to a supplier too long. In many contracts, a possible renegotiation of the condition is agreed upon after three years, but the contract also includes a maximum change (Loorentz, Purchaser, April 21, 2017). So, VEAB commonly includes a maximal price increase of three percent into their contracts. If prices would be raised higher, the contract can be terminated. Other reasons to terminate a contract are just breaches of the contract itself or the pre-requirements (Loorentz, Purchaser, April 21, 2017).

### 4.3 Supplier selection process

Because of the particular situation of VEAB, they are obligated to follow the rules for public procurement (Loorentz, Purchaser, April 21, 2017). This situation limits VEAB’s freedom to determine their supplier selection process. The fact that all demands of the company have to be published for all potential suppliers to apply, eliminates VEAB’s possibility to conduct own research for suppliers and proactively contacting them (Loorentz, Purchaser, April 21, 2017).

The request for proposal that gets published via the online portal Tendsign also has to include all information regarding the demand, contractual conditions, pre-requirements as
well as the selection criteria (Loorentz, Purchaser, April 21, 2017). So, VEAB has to include detailed information about the pre-requirements and their supplier selection criteria into their request for proposal to ensure the transparency of the process. This means that all important criteria for the purchase have to be identified, weighted according to their importance and be combined in a common evaluation model, even before the request of proposal is published. So, the procurement department has their biggest workload in advance of the actual supplier selection at the preparatory stage for the request of proposal (Loorentz, Purchaser, April 21, 2017).

The first step of the supplier selection process is therefore the exact specification of the demand together with the requesting employees and departments of VEAB. Then the identification and the weighting of criteria and pre-requirements that are critical for the purchase and decisive for the final supplier selection has to take place (Loorentz, Purchaser, April 21, 2017). When the complete request for proposal is published, suppliers have a previously determined time period to apply and make an offer.

The actual selection starts by checking if the suppliers that applied fulfill the pre-requirements (Loorentz, Purchaser, April 21, 2017). All suppliers that fulfill the pre-requirements get evaluated according to the previously determined and published criteria and evaluation model. The one supplier, whose evaluation shows the best result, then has to be selected by VEAB. So, VEAB is not able to include other aspects like supplier relationship into their decision making process and have to follow strictly the published selection criteria and model of the request of proposal (Loorentz, Purchaser, April 21, 2017).

4.3.1 Pre-requirements

Different from private sector, public sector companies as VEAB need to conduct the procurement under the regulations of LUF (Loorentz, Purchaser, May 03, 2017). Moreover, the candidate suppliers should have the same communication system which is used by VEAB. According to Loorentz, Purchaser (May 03, 2017), the suppliers should have diploma and education for technical specifications within electricity industry and follow the standards and rules. Thus, the requirement for technical education and certification are also vary depending on the specifics of the purchase. In addition to technical requirements,
VEAB also have pre-requirements from legal perspective (Loorentz, Purchaser, May 03, 2017). The pre-requirements for the suppliers are important for VEAB to select the suppliers in the first stage. According to Loorentz, Purchaser (May 03, 2017), the following are the mandatory requirements for the suppliers who want to apply on the Tendsign:

- The suppliers must be able to deliver during the contract period.
- The suppliers shall be excluded from participation if this has been convicted of organized crime, punishment, fraud, money laundering, terrorist offenses or trafficking in human beings.
- The suppliers will be excluded from participation if they haven’t fulfilled the obligations regarding payment of taxes or social security contributions. VEAB will request the documents from tax office to check information.
- The suppliers will be excluded if the company is bankrupt or provide false information
- The suppliers should be registered in the Official Company Register, Trade Register or similar register by the end of the agreements. In addition, they need to register for reporting and payment of added value tax, provisional A-tax and employer’s fees. It is also needed to provide a document confirming the information about free debts for Sweden taxes and social security contributions.
- VEAB requires the suppliers to have an F-Tax slip and request this document from supplier.
- VEAB requires the suppliers to have financial capacity corresponding to the scope and content of the assignment. The supplier must have a rating of three or better according to the UC (the biggest consulting company in Sweden) or equivalent.
- The suppliers should comply with the UN Convention on the rights of the child, as well as applicable laws and government requirements.
- The suppliers must indicate the price in SEK including VAT.

The suppliers must follow the environmental policy of Växjö and the products should be environmental-friendly (Loorentz, 2017a). The suppliers need to show the environmental statement of company and demonstrate the quality of the products. In addition, given by the requirements from Växjo municipality, the suppliers have to drive fossil-free trucks and use fossil-free fuels.
4.3.2 Supplier evaluation Criteria

Every supplier who fulfills the pre-requirements in the system will be evaluated based on the criteria in the next step which vary between suppliers (Loorentz, Purchaser, April 21, 2017). All the evaluation criteria will be shown in Tendsign before the evaluation and selection of supplier. According to Loorentz, Purchaser (April 21, 2017), cost is one of the most important criteria for VEAB when evaluating the supplier. In addition, VEAB also use reference from consultants, delivery time and quality to assess the suppliers.

Regarding to the priority of those criteria, the purchaser will first choose the suppliers with lowest price or most economical and profitable offer (Loorentz, Purchaser, May 03, 2017). Then, other criteria such as delivery time, references and quality will be considered to provide a whole comparison and choose the most advantageous candidate supplier. The purchasing department spends a lot of time on evaluation to ensure fair competition and the evaluation details will be used as a proof in case other suppliers question the result of supplier selection (Loorentz, Purchaser, May 03, 2017).

