



Supplier Selection & Quality Expectations

Development of a Simple Supplier Evaluation Tool in a Norwegian
Ventilation Systems Company

Leverantörsval och kvalitetsförväntningar –
Utveckling av ett enkelt leverantörsutvärderingsverktyg i ett norskt ventilationsföretag

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Prologue

This master thesis represents the last and final part of our education at Karlstad's University (KAU) within Industrial Economics and Supply Chain Management. The thesis covers 30 university points and has been conducted during the spring of 2014 at Flexit AS in Töcksfors.

We would like to thank Flexit AS for showing a genuine interest in our development, both individually and as engineers on the verge into a career, but also for enabling the subject of the thesis while housing us during the empirical study.

We would also like to thank our tutors, Mr. Anders Wickberg and Mr. Per-Ola Maneschiöld, for their passion, encouragement and drive during the semester - without their help and struggle, our work would have been a lot harder.

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Lastly, we would like to thank our families for endless support during our five years of education. Without their constant love and help, these years would not have been worth doing.

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Abstract

In today's competitive market, survival and response to customer needs and expectations are enabled through high-quality products for low costs – quality products provided by suppliers fulfilling today's quality-requirements for a low price. Companies have until recent years selected suppliers only according to a pricing structure, leaving other criteria's, such as quality, behind.

The purpose of this master thesis is therefore to investigate quality aspects that must be considered from a supplier evaluation perspective and design a simple evaluation tool for first-time supplier selections. Both new and existing suppliers will be tested with the tool according to information given during a case study made at Flexit AS, a Norwegian ventilation-systems company looking to introduce a structured approach for selecting suppliers.

Through an extensive literature- and empirical study, where a survey, of which evaluation criteria's to be included in the evaluation tool, was conducted together with several both semi-structured and unstructured interviews, a foundation for the design of the tool was presented.

Quality management systems and quality performance measurements, such as rejection rate and delivery precision, are considered as fundamental aspects to consider when assessing a supplier. Acceptance levels of approval are set according to in-house objectives. If any evaluation tool including quality should be usable, an in-house quality system must therefore first be implemented by the in-house company – a notable improvement recommended to the case company.

The design of the tool given from the thesis provides the evaluator with an opportunity to visualize and compare existing suppliers according to five criteria's including cost, together with an additional spreadsheet for evaluation of new suppliers put forward as a foundation and an indicator if new suppliers are considering quality on a basic level.

Key Words: *Supply Chain Management, Quality Management & Supplier Selections*

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1. Introduction

To fully understand the concept of this master thesis, a background of the research field is presented, together with a problem formulation generating the very purpose of the thesis - The purpose is narrowed down and framed into three different research questions and aligned with limitations encountered during the study. This introductory chapter aims for better understanding towards its readers.

1.1. Background

Customers, buyers, suppliers and sellers – or actors, are all incorporated within a network, a supply chain. The concept of a supply chain suggests a series of processes linked together to form a chain of events, with a primary objective to achieve a high level of competitiveness (Kermani et al. 2011) – A requirement for today's competitive market. Supply chain management are the teaching of managing the supply chain according to the definition below;

“Supply Chain Management is a process-oriented approach to manage product, information and fund flows across the overall supply network, from the initial supplier to the final customer, with an aim to achieve high customer satisfaction through high quality for a low cost”- Spina et al. (2013), Harrison and van Hoek (2008), Ordoobadi (2009a) and Waters (2003)

Successful supply chain management relies on forming strategic partnerships with trading partners along the supply chain – in order to survive and to respond to customer demands, companies have no choice but to offer high-quality products and services for low costs (Waters 2003; Ordoobadi 2009a). Managing cost throughout the supply chain therefore requires helpful and co-operative supplier relationships, providing companies with high quality products (Harrison & van Hoek 2008). The selection process of suppliers is therefore a major requirement and the first step towards a successful supply chain, while creating a competitive advantage and edge (Kermani et al. 2011; Ordoobadi 2009a).

The purchasing function of a company traditionally encompasses the process of selecting suppliers and is usually the department making decisions whether or not to continue with a specific supplier (van Weele 2001) – the role of purchasing and supply management as a business function, is to manage the

organizations external resources and acquire inputs by the best means possible (Lindgreen et al. 2013).

Purchasing has unfortunately not always filled above role and business function – traditionally, purchasing revolved around single transactions or short-term contracts, putting much effort and emphasis on low cost regardless of the supplier or the quality given (Lindgreen et al. 2013). Cost based considerations have up until this decade formed the foundation for supplier selections, leaving other criteria's behind (Raut et al 2010).

The times are however changing. Studies made by researchers clearly show that there are several different models and techniques developed for selecting and evaluating suppliers considering other parameters than just cost and component price, enlightening quality as equally important (Kermani et al 2011).

Dickson (1966) was one of the first researchers publishing a work in the supplier selection area – according to Dickson (1966), 23 different selection criteria's should be considered when evaluating supplier structures. His work is based upon responses from 170 managers and purchasing agents, where they all had to categorize the importance of a number of different criteria's (Ordoobadi 2009b) - criteria's considered important by Dickson (1966) are for instant price, delivery, performance history, policies and production facilities – the outmost important criteria's was however quality, delivery and price (Kermani et al. 2011; Sim et al. 2010). The criteria's put forward by Dickson (1966) were later accepted as the foundation for supplier selection literature; Quality, delivery and price are today seen as a qualifier and a basic requirement for most purchasers to consider in a supplier selection phase (Sen et al 2008; Sim et al. 2010).

The majority of studies conducted in recent days use Dickson's (1966) general work as a base for new applications, but with a less amount of criteria's for evaluation. Sen et al. (2008) proposed a hierarchical criteria structure including cost, quality, service, reliability, management and organization and technology, since these were surveyed as well suited for the situation handled in their case study made in a Turkish Audio Electronics Company. Both qualitative and quantitative criteria's are brought to light in a hierarchal structure, enabling the Turkish company to examine strengths and weaknesses of alternative suppliers through comparative steps – the case study made by Sen et al (2008) resulted in an effective implementation of a selection process, enabling the company to

elaborate on alternative suppliers and build a better and profitable supply chain.

Raut et al. (2010) presented a study made in an Indian manufacturing- and assembly company - evaluation criteria's enlightened were component quantity, quality, on-time delivery, service, responsiveness, technical capability, production facility and pricing structure. The results given showed that these criteria's are critical if succeeding with a satisfactory supply chain management and with the problem of handling supplier selections. The results also showed that a hierarchal structure of criteria's is preferable.

A third suggestion for supplier selection criteria's are a study made by Labib (2010) in the vending market. According to him, fewer parameters can be considered, since the extent of the evaluation would be too time consuming if the amount of criteria's are too high. The most important criteria's according to Labib (2010) are quality, delivery, service and cost – these are also the criteria's considered key parameters and qualifiers by the supplier selection literature, if assessing performance capabilities of suppliers (Dickson 1966; Sen et al 2008).

Assessing suppliers according to different criteria's is a complex procedure - One important consideration when evaluating suppliers and their future performance level in a certain supply chain is the dependence of market segments and the type of product. According to Sen et al (2008), criteria's put forward varies depending on the product category, while still serving the same purpose of optimizing the supply chain through successful supplier relationships (Spina et al. 2013; Sen et al 2008).

Supplier selection, as the first link in the value chain is of great importance to companies and a critical success factor (Labib 2010). Consequences from the supplier selection process affect activities such as inventory management, production planning and control, cash flow requirements and product quality – in other words, decisions made in the first linkage will reflect every other decision down the chain (Raut et al. 2010). Building a successful supply chain is crucial if achieving customer satisfaction and customer demands through high quality and low costs (Waters 2003).

1.2. Problem

Supplier evaluation is a key element in the industrial purchasing process and the first step towards a successful supply chain – it appears to be one of the

major activities professional industries should and would put focus on though being extremely complicated, owing to a variety of uncontrollable and unpredictable factors that may affect the final decision (Raut et al. 2010). To simplify and ease these unpredictable factors, research within supplier selection for quality improvements and cost reductions has been conducted - current studies show that there are several different methods owing up to different selections procedures, enabling a wider foundation and guidance for an easier choice of supplier towards improved quality products (Lindgreen et al. 2013).

Mathematical programming methods are the most exploited approaches used for supplier evaluation and selection problems, including weight methods (Raut et al. 2010). These models are however complicated from a selective and utilized perspective, consequentially narrowing the user group down to individuals with programming skills. It is also tough to implement due to its complex structure (Sen et al. 2008) – a need for first-time applications and development of a simpler tool is therefore considered a research gap. Other approaches commonly applied uses categorical terms such as “good/bad” as evaluations tools, while linear programming allow subjective thoughts when addressing different weights to the selection criteria’s (Ordoobadi 2009b). The models provided are unfortunately unclear whether both new and existing suppliers can be evaluated with the same tool, or if there is a need for a distinction between both models used and suppliers evaluated – Another research gap is found.

This master thesis will therefore put focus upon today’s quality expectations, propose a simple and basic framework for first-time users within supplier selections towards quality improvements and thereafter investigate the possibility if both new and existing suppliers can be assessed with the same model.

Both qualitative and quantitative criteria’s will be used and evaluated with combined tools from earlier studies, weighted and assigned points according to a quantitative approach. Criteria’s derived during the empirical study will be structured and categorized hieratically according to earlier studies made by Sen et al. (2008), Raut et al. (2010) and Ordoobadi & Wang (2011) since their case studies presented satisfactory results when selecting suppliers, and as an extension, also a successful supply chain management.

The study and the empirically derived information are based on a Norwegian assembly-line company currently selecting suppliers according to a pricing strategy. They are experiencing quality problems and quality difficulties with some of their suppliers, planning to introduce a structured approach to better and easier select suppliers. Due to these problems, room for a supplier structure analysis and development of an evaluation tool for first-time supplier selections are given.

1.3. Purpose

The purpose of this master thesis is to investigate quality aspects that must be considered from a supplier evaluation perspective and design a simple evaluation tool for first-time supplier selections. Both new and existing suppliers will be tested with the designed tool according to a case study made at Flexcit AS, a Norwegian ventilation-systems company.

1.4. Research Questions

RQ₁ – What aspects must be considered and involved from an evaluating perspective, if assessing a supplier according to quality?

RQ₂ – How can a simple supplier selection tool be designed according to a company planning to introduce a structured approach for supplier selection?

RQ₃ – Can/Cannot the newly developed tool evaluate both new and existing suppliers – and if so, why?

1.5. Limitations

According to Sen et al. (2008) a supplier selection problem typically consists of four phases;

1. Problem Definition
2. Formulation of Criteria
3. Qualification of suitable suppliers
4. Final selection of the ultimate supplier

The first three phases are the most emphasized ones and also the phases serving as a foundation for the final selection of an ultimate supplier in phase four. The thesis will be conducted as a base for further and continuing work towards the ultimate supplier.

Phase two, where criteria's are to be formulated, will be limited according to a first-time usage scenario. The criteria's involved in the evaluation tool will be

derived empirically and through previous studies. Due to high complexity and high importance frequency from previous research, quality is a pre-decided criterion, further elaborated on in research question one and later included in the evaluation tool. Quality improvements are the main purpose of supplier evaluations, giving room for deeper investigations within current quality expectations.

A supply chain is a dynamic, stochastic and complex system that may involve hundreds of participants with a primary objective to achieve a high level of competitiveness (Kermani et al. 2011) – due to the complexity of a supply chain, the supplier structure analysis will only go as far as primary suppliers. No subcontractors will take part in the evaluation. Suppliers further investigated will be derived through the Pareto Principle in chapter 4 according to economic value of supplied products. Suppliers supplying fasteners or equal will therefore not be investigated.