4.3.3 Supplier evaluation model

Loorentz, Purchaser (May 03, 2017), mentioned that the value-added model for supplier evaluation is chosen to be used by VEAB. Thus, this model is provided by the public procurement website (Tendsign) to be used by the buyers in this sector. The value-added model is chosen because this model makes it easy to have a good balance between the price and the specified evaluation criteria. In addition, it is easy for the Supplier to understand how the evaluation will take place, as we specify the economic value that is assigned to the different quality criteria.

Loorentz, Purchaser (April 21, 2017), described the value-added model as following. The suppliers are given credits based on the chosen criteria by VEAB. For instance, interviews are conducted with the consultancy suppliers in order to give credits depending on their performance through the interview. In addition, the delivery time can be different from supplier to supplier, which gives more credits to the supplier that offers to deliver within a certain period. Furthermore, the suppliers could have more credits based on how well they
present their application (Loorentz, Purchaser, April 21, 2017). Currently the credits get rather randomly assigned based on estimates of the procurement department. After giving the credits to the competing suppliers, a number is reached after subtracting the credits from the offered price, then the supplier with the lowest relative price wins the contract (as shown in figure 12)

Figure 12. Value-added model

Source from Loorentz (2017a)
4.4 VEAB in electricity industry

According to Loorentz, Purchaser (May 03, 2017), the focus of VEAB electricity business is on the electricity grid by delivering the electricity to customers. However, customers buy the electricity directly from any retailer.

Loorentz, Purchaser (April 21, 2017), highlighted that VEAB’s suppliers for the Electricity segment are divided into two types of suppliers (wholesalers and consultancy suppliers). The wholesaler suppliers can be for example, building, raw and maintenance materials. The consultancy suppliers can be the technical service consultants for example for the replacement of energy meters at homes. In addition, Loorentz, Purchaser (April 21, 2017), pointed out that the suppliers within the electricity sector should show a certification to confirm their qualification for doing the work (education) as a mandatory criterion before doing the business. In addition, those suppliers have to be permitted to do this type of work within the power sector in Sweden. Moreover, the technical requirements for the suppliers in the electrical industry vary depending on what VEAB needs to buy, for instance, when VEAB needs to have a trade agreement for transformers, the capitalized price is evaluated, which means that the losses that product would have during its lifetime are calculated and the least loss will be bought (Loorentz, Purchaser, April 21, 2017).
5 Analysis and discussion

Linking the empirical findings to previously reviewed theories, this chapter will address the research questions in chapter 1. It begins with defining and developing a supplier evaluation and selection process for public procurement in the Swedish electricity industry. Then, this supplier evaluation and selection process will be applied to VEAB by taking its specifications into consideration.

5.1 Supplier evaluation and selection process for public procurement in the Swedish electricity industry

In order to develop the supplier selection process, a conceptual supplier selection and evaluation process has been found previously in this paper based on the literature. As can be seen before in Figure 11, the main steps of the supplier selection process are: 1. Identifying the needs and the sourcing method; 2. Setting the pre-requirements; 3. Supplier evaluation and 4. Supplier selection.

Since the supplier evaluation is the most critical part of the selection process and there is no consensus between the authors about a certain model on how the evaluation can be done, a supplier evaluation model for the Swedish electricity industry will be developed based on the current model in the case company. VEAB is currently using the value-added model for supplier evaluation. This model can be used by every procurement department in the public sector since it is one of the models that are provided by the public procurement website Tendsign (Loorentz, Purchaser, April 21, 2017). The idea behind further developing and adapting the value-added model is to avoid the drawbacks of this model by improving its reliability and credibility. Through the following parts, the supplier selection and evaluation process will be discussed in more details, especially the supplier evaluation steps where a detailed description of the evaluation method will be provided. In addition, an explanation of the needed changes on this model will be presented.
Firstly, the discussion is about developing a supplier evaluation and selection process for public procurement in the Swedish electricity industry, then, the reached process will be applied on the case company, by taking into account the specifications of VEAB.

In the following sections, the conceptual supplier selection process found in the theory part will be further analyzed and extended by including the empirical findings.

5.1.1 Identifying the needs and the sourcing method

Handfield, et al., (2009) mentioned that the first step in every procurement process is to recognize the needs for supplier selection. Through this activity, some specifications can be provided by the engineering staff about the needed materials, processes or services. Furthermore, the method of sourcing is important to be decided for choosing whether to source a turnkey subcontracting (performing the whole assignment) or partial subcontracting besides the pricing method before awarding the work (Weele, 2014).

5.1.2 Setting the pre-requirements

According to Lindskog, Brege and Brehmer (2008), the development of requirements is regarded as the core procedure in the process of supplier selection in public sector, which includes mandatory requirements for the suppliers. The purchasing departments need to provide suppliers with detailed and clear information required for candidate suppliers on the public website, then the suppliers will download the documents online (Leipold, et al., 2004). To follow the standards and rules, the suppliers within the electricity industry should have certification and education to confirm that they are qualified for the work. In addition, suppliers need to fulfill the requirements for technical specification that vary depending on the type of product (Loorentz, Purchaser, April 21, 2017). Thus, the suppliers should follow legal requirements such as taxes or social security contributions (Loorentz, Purchaser, May 03, 2017). In addition to the legal regulations, the suppliers within electricity industry also need to work under the pre-requirements of the local municipality (Loorentz, Purchaser, May 03, 2017).
5.1.3 Supplier evaluation

The supplier evaluation is a critical step in every supplier selection process (Imeri, et al., 2015). Due to the specifics of the public procurement regulations, a market research for supplier is not possible and every supplier is allowed to participate, this increases the significance of the supplier evaluation for the public sector.