Purchasing management involves different tasks connected to different parts of the supply chain – this master thesis will put focus onto purchasing management and the assignment of selecting the most suited supplier. Other responsibilities regarding the purchasing department in a company will not be further elaborated.

The study will only investigate one product family within one business area in the case company, due to experienced quality problems with current suppliers within this business area, together with the simplicity of studying a small supplier structure as a sampling. Quality expectations will be derived from this area only, representing the company's general view of quality.

The structure of the tool will be developed in a spreadsheet in Microsoft Excel, because of its simple nature and applicable use. Every employee in the case company has been in contact with Excel, and the program is also commonly known for purposes similar to this. No other program will be used, since the study aims for a non-programming approach.

Lastly, empirical methodology will only be given from the case company, serving as one example where a pricing strategy has been the first and only focus when creating a supplier structure.

2. Methodology

This chapter will treat and explain methodology concepts chosen and used in this master thesis. The chapter intend to give the reader a better understanding of both the literature study made and the empirical study conducted at the case company.

2.1. Research Strategy

A research strategy or a general plan of how to best conduct a study to finally be able to answer the research questions addressed in the thesis is the first step in a pre-study. According to a multi-method approach, different methods can be mixed and matched according to research field - several different methods aligned with one another can be advantageous since different methods can be used for different purposes in a study. Second of all, usage of different data collection methods within one study can ensure a higher level of reliability (Saunders et al. 2000). The research strategy for this master thesis is therefore to combine several different methods, whereas a literature study and an empirical study represent the body of the methodology chapter.

2.2. Literature Study

A literature study consists of an endless information flow of previous and current studies within your specific field, to read and comprehend. Importance must therefore lie within effectiveness and planning – effectiveness comes from useful research- and key words when searching for information (Ejvegård 1996), while planning makes sure that a sufficient amount of time is applied within this area before the next phase of the research is initiated. A carefully planned literature study will ensure relevant and up-to-date literature, while establishing what has been previously done (Saunders et al. 2000).

Advantages given with a carefully and thoroughly planned literature study are the gaps given and the different research fields not yet established – these gaps will give the study reason and support. Disadvantages with literature studies are however the enormous amount of existing literature and the limited amount of time given to execute the study. When making a literature study, the entire field of previous studies are hard to comprehend and transform, making it hard for the researchers to find a gap, while describing the actual research field (Saunders et al. 2000).

Experienced and perceived difficulties for the authors during the literature study are the disadvantages commonly occurring according to Saunders et al (2000) – the time interference and the great extent of literature existing. Planning the study before conducting it was made by the authors, however within too comprehensive areas due to inexperience of which areas to include in the study. The literature study could have been shorter, if a narrowed area firstly had been selected.

Description of the literature study is made through Saunders et al. (2000) presentation of which aspects to include in the proceedings. The results given are thereafter stated below.

- Defined search parameters (Language, business sector and subject area, literature type)
- Generated key words and search terms
- A wide discussion of ideas (with tutors and company)

This master thesis is conducted within supply chain management, while specializing towards quality demands and expectations, suppliers and the selection of proper suppliers. The literature study made has therefore focused upon research materials and mostly bibliography within supply chain management and quality management for a general view. Current research materials and journals of similar studies within supplier selection methods represent the body of the literature study.

Defined search parameters are;

Subject Area: Supply Chain Management

Business Sector: Effective Purchasing, Quality Management

Language and Literature Type: Journals and Bibliography in Swedish and English

Key words used when searching for literature journals are;

Supply chain management, quality, quality demands, quality performance measurements, suppliers, supplier selection, supply management, selection matrices, purchasing management, selection methods within purchasing, strategic relationships.

2.3. Empirical Study

The empirical study is of enormous importance for the researcher and the research study, being the foundation of the entire work - the empirical study is in fact the craftsmanship of the study based upon different techniques and methods (Ejvegård 1996). The empirical study will follow the problematic design used when addressing supplier selections by Sen et al. (2008).

- Problem Definition
- Formulation of Criteria
- Qualification of suitable suppliers
- Final selection of the ultimate supplier

According to Sen et al. (2008), most of the attention recently paid has so far been upon the very choice of the supplier and not on the earlier processes, where the different criteria's are stated and selected. The quality and time spent on the phases before selecting the final and ultimate supplier determines the characteristics of the selection later made, making these three phases extremely important.

The first phase is addressed in the introduction as the problem formulation. The other phases will be elaborated on according to below described techniques and methods, presented in the flow chart in figure 1.

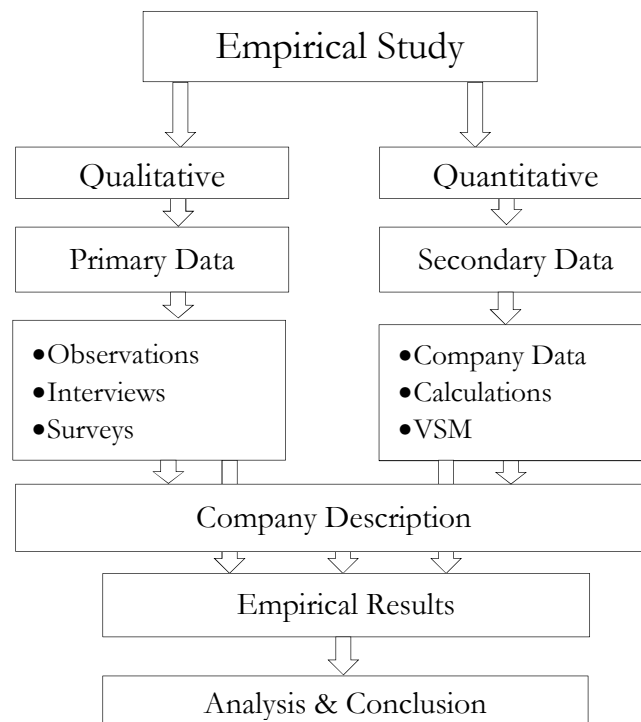


Figure 1 – Flow Chart Empirical Methodology

2.3.1. Primary & Secondary data

The two main approaches commonly used in scientific research are quantitative and qualitative methods. A quantitative method consists of statistical facts or hard data – numbers, graphs and other numerical information that can be given or obtained during the research (Dahmström 2011), while a qualitative method includes interviews or observations - soft data (Saunders et al. 2000). Depending on the type and source of data, the categorization of data deviates. There are two main categories of data - Primary and Secondary Data.

Primary data are new data, collected and gathered with a single purpose of answering specific questions within a specific research or field. There are therefore many advantages with primary data, the major one being the accuracy and truthfulness found in the information, since the data is recently collected and fresh. Limitations and questions within primary data are also advantageous, since these can be adjusted according to the situation given (Dahmström 2011) - primary data like questionnaires, interviews and observations are therefore used by the authors.

Secondary data is typically statistical data or quantitative data. These are usually numbers and figures collected and concluded by the company. Other sources of secondary data might be statistical foundations and different sources on Internet (Dahmström 2011). Usage of secondary data is also of great importance, since this information is interpreted and concluded by someone else in a similar situation, while being cheaper at the same time (Dahmström 2011).

Primary Data – Interviews

According to Ejvegård (1996), interviews are time consuming and tiresome, however of great importance. Who to interview is a matter of its own, and must be elaborated before performed so the right individual answers to and within its particular field. After the interviews are made, just as much work remains with interpretations and analysis.

Interviews are performed all through the pre-study and the mid-study of the thesis and all made by both the authors, eliminating the subjective aspect of misinterpretations from the interviewee – if only one interviewer, risks of subjectivity and intrusive internal feelings might be bigger, since an interview often is performed or transformed into an conversation. The purchasing

department and the quality department with its processes and attitudes were the primarily objectives of examination in this master thesis - the overall purpose with the interviews made is to define and give an understanding of today's working routines within supplier selection and quality expectations.

Interviews are conducted by the authors as both semi-structured and unstructured, and made with specific individuals of a higher managerial position or that has a direct connection to the research field within the company. The case company has only a few individuals working in every department – due to a limited number of individuals, the selecting process of who to interview were narrowed down, and therefore managed fast. Disadvantages with few workers within every department are the ungiven width of opinions - one worker within one department will give its individual opinion of the situation in the specific section, and risks of subjectivity will therefore be high. Several workers within the same department are beneficial, due to several opinions - reason and ground for exclusion of too subjective thoughts and feelings will then be given.

Semi-structured Interviews

Semi-structured interviews were conducted with seven different assemblymen. They were all interviewed separately and anonymously at the actual location of where they perform their daily work – detailed information about the different interviewees and the different questions asked can be found in appendix A. These individuals were selected to represent the mentality and opinions on the floor, closest to the assembly and the possible errors that may occur during a day's work. No possible impact of exterior parts or managers where possible due to the interview location.

Advantages given by performing the interviews with the assemblymen in their natural surroundings are the comfort aspect and the feeling of security towards the interviewers. Another benefit given to the interviewees is the anonymity aspect – the interviewers can be sure of sincerity and truthful answer, however increasing the risk of exaggeration. Feelings of security might have amplified the answers into an exaggerated stage.

Unstructured Interviews

Several unstructured interviews were conducted all through the empirical study and tend to move towards a simple conversation, due to no pre-decided questions – detailed information about the different interviewees can be found

in appendix B. These unstructured interviews had several purposes – one was the teaching aspect and the possibility of receiving a holistic view of the different departments investigated. Another was the questioning – how the manager and the assistants run the department and what sort of wishes, hopes and objectives they strive for.

Both the quality manager and the assemblymen were questioned about quality issues - by obtaining the images of quality from the ones working in the assemble line together with the manager in charge of quality, possibility to get at full-scale picture of the organizational attitude towards quality was enabled. The interviews were however not recorded – the only documentation was made with pen and paper after approval from the interviewee. Risks of missing parts of information are quite high. To mitigate this risk, authors were stationed part-time at the case company for twelve weeks, enabling further questions and repeated interviews if needed. Analyses of every interview were also conducted immediately when finished, taking advantage of the feelings brought from the interviews and the opportunity to ask follow-up questions if necessary.

Primary Data - Questionnaires

To answer the second phase of how to formulate the different criteria's to put focus upon, according to Sen et al (2008) problem formulation, questionnaires as a survey is used. They are handed out to a larger part of the employees at the case company. The questionnaire seeks to evaluate how important each of the supplier selection criteria's for the Norwegian ventilation company are – for a holistic view, every department and the majority of the managerial positions in the case company are represented in the survey and in the answers given, avoiding favourism of any particular in-house department. The different departments participating in the survey are the following:

- Quality
- Product- & Process Development
- Logistics
- Inventory
- Purchasing
- Human Resources & Business Administration
- IT

Sen et al. (2008) recommends that the researcher collect a wide range of possible supplier selection criteria's from literature, where after a survey should be made to enable hierarchal structuring of the different criteria's. The different criteria's found through literature are presented in figure 2 on the next page – through this figure, phase two in Sen's et al. (2008) problem formulation is fulfilled.