The value-added evaluation model used by VEAB is suggested by the public procurement website Tendsign and therefore commonly used in the public sector (Loorentz, Purchaser, April 21, 2017). It is a simple model that is easily understandable by suppliers. Companies in the public sector are obliged to provide full transparency and therefore have to provide the results of their supplier evaluation, if requested (Schapper, et al., 2006, pp. 5). Because of this, it makes sense to keep the model that is currently in use (Loorentz, Purchaser, April 21, 2017).

The value-added model has some major disadvantages, when compared to other popular models mentioned in the theory part. The biggest disadvantage identified is that there is no proper mechanism in place for the weighting of evaluation criteria. In the current model, credits are rather randomly assigned to the criteria by the purchasers’ personal estimation and no direct interrelations are established between the chosen criteria (Loorentz, Purchaser, April 21, 2017). The weighting of one criterion does not get assigned in relation to the other criteria, but rather independent.

The most popular evaluation model that allows the processing of qualitative data is AHP (Liu and Hai, 2005; Omkarprasad and Kumar, 2006). AHP also has a clear mechanism for the weighting of criteria including the establishment of direct relation between the different criteria by the conduction of pair-wise comparisons. Additionally, the establishment of a supplier ranking is enabled by the usage of AHP. Lee (2001) even suggests the usage of the model as the base for the entire supplier selection and management system of an organization.

For VEAB and similar energy companies in the public sector, it is therefore advisable to combine the advantages of their current model with the advantages of the theoretic methods.
By doing so, it is possible to keep the well-established evaluation layout that the suppliers are used to work with. Thus, the transparency is preserved and a proficient mechanism for criteria weighting is integrated, that enables the establishment of relations between the criteria and their assigned weights. Additionally, the suppliers will be able to see how the criteria and credits were determined and assigned.

The supplier evaluation process will be reviewed in more detail and several sub-steps will be established, as can be seen in the following sections.

**Select supplier evaluation criteria**

According to Loorentz, Purchaser (April 21, 2017), to proceed through the supplier selection process, potential suppliers have to fulfill the pre-requirements in order to move to the next step, which includes the selection of evaluation criteria to be used as a basis for the supplier evaluation. Potential suppliers for the organizations are usually evaluated and categorized by the purchasers’ selection criteria with assigned weights (Handfield, et al., 2009). Criteria can vary depending on the subject of each individual purchase. After consulting the literature, it can be seen that there is no consensus between the authors about a certain set of criteria to be used for evaluating the suppliers. For instance, Seshadri, (2005) mentioned that three criteria should be reviewed within the evaluating process, and these criteria are responsiveness, capability, and competitive value. On the other hand, Handfield, et al. (2009) had another view of the three important criteria to be included in the evaluation process, which are the cost or price, the quality and the delivery. For the sake of finding the common criteria between authors, Table 7 is presented based on Table 2 where the important criteria for supplier evaluation and selection were summarized. Moreover, the included criteria in the table are chosen based on the correlation between the authors. Table 7 includes the criteria that are mentioned by several authors.
Table 7. Common criteria in theory

<table>
<thead>
<tr>
<th>Criteria in common</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality</td>
</tr>
<tr>
<td>Price / Cost</td>
</tr>
<tr>
<td>Deliver / On time delivery</td>
</tr>
<tr>
<td>Financial situation</td>
</tr>
<tr>
<td>Capabilities (technical, equipment, facility)</td>
</tr>
<tr>
<td>Historical performance / References</td>
</tr>
</tbody>
</table>

Source from own illustration

**Weight criteria according to their importance:** *(Pairwise comparison according AHP)*

Benyoucef, et al. (2003) mentioned that the purpose of this step is to find a comparative judgement between the criteria and to identify the relative importance of the criteria to the overall goal. Moreover, the common way of comparison is to compare the elements pair-wise and establish a pair-wise comparison matrix. The weights of each criterion are calculated based on the data gathered by pair-wise comparison (Tahriri, et al., 2008).

**Consistency test**

Checking and verifying the consistency of the pair-wised comparison and the weights of the attributes are regarded as the most vital step for AHP analysis (Tahriri, et al., 2008). Consistency check can be used to determine the acceptance of priority, which can be calculated through formula (Saaty, 1980). When consistency rate is lower than 0.10, the results of priority weighting is consistent and acceptable.

**Maximum / credits**

In the currently used value-added model, credits were rather randomly assigned to each criterion based on guesses and estimates of the purchase department. Credits were assigned to each criterion individually without regards to the other criterion and the consistency of the choices.
This issue can be solved by determining a maximum amount of credits that can be assigned by a personal estimation of the buyer. The distribution of the chosen amount of maximum credits will then be conducted according to the weights assigned to each criterion. Because the weights were not chosen randomly but reached by the pairwise comparison and verified by a consistency test, the credits available for each criterion do now reflect the importance of each criterion in relation to the others and the overall importance.

**Grade suppliers on criteria**

The score of each supplier will be calculated by considering all the criteria of the suppliers (Tahriri, et al., 2008). Loorentz, (2017a) pointed out that after all evaluation criteria were chosen, their individual weights were determined and the amount of achievable credits were assigned to the individual criterion according to their importance. Then the suppliers can be graded according to their performance.

Each potential supplier has to be graded on their performance of each evaluation criteria. The grades will determine what portion of the available credits in each criterion the supplier will be rewarded with. The grading system of the current evaluation method at VEAB employs a grading scale from 0-100, which can be seen as the percentage of fulfilment. Meaning if the grade 100 is achieved, the supplier is entitled to 100 percent of the available credits and so forth (Loorentz, Purchaser, April 21, 2017). This grading system does not show any major drawbacks and can therefore be kept in place in the new evaluation process.

**Assign credits according to criteria weights and corresponding supplier grading**

After grading suppliers on the criteria, the company can then assign the credits according to the criteria weights and the achieved grades, instead of randomly assigning the credits to the criteria by purchaser personal estimation. All the criteria are correlating to each other by using AHP analysis (Tahriri, et al., 2008).

5.1.4 Supplier selection

The grades can then be used to rank the suppliers and help the company to choose the most
appropriate supplier in the end (Tahriri, et al., 2008). The suppliers will be ranked according to the relative price, which is reached after subtracting the given credits from the offered price. Then the supplier that has the lowest relative price wins the contract.

**5.2 Supplier evaluation and selection process for public procurement in the Swedish electricity industry discussion**

After consulting the theory in order to develop a general supplier selection and evaluation process for public procurement in the Swedish electricity industry, a process has been found consisting of four steps. As shown in figure 13, the steps are 1. Identifying the needs and the sourcing method; 2. Setting the pre-requirements; 3. Supplier evaluation 4. Supplier selection.

Since the supplier evaluation is the biggest step of the supplier selection process, it has been discussed in more details.

About the supplier evaluation, it can be seen that there is no certain model adopted in the Swedish electricity industry and the purchaser is free to choose the most suitable model. The value-added model is chosen to be the basis of this work which is used by the case company and also available in public procurement system in Sweden (Loorentz, Purchaser, April 21, 2017).

It was found that the value-added model has a drawback with a considerable intervention from the purchaser when estimating and setting the relative prices for every supplier according to the chosen criteria before the final selection. The goal of developing the current model is to reduce the human assessment when deciding the granted relative prices with more precise numbers after merging the AHP model in the first steps of the evaluation process in the developed model. On the other hand, the current model’s layout is advisable to be kept with the same simple design since the applying suppliers can understand the reason of the last selection and some of them are already used to it.
By using the developed model, the main drawback of the currently used model (value-added) is avoided by using the consistent weighted criteria. The consistency between the chosen criteria is reached by using AHP model in the first steps to make the process of setting the relative price more reliable since there would be less intervention from purchaser. Moreover, the developed supplier evaluation and selection process in Swedish electricity industry can be used by other public procurement departments after having a further look at the pre-requisite step. The reason for this is that the pre-requirements might be different between industries and this step is the main step where the industry specifications should be considered. Also the evaluation criteria and their weighting may differ depending on the subject of each individual purchase.

Figure 13. Developed supplier evaluation and selection process for public procurement in Swedish electricity industry

Source from own illustration
5.3 The application of supplier evaluation and selection process to VEAB

In the following sections, the developed supplier evaluation and selection process for public procurement in Swedish electricity industry will be applied to the case company VEAB.

Step 1. Identifying the needs and sourcing method

In VEAB, the employee or department will contact the purchasing department to express their demand for a purchase, then the purchaser will identify the exact needs and sourcing method (Loorentz, Purchaser, April 21, 2017).

Step 2. Setting the pre-requirements

Currently, the purchasing process of VEAB is high-regulated to ensure each step is conducted under the regulations of LUF (Loorentz, Purchaser, April 21, 2017). As shown in empirical findings, VEAB has many pre-requirements including same communication system, diploma and education for technical specifications within electricity industry, obligations regarding payment of taxes or social security contributions financial capacity and so on (Loorentz, Purchaser, April 21, 2017). The development of pre-requirements can be regarded on of the most critical step in the public procurement process (Lindskog, Brege and Brehmer, 2008). In addition, the suppliers should also provide documents from tax office to confirm the information. Setting detailed and clear pre-requirements enables VEAB to select from those suppliers who are qualified to work within electricity industry and fulfill the legal requirements in the first step. The suppliers that do not conform to the mandatory pre-requirements shown on the website will be rejected (Lindskog, Brege and Brehmer, 2008). Beside the mandatory requirements, determined by law and regulation, additional requirements can be set depending on the subject of the purchase. Different purchase items and services may require different pre-requirements.

On the other hand, the suppliers of VEAB also need to fulfill the requirements from Växjö municipality (Loorentz, Purchaser, April 21, 2017). Since Växjö municipality has specific requirement for environment, the suppliers have to drive fossil-free trucks and use fossil-
free fuels, and show the environmental statement of company (Loorentz, Purchaser, April 21, 2017).

**Step 3 supplier evaluation**
The suppliers who fulfill all the mandatory pre-requirements will be evaluated based on different criteria that have been shown in the request for proposal on Tendsign before supplier selection and evaluation process. AHP model is used for weighting and prioritizing the criteria. According to Omkarprasad and Kumar (2006) AHP analysis enables the purchasing department to rank the criteria in order to support the supplier selection and evaluation process.