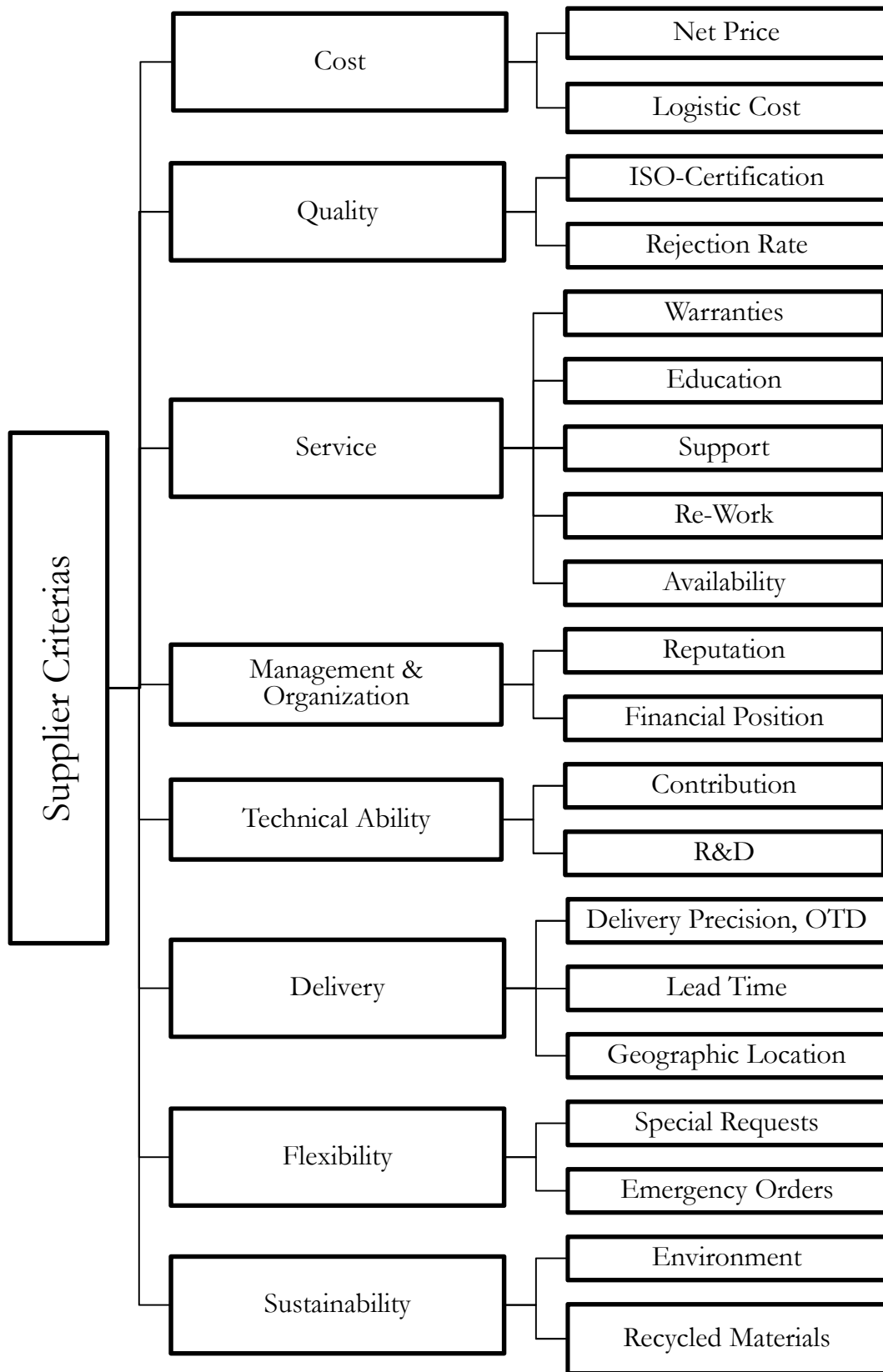


Figure 2 - Every criterion given from the literature study

The questionnaires are given to the employee group, where after they must select criteria's according to what they believe a supplier must uphold and represent. The group must number every criterion and the same number cannot appear twice – the most important criterion will be given number 1, whereas the least important criterion is given number 8 (there are eight main criteria's that must be numbered, situated at the top). Figure 3 displays the questionnaire distributed to the employee group.

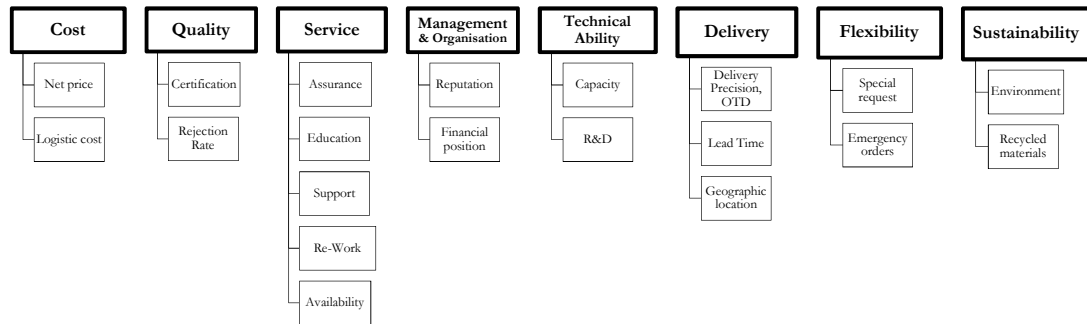


Figure 3 - The design of the questionnaire

To give the questionnaire and authors more in-depth information about what sort of criteria's that must be considered within the head criteria's, a lower level of sub-criteria's has been created – there are 20 different ones, where the same principle of never putting the same number twice must be applied (situated directly below the head criteria's). These two levels demonstrate how a hierarchal structure can be presented in questions and answers. Numbering the criteria's with an individual number and once only, the survey group must also make a decision whether or not the criterion is even worth considering from a customer-supplier point of view.

The survey made is designed according to a hierarchal structure, aiming for categorization of criteria's according to individual importance. Informational materials given to the employee group before answering the survey were minimal, since the authors and the survey strived for independent results without any outer influence. The survey group was informed to visualize and think of suppliers supplying value-adding products (neither suppliers of fasteners nor minor components). Risks with the survey are however misunderstandings and different beliefs of how to best answer the survey, according to bias results of how a supplier ought to behave. The authors were present at all times to answer questions if necessary, but it might still have been errors and left-outs. Too limited information may compromise the test

result, while the material given to the group could have been insufficient. The material given to the group is provided in appendix C.

Numbering the different criteria's are a complicated task – subjective feelings and spur-of-the-moment activities may affect how answers are given in the survey. The head criteria's are easier to number, while the sub-criteria's are harder to understand and put into a correct context. Due to a complex procedure of the survey, numbering of every sub-criterion was not performed by everyone in the survey group. As a consequence, the result given from the survey includes errors.

To be able to answer the third phase of Sen et al. (2008) problem formulation of how suppliers qualifies, the outcome from the questionnaires is further analysed and finally put into a designed supplier evaluation tool. The survey includes eight head criteria's and 20 sub-criteria's – all of these will not take part in the evaluation tool, but sorted according to the survey result. Depending on the result, a limited amount of criteria's will be included in the evaluation tool.

To be able to reflect the results given from the survey and the criteria's varying importance, weights will be assigned to the different criteria's - percentages calculated from the amount of votes put on the specific criterion will serve as weights. The procedure of calculating and distributing weights to the different criteria's are presented as an empirical result (found in chapter 5) since the amount of criteria's to be involved in the evaluation tool is decided from the survey result.

Usage of weights in the evaluation tool will provide the evaluator with quantified figures – points. These points are given to the criteria's according to the weights calculated from the survey results. The points given to each criterion are further divided into sub-points with regards to the sub-criteria's.

According to Sim et al. (2010), each evaluated supplier must satisfy a few head criteria's to qualify as suitable, while other supporting criteria's are helpful from a selecting point of view. The evaluation tool will therefore have two levels, where the first one consists of criteria's with highest rates or weights – these criteria's are here after called the qualifying ones. The supporting criteria's will only be used if the supplier qualifies – if not, the supporting criteria's will not be further used. According to these different levels of

qualification, Sen et al (2008) third phase of a supplier selection problem is solved.

2.3.1. Secondary Data - Value Stream Mapping

Secondary data used and evaluated throughout the thesis are based upon figures and graphs given from the case company and the business area investigated. To evaluate the current situation within the company and the specific field, analysis of secondary data as a descriptive method has been one major part of the empirical methodology.

A descriptive method is the easiest and simplest way of approaching a problem. The researcher simply states observations made – it could be how a country is governed, how an organization works, how decisions are made or how Catholics celebrate Easter. The basics of the method is however to be systematic. Every data collected and retrieved must be categorized, sorted and evaluated. The researcher continually has to make selections, whether or not the data is useful (Ejvegård 1996).

One example and concept used as a descriptive method is value stream mapping – a mapping-tool providing a general understanding of a situation given through a structured and categorized approach. It can be applied on to a company, a specific process or on to an entire supply chain (Slack et al 2010). The key is however to look at the entire process flow, from raw material to finished products, and not a single process or unit, if the overall picture ought to be obtained – see figure 4 below (Slack et al 2010, Rother & Shook 2008).

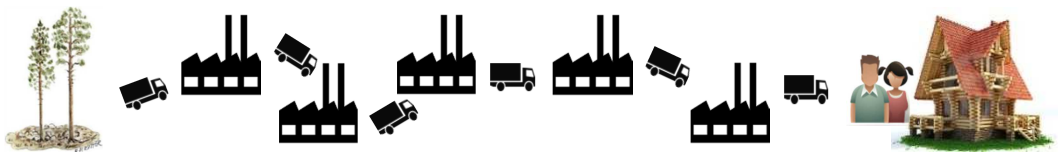


Figure 4 - A value stream mapping-example

During this master thesis, value stream mapping will be used as a descriptive tool based upon secondary data such as company figures, enabling the researchers to understand the supplier-situation within the specific business area of the case company. The map will be complemented with information given from the unstructured interviews made with the plant manager and the purchasing department. Parameters included in the map are the following

- Rejection Rate of every supplier (if registered by the case company)
- Delivery Precision (if registered) and lead time

- Terms of payment (TOP)
- Information- and material streams
- Geographical location

For further description of the supplier situation and the value stream map made, the entire map is presented in appendix D.

Difficulties encountered by the authors during the mapping process are what sort of limitations that must and ought to be made, in order to achieve an accurate picture of the company. Gathering information from different and independent parts of the case company enabled a holistic picture and worked as a mitigation process towards possible subjective thoughts and company views.

2.4. Reliability & Validity

Reliability or factuality are first and foremost aimed towards upright and stand fast studies – scientific research must be accurate and true, meaning that nobody may approve data without further control. One major rule within scientific research and case studies is to always refer to the primary source. As a researcher, being able to fully rely on sources used is extremely important since every statement made is founded upon earlier references (Ejvegård 1996).

Reliability can be assessed by posing the two following questions:

- Will the measure yield the same results on different occasions?
- Will similar observations be made by different researches on different occasions?

Validity is concerned with whether the findings are really about what they appear to be about (Saunders et al. 2000) and mainly – has the researcher measured what he firstly intended to measure and investigate? The importance of validity is to state methods and measures used and to apply these in a consequent manner. Validity is complicated and harder to establish, while reliability is easier (Ejvegård 1996).

There are however threats when assessing the reliability of a study. One threat can be subject error, where the subject analysed or investigated can be affected by some exterior event or feeling. Another threat can be subject bias, where the subject may answer according to its beliefs of how an answer should be.

Observer errors or observer biases are also threats that might occur during the research (Saunders et al. 2000).

This thesis assures both reliability and validity through support by previous research – others have made the same study before, however with different designs of the questionnaire and within different fields. The empirical methodology is never the less the same due to the adapted problem formulation given by Sen et al. (2008), providing this master thesis with proper guidance of what to measure, while assuring that the correct measurements are made. The empirical methodology is therefore applied onto the research field in a structural and planned manner, supporting the validity statement further.

Another aspect of reliability-assurance is the selection process of participants for the survey – the survey investigates the general opinion of what aspects to consider when evaluating and selecting a suitable supplier. Only managerial positions with quality, purchasing and production participated in the survey, together with one assemblyman and one floor manager within the investigated business area, together with the responsible for inventories. All participants were given the survey simultaneously, making it impossible for them to discuss and influence each other's responses, avoiding the threat of external influences.

Reliability of the study is also assured through the actual structure of the semi-structured interviews – by organizing questions beforehand, no subjectivity from the interviewers was allowed. The interviews were also all performed in their natural surroundings, avoiding threats of subject bias.

3. Theoretical Framework

This chapter will clarify several theories used as a foundation for the study according to the research questions stated in the introduction, to finally answer the main purpose of this master thesis.

Theories and how they are separately applied to set the scene to finally answer the purpose of the thesis are visualized below in figure 5 as a holistic flow chart.

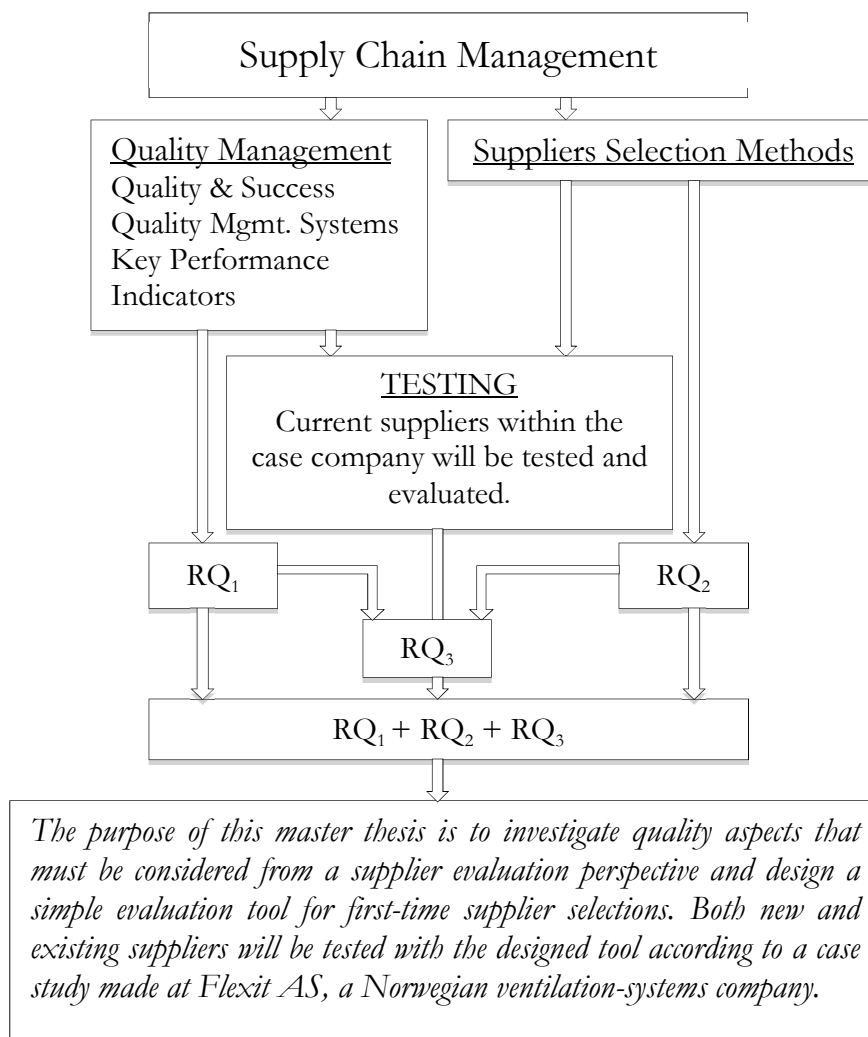


Figure 5 - Flow Chart of Theoretical Framework

3.1. Supply Chain Management

The concept of a supply chain suggests a series of processes linked together to form a chain of events. Inputs, i.e. materials are transformed to outputs in form of goods and services (Harrison & van Roek 2008).

Supply chain management refers to the managerial task of viewing the supply chain as a single entity, keeping materials flowing from source to end-customer. Successful supply chain management relies on forming strategic partnerships with trading partners, such as suppliers, along the supply chain, aiming for pleased customers in every line. Supply chain management strives towards high customer satisfaction through high quality for lowest possible price (Harrison & van Roek 2008) – the quality concept are becoming increasingly more important every day, and companies working with quality and quality improvements have often achieved great success on the market, lower internal costs and shorter design-phases during product development (Bergman & Klefsjö 2010).

3.1.1. Purchasing Management

The role of purchasing and supply management as a business function is to manage the organizations external resources and acquire inputs by the best means possible - Lindgreen et al. 2013.

Manufacturing companies spend approximately 50-70 % of each sales dollar on purchased materials and components – a company's success therefore lies and is heavily influenced by the performance of their suppliers and where they purchase their components (Lee & Drake 2010). Purchasing is the part of the supply chain that manages and nurtures supplier relationships (van Weele 2001).

During the past few years purchasing and supply management as a discipline and business function has changed considerably (van Weele 2001) and are today one of the most critical activities in a manufacturing business (Lee & Drake 2010), being the department making decisions whether or not to continue with a specific supplier (van Weele 2001).

Purchasing has unfortunately not always filled above role and business function – traditionally, purchasing revolved around single transactions or short-term contracts, putting much effort and emphasis on low cost

(Lindgreen et al. 2013) regardless of the supplier or the quality retrieved (Sim et al. 2010).

It was first in the late 1990s a growing need to improve quality and reduce costs in the face of international competition, that led organizations to realize that purchasing and supply management offered enormous potential for strategic decisions regarding costs, risks and value (Lindgreen et al. 2013). The JIT¹ revolution in the 1980s was another reason for purchasing departments to change focus from the dominating pricing structure (Sim et al. 2010) - Moving away from their traditional, operational roles, purchasing and supply managers are now filling more strategic roles in their organizations, focusing on getting better performance and higher quality from suppliers through active management of supplier relationships (van Weele 2001).

The purchasing function of an organization is today to (van Weele 2001);

- Determine the specification (in terms of required quantity and quantities) of the goods and services that need to be bought
- **Selecting the most suitable supplier**
- Preparing and conducting negotiations with the supplier in order to establish an agreement
- Place the order with the selected supplier
- Monitor and control the order (expediting)
- Follow up and evaluate (setting claims, keeping product and supplier files up-to-date, supplier rating and supplier ranking)

3.1.2. Strategic Buyer-Supplier Relationships

Forming strategic relationships ensures successful supply chain management – Strategic relationships with suppliers are of vital importance in order to survive and to respond to customer demands, which usually are high quality products for the lowest possible cost (Waters 2003; Ordoobadi 2009b).

There are different relationships found in the supply chain – relationships between the buyer and supplier are of major importance for further development and future collaboration (Sen et al. 2008). Depending on the type of relationship established between the two parts, different competitive advantages might be gained if nurtured carefully. There are mainly two

¹ The JIT (Just In Time) approach strives towards reduced inventory levels by delivering the right quantity of products at the right time (Bergman & Klefsjö 2010).

different relationships within the supply chain – adversarial competitive and collaborative partnership; tough negotiations, price focus and short-term contracts are characteristics of the adversarial competitive relation, while the collaborative partnership is a direct contrast. - a collaborative partner is based upon cooperation, mutual beneficial aspects and mainly trusts for one another. Today's market and industry moves towards the collaborative partnership away from pricing structures and price focus (Bergman & Klefsjö 2010).

Single Sourcing

There is however always a risk when establishing strategic partnerships along the supply chain. The market tend to move towards long-term relationships with suppliers, putting the company in a situation with only one supplier for each field of required material or component – the supplier is a single source, or the organization is single sourcing the supplier. Single sourcing may be risk filled, leaving the organization in a vulnerable state. If something ought to happen with the supplier, the company in need of materials will be put in a difficult and severe situation (Waters 2003).

A general recommendation to organization with only one supplier is to expand the supply market and lower the supply risk through multi-sourcing, i.e. buying the same materials from several suppliers and divide the risk of a fall-out (Waters 2003).

3.2. RQ₁ - Quality Management

The old purchasing perspective of only selecting suppliers according to a pricing structure, and possibly also according to the lowest price offered, is consequential for customers down the chain. Reasoning only according to price will leave quality issues behind, sourcing out suppliers offering high quality products for a higher price while entering questionable quality onto the market, affecting every customer relationship (Bergman & Klefsjö 2010).

Quality is defined as *the ability to satisfy or preferably exceed the needs and expectations of the customer* - the degree of customer satisfaction is the ultimate measurement of quality (Bergman & Klefsjö 2010). It is important for a company to understand the quality concept and the importance of customer satisfaction.

Quality management is a distinct discipline enabling companies to fully implement and thereafter put focus upon customer-oriented quality. Focus lies within constant and continuous improvements, where values, methodologies

and tools are combined to attain higher customer satisfaction with less resource consumption. Considering the constant pressure companies experience from the market and its competitors, where prices are pushed to its limits, focus must lie towards better quality with constant quality awareness within the entire company (Bergman & Klefsjö 2010).

3.2.1. Quality & Success

Improved quality affects the success and the prosperity of a company in many ways. Examples of such are more satisfied and loyal customers, a stronger market position, shorter lead times and reduced costs due to waste and rework. Poor quality affects a company in the opposite way – production problems, leading to larger buffers and increased stock levels due to higher risk in manufacturing are possibilities that may happen (Bergman & Klefsjö 2010).

Quality has always been an important issue to the customer when buying different products – companies with an innovative and systematic way of working with quality and quality improvements have achieved great success on the market while lowering their internal costs - cost of poor quality in industries are estimated to be 10-30% of actual sales (Bergman & Klefsjö 2010).

Management and leadership set the standard for how the company ought to succeed with quality. Top management must make a commitment towards improved quality by demonstrating this through sincere and serious actions. Management has to be the first ones to implement quality in the everyday work, where after quality can be implemented down the lines in the organization. Importance lies in the leadership role and how the company is managed, if ability to implement quality thinking shall be achievable (Bergman & Klefsjö 2010).

3.2.2. Quality Management Systems

There is one basic recommendation that companies usually follows – creating a reliable company-image together with a truthful product or service, a certification of the company should be assured (Lindgren & Sandell 1994).

The International Organization for Standardization (ISO) has developed a standardized system with ability to evaluate and assess quality and quality management – the system is called the ISO series, whereas quality is measured

according to the ISO 9000 series. The certifications are made by an objective third party, accredited to certify quality systems according to the ISO standards (Lindgren & Sandell 1994; ISO 2013a) – in other words, the organization instituting the standards are not the company issuing the certification.

Assuring quality through a quality certificate can be translated to *do it correctly right away*. According to a survey made in England, 60% of ISO certified companies believed that suppliers certified according to the ISO 9000 series performed better than those not certified (Lindgren & Sandell 1994) - companies therefore usually demands that their suppliers ought to have a documented quality management system (Bergman & Klefsjö 2010). There are over one million organizations in 170 countries worldwide using the ISO-certification system today (ISO 2013c).

Parameters that must be fulfilled and answered for, in order to be certified according to ISO 9000 are the following (ISO 2013b):

- Customer focus – The company must understand current and future needs of their customers
- Leadership – Leaders within the organization should create and maintain the internal environment, involving employees towards achieving company goals
- Involvement of people – Involvement of employees are the essence of encouragement and therefore beneficial for the organization
- Process approach – Manage activities and resources as processes in a continuous manner
- System approach to management – Identify, understand, continuously improve and manage interrelated processes as a system for effectiveness and efficiency
- Continual improvements – Continuous improvements is a must-have objective for every organization working with quality
- Factual approaches to decision making – Effective decisions are based upon analysis of data and information
- Mutually beneficial supplier relationships – An organization and its suppliers are interdependent. A mutually beneficial relationship enhances the ability for both to create value

Requirements involved in the ISO certificate ensures that suppliers clearly understand their customer's needs, in ways in which the supplied products can

be verified according to tools provided along with the certification. Companies without a certification of any kind runs high risks of varying products and services, consequently leading to increased waste, claims, rework and price changes. An ISO certification provides the company with a continued and consequential approach, decreasing variations in both goods and services (Lindgren & Sandell 1994).