**Step 3.1 Determining and setting evaluation criteria**
The first step for supplier evaluation is to select the most critical criteria for VEAB. According to Saaty (1990) the selection of factors that are vital for decision making is the most creative step in AHP analysis. Based on previous literature and specifications of VEAB, the criteria used in this model for supplier evaluation were chosen together with the purchaser in VEAB. The following criteria were selected: quality, delivery time, reference and capability.

**Step 3.2 Weight criteria according to their importance**
After determining evaluation criteria, the next step is to compare the elements pair-wise and to build a pair-wise comparison matrix (Benyoucef, et al., 2003). Each criterion will be compared with every other criterion based on their importance to the overall goal. This has been achieved by asking the purchaser in VEAB decide the preference value for every comparison to present the relative importance of each criterion compared with the others. As shown in Table 8, the four most important criteria are compared pair-wise.

The preference value was given to each criteria based on nine-point scale shown in Table 5 in order to quantify the judgement or preference (Benyoucef, et al., 2003). For example, the preference value (2) means that the quality is moderate preferred than delivery time and quality is moderate preferred than capabilities. Then, each criterion in the hierarchy level
was weighted based on the data that was gathered by the pair-wise comparison of criteria (shown in table 8).

**Table 8. Pair-wise comparison**

<table>
<thead>
<tr>
<th>Pair-wise comparison</th>
<th>Quality</th>
<th>Delivery time</th>
<th>Reference</th>
<th>Capabilities</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality</td>
<td>1,00</td>
<td>2,00</td>
<td>3,00</td>
<td>2,00</td>
<td>0,42</td>
</tr>
<tr>
<td>Delivery time</td>
<td>0,50</td>
<td>1,00</td>
<td>2,00</td>
<td>3,00</td>
<td>0,29</td>
</tr>
<tr>
<td>Reference</td>
<td>0,33</td>
<td>0,50</td>
<td>1,00</td>
<td>2,00</td>
<td>0,17</td>
</tr>
<tr>
<td>Capabilities</td>
<td>0,50</td>
<td>0,33</td>
<td>0,50</td>
<td>1,00</td>
<td>0,12</td>
</tr>
</tbody>
</table>

Source from Appendix excel sheet 1

**Step 3.3 Conduct a consistency test**

The next step is to verify the consistency rate of the pair-wised comparison and the weights of the criteria, which is regarded as the vital part of AHP analysis (Tahriri, et al.2008). The consistency check is conducted to eliminate the potential inconsistency in the pair-wise comparison and criteria weighting. Consistency rate is calculated by formula (1.1) and consistency index is calculated by formula (1.2).

\[ AV \lambda_{max} * V, \] where A means a par-wise matrix with v rows.

\[
\begin{pmatrix}
1 & 2 & 3 \\
\frac{1}{2} & 1 & 2 \\
\frac{1}{3} & \frac{1}{2} & 1 \\
\frac{1}{2} & \frac{1}{3} & \frac{1}{2} \\
\end{pmatrix}
\begin{pmatrix}
0.42 \\
0.29 \\
0.17 \\
0.12 \\
\end{pmatrix}
\]

\[ = \left| \begin{array}{c}
1 \times 0.42 + 2 \times 0.29 + 3 \times 0.17 + 2 \times 0.12 \\
\frac{1}{2} \times 0.42 + 1 \times 0.29 + 2 \times 0.17 + 3 \times 0.12 \\
\frac{1}{3} \times 0.42 + \frac{1}{2} \times 0.29 + 1 \times 0.17 + 2 \times 0.12 \\
\frac{1}{2} \times 0.42 + \frac{1}{3} \times 0.29 + \frac{1}{2} \times 0.17 + 1 \times 0.12 \\
\end{array} \right| \\
= \begin{pmatrix}
1.75 \\
1.2 \\
0.695 \\
0.46 \\
\end{pmatrix}
\]

In order to \( \lambda_{max} \), all the elements of weighted matrix will be divided by the weights
\[ \lambda_{\text{max}} = \frac{A_V}{V} \]

\[
\begin{array}{|c|}
\hline
 0.12 \\
 0.17 \\
 0.695 \\
 0.29 \\
 1.2 \\
 0.42 \\
 0.175 \\
 \hline
\end{array}
\]

\[ = 4.16 \]

The value of random consistency index (RI) for different size of matrix can be found in Satty’s table (shown in table 6)

\[ CI = \frac{\lambda - n}{n - 1} \frac{4,16 - 4}{4 - 1} \]

\[ CR = \frac{\text{Consistency Index (CI)}}{\text{Random Consistency Index (RI)}} \frac{0,053}{0,9} = 0,059 \]

Since the result of Consistency rate is lower than the acceptable value (0.10), which means the result of pair-comparison and priority weighting for each criteria in this thesis are consistent and acceptable.

**Step 3.4 Determine max achievable credits**

As it was mentioned in the analysis for the developed model, it was decided to decide for a max. amount of credits achievable for good performance in the determined criteria. Deciding on a total amount of credits attainable, enables the model to assign partly amounts of credits to each criterion according to its weighting, which was determined by the pair wise comparison. In the example executed for VEAB it was decided to assign a max. amount of 20,000 credits.

| Max. Credits | 20,000 |

**Step 3.5 Supplier grading for each criterion**

After the application period is ended and all suppliers submitted their offers, the suppliers that fulfill the pre-requirements have to be graded according to their performance. The currently used grading scale from 0-100 is suitable to be kept in the new evaluation model.
Grading the supplier from 0-100 is equal to the percentage of presumed achieved performance in each criterion. This means that suppliers with a grade of 100 are entitled to 100 percent of the credits attainable for the graded criteria. In this example it was chosen to take four potential suppliers into account for the grading of their performance, as shown in table 9.