It is however no certainty that companies focusing and putting much effort on quality and quality improvements achieves the objective of satisfied customers. The supplier may see its customers as unmotivated with too demanding needs, complicating the suppliers task. By requiring at least the same quality standards from the supplier as the in-house company objectives, frustration and communication failures can be avoided while quantifying the demand into actual figures and words. Quality improvements must be a mutual interest involving both the customer and the supplier (Lindgren & Sandell 1994).

If requiring even higher levels of quality, other certification standards within the ISO system occur. One popular quality standard within the automotive industry is the ISO/TS 16949, since this standard provides harder requirements and higher levels of achievements within quality management. Compared to the ISO 9000 series, suppliers with ISO/TS 16949 certifications deliver less non-conforming products with higher rates of delivery precision, due to an effective in-house quality management (Bergman & Klefsjö 2010). It is important to remember that every market segment has its own quality performance levels – the automotive industry are an extreme example of quality excellence where levels of high quality is increasing every day due to the human safety aspect, the extreme competition on the market and the requirement of traceability of every component included in the car (Volvo 3p 2010). Every industry has its own levels of good and bad quality, but the ISO standards set a minimum level that can be applied onto every industry (Lindgren & Sandell 1994).

There are separate opinions regarding quality certifications and supplier performance. Several companies believe an implementation of a quality system is too time-consuming due to all paper work, and too costs-some, not worth investing in (Lindgren & Sandell 1994). Another study made in England and reviewed by Lindgren and Sandell (1994) criticizes the standardized system of ISO – according to the study, the certification policies has cost the English government billions of Swedish crowns, and as many as 80 % of the companies implementing the standard has failed to deliver satisfactory quality.

The study claim and almost accuse the ISO system of fraud due to severe company failure and money loss (Lindgren & Sandell 1994).

It is important to remember that no standard can ever create business success and business excellence – success is due to how the standard, as well as supportive tools, are used in the daily operative work and within long-term strategic decisions (Bergman & Klefsjö 2010).

3.2.1. Key Performance Indicators

Key performance indicators or KPI's are measurements assessing different performance parameters and used when evaluating the success of a specific company. The figures must coincide with the company's goals, they must be the key to achievement and they must be quantifiable. The different KPI's are chosen by the organization according to their vision and the goals put up (About.com 2014).

KPI's and ISO certifications are both tools for quality improvements and a quality management system. The ISO certificates ensure a continuous development of higher quality levels towards the customer, while KPI's are in-house figures measuring the daily performance of the company towards the market (ISO 2013a).

3.2.2. Volvo Group – An Industrial Example

Volvo Powertrain and Volvo Group is a company where quality together with safety is of vital and decisive importance – due to a clear and emphasized quality management system, Volvo Powertrain is presented in this master thesis as an Industrial Example of quality excellence.

Quality and safety is of extreme importance at Volvo - they evaluate their suppliers every third month according to an evaluation tool designed by the organization – supplier evaluation must be a constant focus and a strong recommendation. According to the senior vice president at Volvo Group Purchasing, suppliers not committed to quality and a zero-defect approach is not worth doing business with. The mission of Volvo purchasing department is to provide the organization with a competitive advantage through quality awareness and quality focus. To maintain a reputation of selling the highest quality and safest products on the market, supplier evaluation and supplier assurance is a constant focus and a necessity for Volvo (Volvo 3P 2010).

According to Volvo Powertrain (2010), supplier quality is assured through quality performance measurements (QPM) and quality management systems. The supplier must be certified according to at least ISO 9000, but preferably according to ISO/TS 16949. The supplier must also share Volvos vision of a “zero-defect attitude”.

QPMs are quantitative figures assessing the supplier according to its individual level of performance within quality and deliverance of products. Assessing quality is achieved through measurements of rejection rates in PPMs - number of non-conforming parts supplied divided to the number of total parts supplied equals the rejection rate (see equation 1 below).

$$(1) \text{ Rejection Rate} = \frac{\text{Non-conformed products}}{\text{Total quantity of Delivered product}} \text{ (Volvo 3p 2010)}$$

This rate must be kept at a certain level if acceptable and tolerable from a customer perspective. At Volvo, the maximum rate of rejection is 10 PPMs (Volvo 3P 2010). It is however important to remember that zero-defects might sometimes not be enough to retain sufficient quality (Bergman & Klefsjö 2010) – in Volvo’s case with objectives of 10 PPM, one deficient article within the wrong set of circumstances might jeopardize the entire truck, and therefore also the security of the individual driving it.

Another important measurement made when assessing suppliers in the Volvo organization, is the delivery precision and the quality aspect of delivering the correct products every time. Delivery precision is measured as the accurate orders delivered in time, divided with the total amount of delivered orders (see equation 2 below).

$$(2) \text{ Delivery Precision, OTD} = \frac{\text{Orders Delivered in time}}{\text{Total Delivered Orders}} \text{ (Volvo 3p 2010)}$$

For Volvo, the acceptable level of delivery precision is 98%, whereas the long-term goal for every supplier must be 100% (Volvo 3P 2010).

3.3. RQ₂– Supplier Selection Methods & Criteria’s

Suppliers play a key role in the supply chain, representing the first linkage in the chain. Managers all over the world have come to realize that they as a company cannot do it without satisfactory suppliers, since strong competitive pressure forces organizations to provide their product and service to customers faster, cheaper and with higher quality – supplier selections has therefore been a major subject to research during the last fifty years (Raut et al.

2010). This chapter will elaborate on current supplier selection methods, whereas different techniques from these studies will be further involved in the development of a new, simple evaluation tool for first-time users.

Categorical Method – The selection of suppliers are made through performance indicators with categorical terms, such as “good/positive”, “fair/neutral” and “poor/negative”. The supplier receiving the most “good” terms is considered best and the supplier to select. This method is usually applied without knowing about it, due to its simplicity and non-complex structure. Disadvantages with this method is the room for subjectivity – the evaluator distributes and grade the supplier according to qualitative measures, with risks of making the evaluation according to experiences, or even personal judgments (Ordoobadi & Wang 2011).

Linear Weighted Average Method – Relative weights are assorted and distributed to the different selection criteria's. The evaluator rates the performance of suppliers with respect to each criterion. This weight is then multiplied with a figure called *criterion importance*, giving a weighted score according to the evaluators' judgment. *Criterion importance*-figures are pre-calculated by the investigator or evaluator before usage (Ordoobadi 2009a).

Dimensional Analysis – The evaluation process involves a series of one-to-one comparisons and can only compare two suppliers at a time. The process is extremely time-consuming and it limits the evaluator through indifferences' about which supplier to select (Ordoobadi & Wang 2011).

Mathematical Programming Methods – This is a category of several different methods applying a mathematical approach to supplier selections. Through heavy mathematical formulations and matrix estimations, the evaluator is subject to a series of different criteria's (just as the other methods) to range. Programming transforms the evaluation of criteria's into different weights and scores, giving the evaluator a quantitative score of which supplier to select. The methods are usually complex and hard to implement, together with specific and demanding pre-work (Raut et al. 2010).

Taguchi loss function – This method includes intangibles in the evaluation and selection of suppliers. These intangibles are classified as the benefits and risks of using a supplier to perform an outsourcing function. The decision maker has certain expectations regarding these intangibles, and when these are not met, a loss occurs. The Taguchi loss function is a mean of measuring this loss

according to benefits and risks, together with a score setting. The supplier who receives the lowest loss score will then be selected to perform the task (used in outsourcing decisions) (Ordoobadi 2009a).

Fuzzy logic method – To capture the subjectivity of decision makers when making and taking complicated decisions regarding suppliers that cannot be expressed in pure numeric scales, a method transforming perceptions and feelings from linguistic terms into different mathematical fuzzy membership functions and numbers has been developed. This method assimilates to the Taguchi loss function where intangibles are evaluated – the fuzzy logic method takes however the concept of subjectivity a bit further. According to Ordoobadi (2009b), subjective manners must be captured in an evaluation situation, since numeric figures limit the evaluator and imprecision associated with perceptions are lost. This method categorizes as a mathematical method, but due to its specialty to transform linguistic terms into figures and capturing the subjective perspective, it stands on its own (Ordoobadi 2009b).

Analytical hierarchy process, AHP – This approach has found widespread applications in decision-making problems worldwide, involving both quantitative and intangible criteria's. AHP can be applied and utilized to identify both the importance of weights for different criteria's and the relative ranking of potential suppliers. The strength lies in its ability to accommodate judgment factors (Raut et al. 2010) - it is a multi-criteria decision making method helping the decision maker facing complex problems with several conflicting and subjective criteria's designed to solve problems when there is more than one criterion to consider (Labib 2010). The difficulty occurred when applying the AHP method is the ignorance of interdependencies among the different decision factors (Ordoobadi & Wang 2011)

The suitability of any of the above models is mainly dependent on three conditions, in order for the models to work and be utilized properly. These parameters are; complexity of the situation, amount of information available on the performance of the suppliers and the importance of the situation (Ordoobadi & Wang 2011).

3.4. Theoretical Summary

Supplier selection is a complicated task – wrong supplier may lead to fatal consequences for every actor down the supply chain and lost end-customers. Supplier evaluation according to different criteria's is therefore of vital

importance for the company seeking new and future suppliers. Companies have traditionally selected suppliers only according to a pricing structure, sourcing out suppliers offering high quality products for higher costs. Development of different evaluation tools and techniques are therefore a hot research topic – methods enabling the purchasing department to assess suppliers according to different characteristics, criteria's and performance indicators, providing an objective view of which supplier to select.

Successfulness towards end-customers is usually derived from successful supply chain management and through expected or exceeding quality. The quality concept is becoming increasingly more important, and companies working with quality, quality systems and quality improvements on an every-day basis are evidence of successfulness through lower internal costs and shorter lead-times (Bergman & Klefsjö 2010) – quality is therefore a foundation, a necessity and an obvious criterion when developing a supplier selection tool.

Well-performed supply chain management and shared quality visions are decided and established through collaborative partnerships between the buyer and the supplier. Mutual beneficial aspects, a shared quality vision and reliance are characteristics given through satisfactory future supplier partnerships (Sen et al. 2008).

Different supplier selection methods have been described throughout the theoretical framework, giving the reader a compressed view of today's supply of selection methods. Different characteristics will be taken from these methods and applied on to a design of a simple supplier evaluation tool, applicable for first-time users and first-time supplier selections. Through benchmarking, Volvo Powertrain will in this master thesis represent a company of quality excellence. The development of the tool will be therefore be supported by the industrial example given by Volvo Powertrain, where quality and quality management systems pervade every corner of the organization.

4. Corporate Description

The reader is introduced to the case company's, its quality management principles and expectations, together with how they currently evaluate and select suppliers.

4.1. Business

Flexit develop, produce and market energy efficient products, services and solutions within houses and office plants through their Air-Handling units, creating a healthy, clean and fresh indoor climate

Flexit's main products are air-handling units, ranging from small to large buildings, entire ventilation systems for houses and production plants, together with central vacuum cleaners - all according to figure 6 (Flexit 2013a).