Table 9 supplier performance grading

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Supplier 1</th>
<th>Supplier 2</th>
<th>Supplier 3</th>
<th>Supplier 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality</td>
<td>90</td>
<td>70</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Delivery time</td>
<td>60</td>
<td>80</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>Reference</td>
<td>80</td>
<td>90</td>
<td>70</td>
<td>60</td>
</tr>
<tr>
<td>Capabilities</td>
<td>90</td>
<td>60</td>
<td>80</td>
<td>50</td>
</tr>
</tbody>
</table>

Source from Appendix excel sheet 2

**Step 3.6 Assign credits according supplier grade and criteria weight**

When the supplier grading is completed, it is possible to assigned credits to each supplier and each criteria according to the suppliers’ grade and the weights of the criteria. As previously mentioned a max. amount of 20.000 credits was chosen to be attainable in this example. In the following table 10, the first column shows the max. amount of credits attainable for each criteria base on the total max. amount of credits and the weights of the criteria. The following columns show the credits each supplier is entitled to according to their performance and grading. Summing up the credits of all criteria, the total credits achieved by each supplier can be seen.

Table 10. Assign credits according to supplier grade and criteria weight

<table>
<thead>
<tr>
<th>Criteria</th>
<th>max credits</th>
<th>Supplier 1</th>
<th>Supplier 2</th>
<th>Supplier 3</th>
<th>Supplier 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality</td>
<td>8.319,36</td>
<td>7.487</td>
<td>5.824</td>
<td>6.655</td>
<td>3.328</td>
</tr>
<tr>
<td>Delivery time</td>
<td>5.882,68</td>
<td>3.530</td>
<td>4.706</td>
<td>3.530</td>
<td>4.118</td>
</tr>
<tr>
<td>Reference</td>
<td>3.396,37</td>
<td>2.717</td>
<td>3.057</td>
<td>2.377</td>
<td>2.038</td>
</tr>
<tr>
<td>Capabilities</td>
<td>2.401,59</td>
<td>2.161</td>
<td>1.441</td>
<td>1.921</td>
<td>1.201</td>
</tr>
<tr>
<td>Total Credits</td>
<td>20.000</td>
<td>15.896</td>
<td>15.027</td>
<td>14.484</td>
<td>10.684</td>
</tr>
</tbody>
</table>

Source from Appendix excel sheet 2
Step 4 Supplier selection

In this example it is assumed that all four suppliers handed in an offer with a price of 1,000,000. So, the final supplier selection decision cannot be based on the price offered but the criteria chosen and the supplier performance will determine which supplier will be selected. The amount of credits each supplier is entitled to was determined in the previous step and has to be subtracted from the price offered to get the relative price, the final supplier selection will be based on.

As it can be seen in table 11, Supplier 1 and Supplier 2 show the best performance and therefore attained the most credits and show the lowest relative price.

In this example Supplier 1 would have been selected. Considering the public procurement regulation concerning transparency VEAB is obligated to choose this supplier, because it shows the best result in the previously determined and in the request of proposal published supplier evaluation and selection process.

Table 11. relative supplier price

<table>
<thead>
<tr>
<th>Relative supplier price (incl. Credits)</th>
<th>Supplier 1</th>
<th>Supplier 2</th>
<th>Supplier 3</th>
<th>Supplier 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price offered</td>
<td>1,000,000</td>
<td>1,000,000</td>
<td>1,000,000</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Total Credits:</td>
<td>15,896</td>
<td>15,027</td>
<td>14,484</td>
<td>10,584</td>
</tr>
<tr>
<td>Relative Price</td>
<td>984.104</td>
<td>984.973</td>
<td>985.516</td>
<td>989.316</td>
</tr>
</tbody>
</table>

Source from Appendix excel sheet 2

5.4 Supplier evaluation and selection process discussion (VEAB)

Following the steps as mentioned in the developed model, VEAB will not only have a more profound supplier evaluation tool and selection process, but is also able to keep the same layout of their previous model as shown in figure 12. Step 1 to Step 3.4 will be conducted before the request for proposal is published and also include the selection of criteria. Step 3.5 to Step 4 will be conducted when the application period is over and all potential supplier have submitted their offers. These steps can simply be carried out by using the same layout as in the current value-added model. Therefore, changes in the process are not visible for the
suppliers and therefore no additional explanation is needed for the introduction of the new process. An example of developed supplier evaluation model is shown in figure 14.