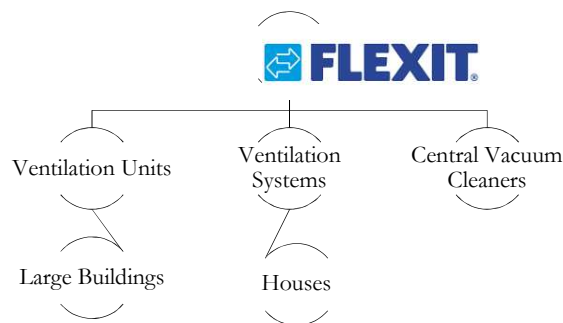


Figure 6 - Main products at Flexit

Flexit is oriented towards a ventilation-systems market involving hardware stores, construction, production and real estate firms – They operate in several markets abroad, whereas their head markets and customers are in Norway and in Sweden. Through different distributors in European countries, they export products and services to Denmark, Finland, Germany, Netherlands, Poland and the Baltic countries. Market shares in Norway are as good as 30 %, stating Flexit as market leaders, while encountering tougher competition in Sweden, resulting in shares of less than 5 % of the market (Flexit 2013a).

Due to overall quality problems within small air handling units, and Chinese components in particular, Spirit UNI 3 is the unit and business area further investigated (Spirit UNI 3 is a small air-handling unit for private houses and

villas). The rotating system² is the component within Spirit UNI 3 that has suffered most due to insufficient supplied goods. To be able to categorize articles within the rotating system, enabling an overall visualization of which products that are of highest economic value, the Pareto principle³ is used.

Figure 7 presents every component included in the rotating system and their purchasing price, after which the Pareto principle narrowed the number of articles down into only a few, in which focus will be put.

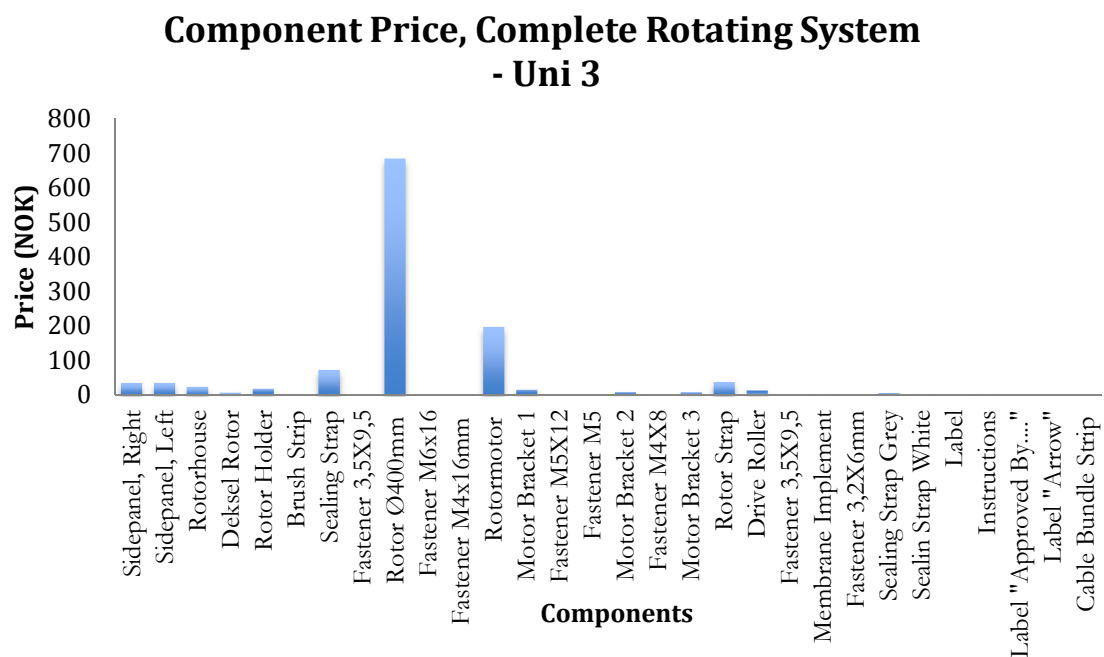


Figure 7 - Component price of complete rotating system

Articles with highest economic value are;

- Rotor: Supplier from Sweden
- Rotor engine: Supplier from China
- Rotor strap: Supplier from Norway & Germany
- Left and right side panel: Supplier from Sweden

Suppliers providing different goods to Flexit within the investigated business area (Spritit UNI 3) are geographically located both within and outside of Europe – for further description of every supplier within Sprit UNI 3, please see appendix D. Focal suppliers further investigated for evaluation are above stated according to the Pareto principle. These suppliers are providing Flexit

² The rotating system is a rotating heat exchanger and the central part in the air-handling unit

³ The Pareto Principle is a rule stating that 80% of the total value comes from 20% of the products used – used as an aid to determine which products to put focus upon (Bergman & Klefsjö 2010).

with individual assembly- and production goods on a continuous basis – no single purchases will therefore be handled or treated.

4.2. Case Area Overview

The Spirit UNI 3 is a steady product on the market – according to Edvinsson⁴ and Lindberg⁵, the annual demand is approximately 5000 units, enabling a stable daily production rate of 24 units. Assembly occurs within the facility plant in Sweden – the effective area of assembly is 4400 m², whereas the rest of the plant consists of inventory area aligned with show room, laboratory, maintenance room and office levels⁵.

Assembling within Flexit consists of a number of operations – an operator puts air-handling units together in a certain order, being responsible for the operation at the same time. The assembly line takes place in between tall shelves, where raw material is stored and gathered when needed. Refill of shelves are controlled by a foreman responsible for a specific air-handling unit, making sure no operator is left without material to work with. The refill system within the production area assures a continuing process flow and a production rate of 24 units a day⁴.

Forecasts for UNI 3 are based upon smooth demand rates, showing a positive future sale image. Forecasts sent to suppliers span over three months from a given start point (see appendix D for further information). They are in turn founded upon data and statistics from an MPS system – a business system where every sale, every product and every cost is represented and calculated for. The MPS handle the details of what is planned and what is happening (Harrison & van Hoek 2008). Based upon forecasts from Flexit, suppliers may adjust their production accordingly, trying to assure that communication, lead-time and delivery precision coincide.

Overall management at Flexit uses policies and document to establish different regulations and requirements – or wishes for the company staff to uphold. According to these documents, different policies regarding quality management, quality assessment and supplier selections are daily used.

⁴ Conny Edvinsson: Sub-Ordering Assistant Sweden & EU. Interview at the 12th of February 2014.

⁵ Mikael Lindeberg, Production Manager, Interview at the 12th of February 2014. All further references to Lindeberg are referring to this interview.

4.3. Today's Quality Management

Flexit has one manager responsible for every activity associated to quality and quality performance within the company – his role includes documentation of quality management, while upholding a continuous and constant work towards better quality in Flexit's own products. According to Larsson⁶, Flexit is however not certified according to any ISO standard or equivalent, hampering any work or implementation of a continuous quality approach.

Flexit uses KPI's, or performance figures as quantitative goals – the quality goal set towards their customers' are 1300 PPM. This value is however very misleading, since the measurements and calculations of Flexit's quality defect rate is comparing rejection claims and delivered products. Rejected claims may be only one, but the amount of products returned due to one claim might be several. The rate and figure calculated is therefore always better, giving a lower PPM than the actual figure if calculated correctly⁶.

Quality assurances and quality controls are not a standardized procedure at the production plant, due to inexistent standards. There is no delivery control or follow-up procedure when goods are arriving at the factory. Goods are unloaded and placed in stock immediately at arrival. Due to no quality control at arrival, insufficient goods will only be detected by the people working in the assembly line – there is therefore stated as an individual responsibility to make a claim when deficient goods appear in the assembly line⁷.

When a non-conformed or insufficient article is brought to the assembly, only one claim of that particular article is filed, even if the box contains more than one non-conforming product – the entire load or pallet is not checked for other non-conformed products that might occur later in the assembly. The claims are filed as a paper copy – in early January 2014 a digital system of filing the claims electronically was instated, to make monitoring and controls easier for the quality manager and the production manager. This has unfortunately made it very hard when trying to investigate and create an accurate image of the quality handling within the company.

Despite this behaviour, there is no established line of action of how to manage these non-conformed products. Some of the workers inform the head of assembly of the non-conforming products, while others puts the non-

⁶ Anders Larsson, Quality Manager, Interview at the 10th of April 2014. All further references to Larsson are referring to this interview.

⁷ Semi-structured interviews with the assembly-men in UNI 3 at the 23th of April 2014 – see appendix A for further details.

conforming product on a trolley placed in the assembly area, together with a paper-claim marked with part number and the cause of error. The trolley is moved once a week to the inventory office that documents the different claims in the electronically installed computer log.

The workers have in general good experiences of the quality brought by the case company's different suppliers. There is however one overall concern bothering the assemblymen – the high occurrence of unacceptable and poor quality of the rotor engine. One general wish is therefore an implementation of a standardized approach, improving insufficiencies in the assembly area - for further comments from the semi-structured interviews with the assemblymen, please see appendix A.

4.4. Current Supplier Selection Method

Supplier evaluation is a key element in the industrial purchasing process and appears to be one of the major activities professional industries should and would put focus on (Raut et al. 2010). The purchasing department at Flexit uses a supplier policy as a guideline when assessing suppliers – Flexit states in one of their policies that “*purchasing will establish effective and rationale purchasing systems towards their suppliers on a professional level and they should only use suppliers that comply with demands and expectations from Flexit - Suppliers should have a working quality assurance system according to ISO 9001, together with standards and regulations suited for ISO 14001*”. Today's purchasing system at Flexit is run and controlled by a purchasing manager and one purchasing assistant, selecting and evaluating suppliers according to experience, subjective estimations, earlier relationships, and mostly price.

According to Buer⁸, the supplier situation is quite fragile, since Flexit is situated in China with a large warehouse, built up for support and ease when purchasing products from the Asian domestic market. Buer⁸ is positioned in Norway and runs the warehouse along with all contact information to China. He single-handily selects domestic suppliers from China according to quality, logistic solutions and cost, after which these domestic suppliers deliver their products to the Chinese warehouse with no further forecast of future demand curves. The evaluation process of domestic, Chinese suppliers is a continuous process – suppliers are currently single sourced depending on what sort of

⁸ Petter Buer, Manager China Relations, Interview at the 7th of March 2014. All further references to Buer are referring to this interview.

products they are offering, but future plans towards backup is a work-in-progress⁸.

The mentality and attitude towards Chinese suppliers and products are different, depending on whom within Flexit you might ask or talk to. The main purpose for the manager of the Chinese warehouse is to find reliable, stable domestic Chinese suppliers that offer high-quality products for a low price.

The warehouse in China is divided into two parts – the part that belongs to Flexit contains large inventories of purchased Chinese goods, while the other part is a Chinese production facility, says Berglund⁹. This facility split the goods into larger batches suited for pallets and containers, to later pack these batches for transfer into the first warehouse part govern by Flexit. Flexit has chosen this warehouse layout for one main reason – ownership in China is complicated and a large bureaucratic process⁹.

Back in Norway, one assistant put purchasing orders to the warehouse in China regarding existing products delivered from domestic, Chinese suppliers. He tries to assure a stable product flow, but the products are however randomly delivered from China to both Sweden and Norway. According to Braarud¹⁰, lead-times from China are nine weeks – these nine weeks are divided into three weeks of booking and shipping confirmations, together with 6 weeks of delivery time. These weeks are an estimated lead-time, where additional time has been added by Flexit, due to lead-time deviations and delays when the supplied products are from a country far away.