Figure 14. Example of supplier evaluation model

<table>
<thead>
<tr>
<th></th>
<th>Supplier 1</th>
<th>Supplier 2</th>
<th>Supplier 3</th>
<th>Supplier 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price offers</strong></td>
<td></td>
<td>1,000,000</td>
<td>1,000,000</td>
<td>1,000,000</td>
</tr>
<tr>
<td><strong>Max. Credits</strong></td>
<td>20,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Max. grade</strong></td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Criterion 1 Quality</strong></td>
<td></td>
<td>90</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td><strong>Max. credits</strong></td>
<td>8.319</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Max. grade</strong></td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Criterion 2 Delivery time</strong></td>
<td></td>
<td>60</td>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td><strong>Max. credits</strong></td>
<td>5.883</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Max. grade</strong></td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Criterion 3 References</strong></td>
<td></td>
<td>80</td>
<td>90</td>
<td>70</td>
</tr>
<tr>
<td><strong>Max. credits</strong></td>
<td>3.396</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Max. grade</strong></td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Criterion 4 Capabilities</strong></td>
<td></td>
<td>90</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td><strong>Max. credits</strong></td>
<td>2,403</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Credits for criterion 1</strong></td>
<td></td>
<td>7,487</td>
<td>5,824</td>
<td>6,655</td>
</tr>
<tr>
<td><strong>Credits for criterion 2</strong></td>
<td></td>
<td>3,530</td>
<td>4,706</td>
<td>3,530</td>
</tr>
<tr>
<td><strong>Credits for criterion 3</strong></td>
<td></td>
<td>2,717</td>
<td>3,057</td>
<td>2,377</td>
</tr>
<tr>
<td><strong>Credits for criterion 4</strong></td>
<td></td>
<td>2,162</td>
<td>1,442</td>
<td>1,922</td>
</tr>
<tr>
<td><strong>Total credits</strong></td>
<td></td>
<td>15,896</td>
<td>15,028</td>
<td>14,485</td>
</tr>
<tr>
<td><strong>Comparison price</strong></td>
<td></td>
<td>984,104</td>
<td>984,972</td>
<td>985,515</td>
</tr>
</tbody>
</table>

Source from own illustration based on value-added layout

This developed supplier evaluation and selection process can avoid the drawbacks of VEAB’s current supplier selection process by combining the advantages of value-added model with the advantages of the AHP model. In addition, this supplier evaluation and selection process is applicable for different kinds of suppliers, such as raw material supplier, maintenance suppliers and consultancy suppliers. Besides the mandatory pre-requirements, additional requirements and criteria used in this process can be flexible depending on the specifics of the purchase. For example, for the consultancy supplier, maybe the criteria of delivery time is not needed but new criteria might be required to be added to enable a better evaluation. On the other hand, the pre-requirements such as diploma and certificate for technical specifications will vary depending on what type of material and service is needed.
6 Conclusion

In conclusion, this thesis is written to answer the research questions “How to develop a supplier evaluation and selection process for public procurement in the Swedish electricity industry?” and “How to apply the developed supplier evaluation and selection process at the case company VEAB?” Furthermore, the extent of generalization of the findings and the relevance of the chosen topic will be illustrated. In the end of this chapter reflections and comments towards this paper will be given and fields for further research suggested.

6.1 Answers to research questions

This thesis contributes to the supplier evaluation and selection process for public procurement in the Swedish electricity industry in theory as well as in practice. Theoretical approaches to the topic were compared to actual applied ones to identify possible synergies, contradictions and similarities in order to answer the following two research questions.

RQ 1. How to develop a supplier evaluation and selection process for public procurement in the Swedish electricity industry?

Every supplier selection and evaluation process starts with the clarification of the demand together with the entity in need. The further progress through the process in the Swedish electricity industry shows some unique characteristics due to its affiliation to the public sector. The Public procurement process is highly regulated in a way that increases the importance of the supplier evaluation and selection process. In public procurement a request for proposal has to be published for every new procurement process. Therefore, the preparation phase for the request of proposal bears the highest workload. First, all necessary pre-requirements have to be identified, including mandatory legal requirements, requirements imposed by the municipality as well as requirements determined by the characteristics of the individual procurement. The second subject that has to be clarified and also be included in the request for proposal is the exact process of supplier evaluation and its criteria. Several theoretical methods for supplier evaluation were reviewed, for instance
AHP, TCO, DCA. The theoretical findings were compared to the method used in the case company. The currently used model is suggested by the public procurement platform, on which all request for proposals are published. Therefore, many suppliers are familiar with the model and are able to educate themselves about the model on the internet platform. Compared to the theoretical models the major drawback identified, was the lack of a precise process for the weighting of chosen evaluation criteria. The AHP model showed to have a very sophisticated mechanism for the weighting of criteria that also enables the establishments of interrelation between evaluation criteria. Therefore, the research team came to the conclusion, that the combination of the currently used model and the evaluation and weighting mechanism of AHP would be a suitable fit for the industry. As shown in the analysis of this research, this combination will allow companies to retain the current layout of their supplier evaluation process and use the advantageous criteria weighting mechanism of AHP. So, the proficiency of the supplier selection and evaluation process can be improved without the need to introduce a new layout to their request of proposals and their potential suppliers.

RQ 2. How to apply the developed supplier evaluation and selection process at the case company VEAB

The supplier evaluation and selection process developed for public procurement in Swedish electricity industry has been applied to the case company VEAB. Compared with the process that they currently use for supplier selection, the new developed process enable the purchasing department to select and evaluate the potential suppliers in a more logical and rigorous way. The developed supplier evaluation model is also able to keep the same layout of their previous model, which makes it easy for the suppliers to understand the supplier selection. In addition, this developed supplier evaluation tool innovatively combines the advantages of the value-added model with the advantages of the AHP model.