The products from China and the Chinese warehouse represent one main group of goods and articles where quality deficiencies have been and are a current problem for the assembly production in Flexit – there is however only one insufficient product within the rotating system supplied from the Chinese warehouse (the rotor engine). Quality assurances and quality systems have been implemented in the Chinese part of the warehouse according to Flexit policies, but there are still high rates of quality deficiencies slipping through⁷. Since the purchasing department lack a supplier evaluation system, larger volumes are purchased and put into stock - as a consequence due to high

⁹ Jörgen Berglund, Purchasing Assistant, Interview at the 6th of February 2014. All further references to Berglund are referring to this interview.

¹⁰ Roger Braarud, Sub ordering Assistant, Purchasing China, Interview at the 7th of March 2014.

volumes, inventory levels are higher than recommended and stock build-ups are regrettably increasing every day if quality rates do not improve.

5. Empirical Results

The reader is presented to the empirical results obtained during the case study according to research question one and two. Research question three is further elaborated on in the chapter 6.

5.1. RQ₁

- **What aspects must be considered and involved from an evaluating perspective, if assessing a supplier according to quality?**

To be able to compete on the market and uphold a competitive edge, quality management and quality awareness is imperative. According to Bergman & Klefsjö (2010), quality and success are aligned with one another through customer satisfaction by meeting and exceeding customer needs and expectations. Ever since the quality revolution in the early 1980s, the quality concept pervades every department and every organization in one-way or another – especially when assessing a supplier and selecting appropriate suppliers. Every company is in search for the highest possible quality for the lowest possible price (Ordoobadi & Wang 2011) – understanding what aspects that must be considered when evaluating different suppliers according to quality is therefore the first step towards a successful selection of suppliers and supply chain management (Kermani et al. 2011).

As a result due to quality problems within a specific business area and with a specific supplier, the case company is buying larger volumes and buffering high levels of reserves in stock, instead of evaluating suppliers according to criteria's other than price. For a company only evaluating suppliers according to price, but interested in introducing other evaluation aspects as well, only the most basic applications can be considered (at first).

Fundamental aspects that must be considered when evaluating supplier quality are therefore the following (Bergman & Klefsjö 2010; Lindgren & Sandell 1994; Volvo 3P 2010; ISO 2013b):

- Certification according to a Quality Management System; ISO 9000 (or equivalent) or higher

- Assessment according to Quality Performance Measurements – Rejection Rate (PPM) & Delivery Precision (%)

According to Lindgren and Sandell (1994) the levels of quality should be put according to the in-house quality standards, in line with the company's quality expectations – according to the case study made, quality assessments should therefore be set after own quality objectives and KPI's at the case company, to avoid confusion and frustration between the case company and their different suppliers. The KPI's found (relevant ones only) at the case company are:

- **Quality**
Definition – Amount of claims in relation to amount of sold articles
Objective – 1300 PPM
- **Lead Time**
Definition - Process time from order intake to delivery
Objective - 5 weekdays (small air-handling units)
- **Forecast accuracy**
Definition – How well the forecasts are in line with actual outcome
Objective – 80%

Highest acceptable rejection rate is 1300 PPM, according to the KPI's put up by the case company. Since other quality aspects, such as delivery precision is not a stated KPI, the interview with the plant manager - Jonsson¹¹, lead to an agreement of a lowest acceptable level of delivery precision for future evaluation of suppliers to 94%.

Other qualitative parameters that should be considered according to the literature study made (Bergman & Klefsjö 2010; ISO 2013b), when assessing suppliers according to quality, are:

- Supplier Vision – the supplier should have a shared quality vision
- A Quality-Committed In-house Management Team

To ensure high quality and satisfied customers in every supply step and linkage, suppliers with a shared quality view is extremely important. This requirement is aligned with shared quality objectives set after in-house requirements, to avoid confusion and frustration between actors.

¹¹ Ulf Jonsson, Plant Manager Sweden, Interview at the 6th of February 2014. All further references to Jonsson are referring to this interview.

The last parameter that should be considered when assessing suppliers from a quality perspective is the existence of a quality-committed in-house management team. If suppliers ought to have sufficient quality on their products, the company and above all, the management team must consider quality and quality systems important.

5.2. RQ₂

- **How can a simple supplier selection tool be designed according to a company looking to introduce a structured approach for supplier selection?**

To further develop the concept of supplier evaluation and selection of appropriate suppliers, considering not only price but other criteria's as well, development of an evaluation tool has been made, simplifying future supplier selections. The tool is aimed towards companies looking to introduce a structured approach within supplier selections.

The previous research question elaborated on quality and the quality concept regarding suppliers, together with what sort of parameters that must be considered if evaluating a supplier from a quality perspective. These parameters have been considered when developing the supplier evaluation tool for future supplier assessments, and also included in the evaluation tool. Other criteria's to consider has been derived through a survey, where the results are presented in the next section.

5.2.1. Survey Results

The survey result is presented below in figure 8.

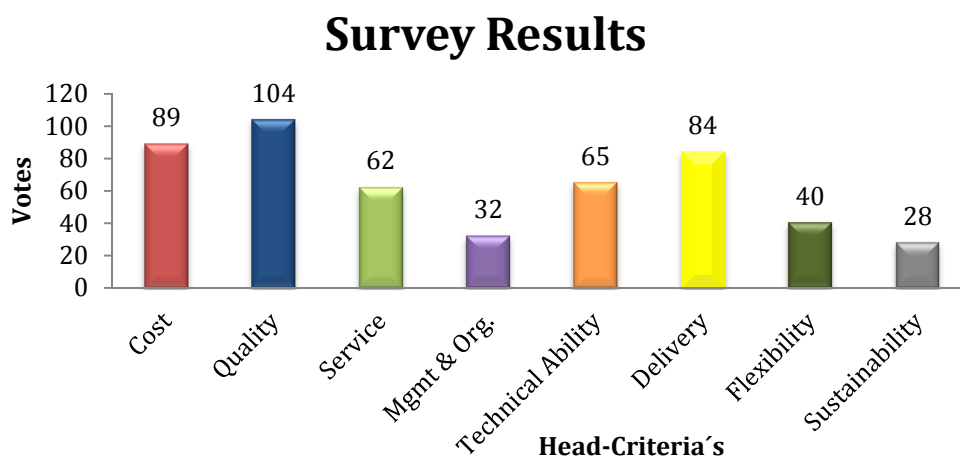


Figure 8 - Survey Results

Due to the survey result, the amount of criteria's and which criteria's that ought to be considered from a first-time evaluator point-of-view is given through the distinct difference between votes received – Quality, Delivery, Cost, Technical Ability and Service received highest amount of votes.

The criteria's and aligned sub-criteria's to be further investigated and included in the evaluation tool is presented in figure 9 and 10 below:

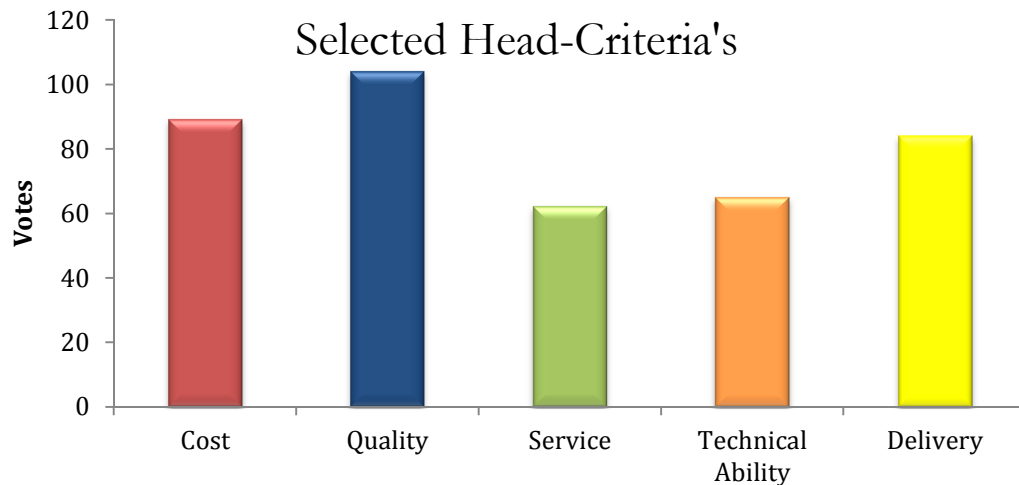


Figure 9 - Selected Head Criteria's

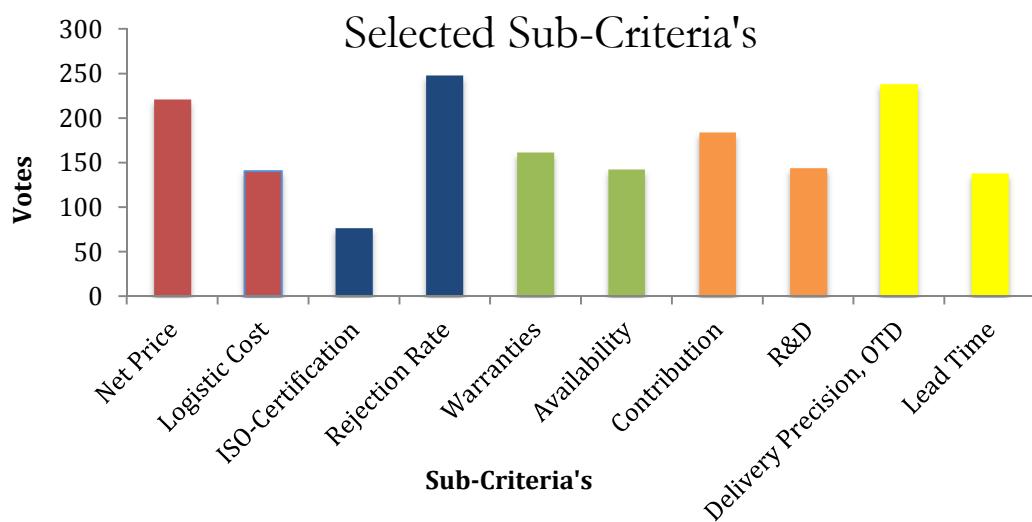


Figure 10- Selected Sub-Criteria's

According to the survey result, flexibility, sustainability, management and organizational aspects will not be further investigated or involved in the evaluation tool due to few votes. For an overall visualization of the different head- and sub-criteria's involved in the evaluation tool, please see figure 11 on the next page.

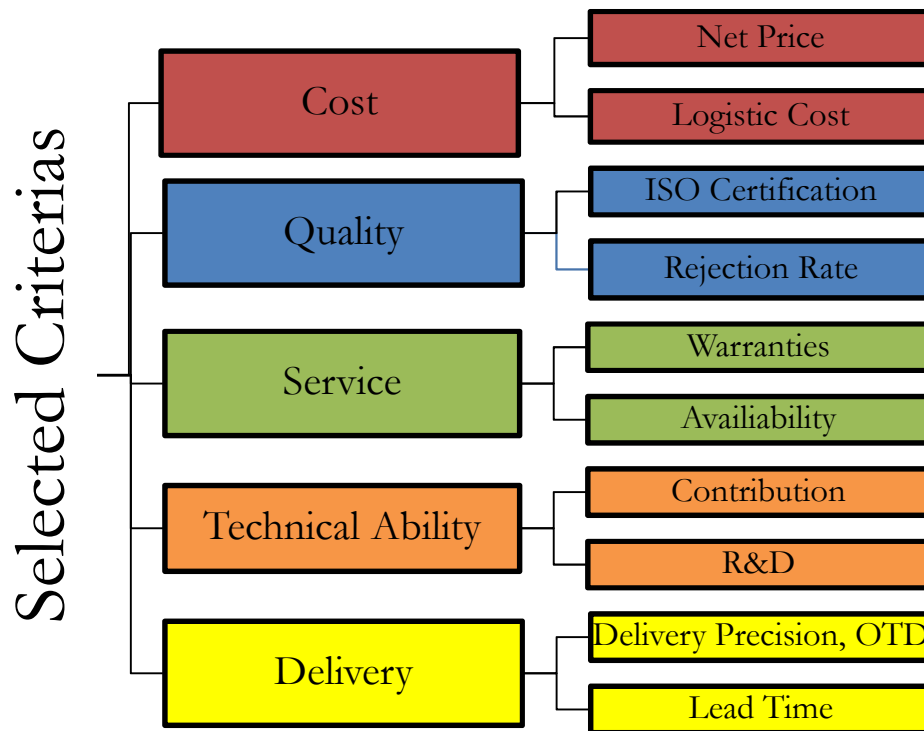


Figure 11 - Overall selected criteria's

5.2.2.Evaluation Tool

The design of the evaluation tool is based upon a mixture of previous research by Ordoobadi and Wang (2011) and within hierarchal supplier selection methods, due to satisfactory results presented by Raut et al (2010). The design is focused towards simplicity and for first-time users, since the case company currently selects suppliers only according to price. Simplicity and first-time utilization are also considered as a need and research gap, due to Sen et al. (2008) research presenting too complex implementation procedures of mathematical programming methods.