Following the steps mentioned in the developed process, VEAB can have a more profound supplier selection tool to evaluate different kinds of suppliers including raw material supplier, maintenance suppliers and consultancy suppliers. The mandatory pre-requirements, additional requirements and criteria used in this process can be vary depending on the
specifics of the purchase. Thus, the technical specifications will also be convertible depending on what type of material and service is needed.

6.2 Limitations and method critiques

Currently, VEAB has only one purchasing manager and one purchaser in purchasing department. Since the purchasing manager is busy during the period of research, interviews can only be conducted face to face with the purchaser in the case company VEAB. The purchaser is familiar with the whole supplier selection and supplier evaluation process. Considering that all the empirical information is gathered by only one employee, the single-source information might under the risk of being inaccurate. However, due to the limitation of time, we were not able to book more interviews to verify the information face to face with the purchasing manager in VEAB.

The subject of this research is to develop a supplier evaluation and selection process for the buyer company VEAB and there was no contact with the suppliers, which minimize the ability to include the supplier perspective in this work. Thus, since the study object of this research is the power plant company that manufactures products and services in the area of electricity and district heating, this research can only provide useful information and techniques for future studies within the research domains.

6.3 Further research

In this master thesis, the authors analyzed the supplier evaluation and selection process in theory as well as empirically in order to develop a process fitting the needs for public procurement in the Swedish electricity industry. Nevertheless, it would have been desirable to include more companies in this research to get a broader base of empirical information. Therefore, a multiple case study gathering more empirical data can be suggested as a topic for further research, in order to verify the findings of this thesis.
Another suggestion is to apply this research on other industries in public procurement to identify similarities and differences and examine if the findings of this research are also applying to other industries in public procurement.

A change of the perspective could also be a subject for further research, the focus could for instance be shifted to the supplier and the research be conducted from their point of view. Such a research could complement the findings of this thesis to get a more diverse and complete overview about the processes.

6.4 Generalization of the findings

In this research, a supplier evaluation and selection process for public procurement in the Swedish electricity industry has been developed and the process is applied to the case company VEAB. The results indicate that this new process enable the purchasing department to better evaluate and select the potential suppliers and this process can be applicable to different kinds of suppliers. It is found in empirical finding that this process can also be adopted by public sector companies in other industries in Sweden since the model is suggested by the Swedish public procurement platform, on which all request for proposals are published. On the other hand, the public procurement process in Sweden is highly-regulated and each step needs to follow the regulations of LOU. The public sector in other industries can change the pre-requirement and additional criteria depending on the specifications of the industry and requirements imposed by the local municipality. The selection of criteria and pre-requirements will not influence the application of this developed supplier evaluation and selection process. In addition, the model contained in this process keeps the well-established evaluation layout that the suppliers are used to work with, which means no additional explanation is needed for the introduction of the new process.

6.5 Implications for society

This supplier evaluation and selection process for public procurement in Swedish electricity industry provides a transparent and systematic approach for supplier selection in public procurement. The selection and evaluation of potential suppliers need to be conducted under clear procedures without subjective judgement, which means that each supplier applying for
the deal will be treated equally. Ensuring fair dealing is essential for minimizing the potential risk from undue influence under the circumstance of discretion. In addition, the suppliers will be more aware of the importance of following regulations and the obligations regarding payment of taxes or social security contributions since they are mandatory pre-requirements for the suppliers. Moreover, the pre-requirements set by local municipality can motivate environmental-friendly practice. For example, Växjö municipality has specific requirement for environment and they require the suppliers to drive fossil-free trucks and use fossil-free fuels. Thus the suppliers need to show the environmental statement of their company.
7 References


Loorentz, L. (2017b). In-depth information about VEAB’s criteria for supplier selection and evaluation process [Interview] (03 05 2017)


Appendix 1

Project plan

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83
Interview guide

First interview

1. Can you please introduce yourselves and what are your roles in the company
   - How long have you been working here?

2. Could you please give as a brief view about the purchasing department (staff, the structure of purchasing process, objectives)?

3. Do you have a procurement strategy or are you basing your plans on the overall strategy of VEAB?

4. What are the current practices in VEAB for evaluating the supplier and their performance?

5. How much time do you spend to conduct the evaluation?

6. What kind of suppliers do you have?

7. We would like to know which suppliers do you have especially for the electricity segment?

8. Which suppliers would you chose to base our work on (products) (within the electricity segment)?

9. Can you describe the market situation and the balance of power between VEAB and these suppliers (the chosen ones)?
   - The possibility of switching between suppliers (in case there is a competition in the supplier market)
10. What are the important criteria for evaluating the supplier performance (for the chosen suppliers)? (quality, delivery performance, cost, lead time, responsiveness to the demand changes, sustainable measures including waste, recycling and resource usage)

11. Do you have any unique requirements for the electricity segment in term of supplier relation? (certifications and regulations)

12. Do you have any aspect the needs to be improved with the chosen suppliers
   - What kind of aspects are they?
   - How do you deal with this?

13. Do you have any strategic perspective in term of supplier relation? (Relation more important than price? Or cost driven)

**Second interview**

**Prioritizing criteria**

1. Which criteria are you currently using? Can you rank them, which are the most important for you?

2. Which criteria do you think are unique for your electricity business?
   - Technical ability/ professional ability

3. Can you explain in detail what the technical requirements for your suppliers in electricity business are?

4. We would like to know if you have special environmental requirements for your suppliers in electricity industry?

5. We would like to have a look at the website you are using for a further look on the needed requirements?

6. What are the mandatory requirements?