To be able to create a hierarchal structure of the evaluation tool, two levels of criteria's are made in-line with the design of the survey. The first level consists of qualifying criteria's that must be fulfilled by the supplier, in order to be further assessed by the evaluating company. The second and lower level of the tool involves supporting criteria's, used solemnly when a supplier passes the first level of qualifying criteria's. Usage of qualifying criteria's is in-line with Dickson's research-foundation in 1966 – he stated that qualifying criteria's are essential for the evaluation and that purchasers ought to put focus upon these.

Categorization of both qualifying criteria's and supporting criteria's are made with the results given from the survey. Qualifying criteria's had votes representing approximately one fourth to one fifth of the votes, whereas the supporting criteria's had roughly 17% of the votes. The categorization is presented in figure 12.

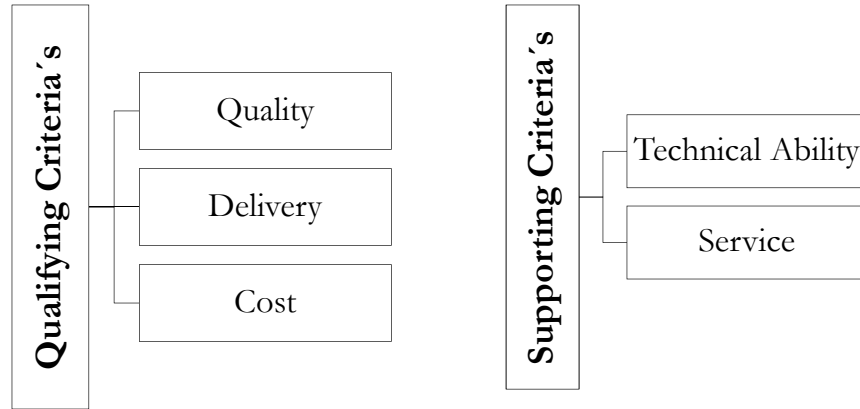


Figure 12 - Categorization of criteria's

Weights & Points

In order to reflect the different survey results on to the evaluation tool, different weights are assigned to the criteria's according to successful results presented by Ordoobadi & Wang (2011), Raut et al. (2010), Sen et al. (2008) and Sim et al. (2010) when using weights. To make the evaluation quantified, points are distributed to the different criteria's according to the calculated weights. The points given to each criterion are further divided into sub-points with regards to the sub-criteria's. Weights for each individual criterion are calculated with formulas presented below, together with figure 13. Distributed points for every criterion will be presented in the next section.

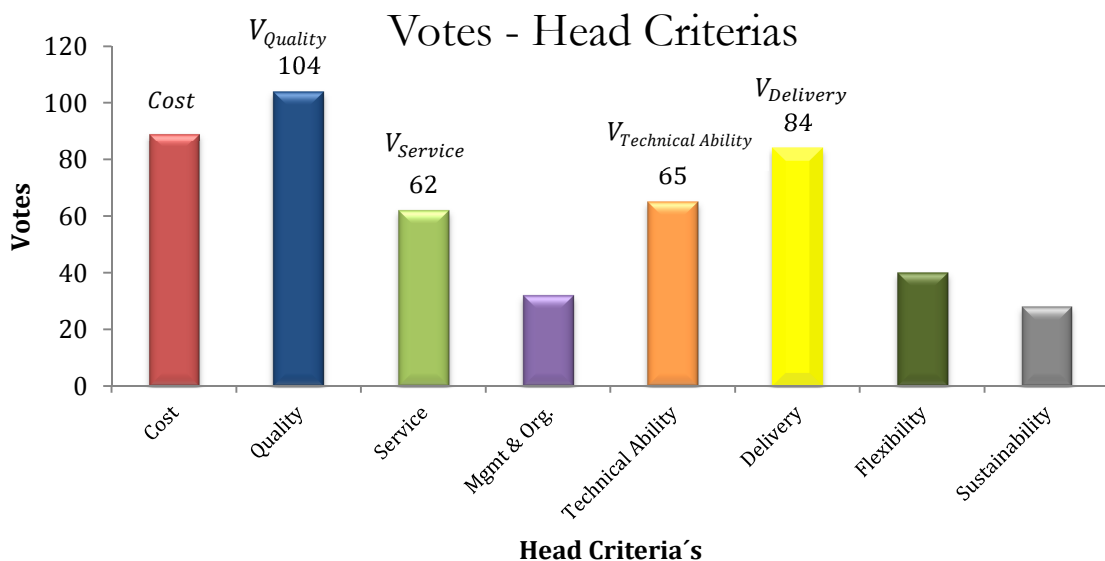


Figure 13 –Points assigned to the Head Criteria's

By summarizing the votes of only the selected head-criteria's, a total amount of votes are received - $V_{Total(HC)}$. Through this total amount of votes, an individual weight-ratio (WR) for every head-criterion can be calculated according to equations 3 to 11.

The cost criterion, in contrast to the other criteria's, is valued after the actual size of the total cost - the parameters used in the supplier selection tool are *Net Price* and *Logistic Cost* (derived from the survey). This criterion is therefore excluded of the scoring system calculated below.

$$(3) \quad \begin{aligned} V_{Quality} + V_{Service} + V_{Technical\ Ability} + V_{Delivery} &= V_{Total(HC)} \\ V_{Total(HC)} &= 104 + 62 + 65 + 84 = 315 \end{aligned}$$

Weight-ratio Quality:

$$(4) \quad \frac{V_{Quality}}{V_{Total(HC)}} = WR_{Quality} (\%), \quad \frac{104}{315} = 0,330$$

Weight-ratio Service:

$$(5) \quad \frac{V_{Service}}{V_{Total(HC)}} = WR_{Service} (\%), \quad \frac{62}{315} = 0,197$$

Weight-ratio Technology:

$$(6) \quad \frac{V_{Techn.Ability}}{V_{Total(HC)}} = WR_{Technical\ Ability} (\%), \quad \frac{65}{315} = 0,206$$

Weight-ratio Delivery:

$$(7) \quad \frac{V_{Delivery}}{V_{Total(HC)}} = WR_{Delivery} (\%), \quad \frac{84}{315} = 0,267$$

A supplier may receive a total of 1000 points in the evaluation tool. These points will be divided between the different head-criteria's using the weight-ratio computed above. The different individual points given to every head-criterion are calculated below.

Maximum points for the Quality-criterion - $Quality_{Max}$ are:

$$(8) \quad WR_{Quality} \cdot 1000 = Quality_{Max}, \quad 0,330 \cdot 1000 = 330 \text{ points}$$

Maximum points for the Service-criterion - $Service_{Max}$ are:

$$(9) \quad WR_{Service} \cdot 1000 = Service_{Max}, \quad 0,197 \cdot 1000 = 197 \text{ points}$$

Maximum points for the Technology-criterion - $Techn_{Max}$ are:

$$(10) \quad WR_{Techn.Ability} \cdot 1000 = Techn_{Max}, \quad 0,206 \cdot 1000 = 206 \text{ points}$$

Maximum points for the Delivery-criterion - $Delivery_{Max}$ are:

$$(11) \quad WR_{Delivery} \cdot 1000 = Delivery_{Max}, \quad 0,267 \cdot 100 = 267 \text{ points}$$

Different individual points are assigned to the different sub criteria's as well, according to the same calculations as the head-criteria's. For visualization, see figure 14.

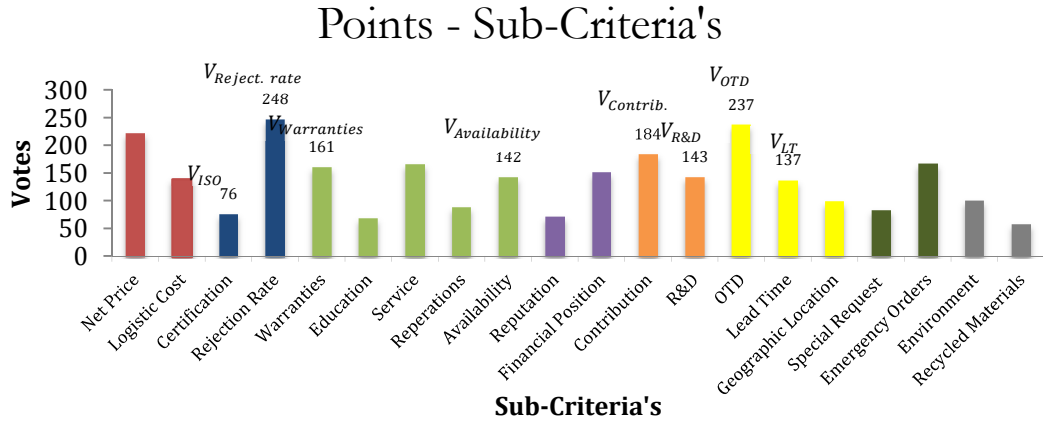


Figure 14 - Points assigned to Sub-Criteria's

The total amount of points given to each head-criterion represent the maximum amount of points available for an individual division between the aligned sub-criteria's – a division where the sub-criteria's will be weighted in relation to each other (according to the survey result) within the same head-criterion. These calculations are below presented in equation 12 - 31.

Quality Criterion:

By summarizing the different points calculated according to equation 3 to 10, a weight-ratio (WR) for every sub-criterion within one head-criterion are calculated. A maximum score can thereafter be calculated for each sub criterion:

$$(12) \quad V_{ISO} + V_{Reject. rate} = V_{Quality total}, \quad 76 + 248 = 324$$

Weight-ratio *Certification* - (WR_{ISO}):

$$(13) \quad \frac{V_{ISO}}{V_{Quality total}} = WR_{ISO}(\%), \quad \frac{76}{324} = 0,234$$

Maximum points for the *Certification-criteria* - (ISO_{Max}):

$$(14) \quad WR_{ISO} \cdot Quality_{Max} = ISO_{Max}, \quad 0,234 \cdot 330 = 77 \text{ points}$$

Weight-ratio *Rejection Rate* - ($WR_{Reject. rate}$):

$$(15) \quad \frac{V_{Reject. rate}}{V_{Quality total}} = WR_{Reject. rate} (\%), \quad \frac{248}{324} = 0,765$$

Maximum points for the *Rejection Rate-criteria* - ($Reject. rate_{Max}$):

$$(16) \quad WR_{Reject. rate} \cdot Quality_{Max} = Reject. rate_{Max}, \quad 0,765 \cdot 330 = 253 \text{ points}$$

This procedure is repeated for all sub criteria's according to further calculations below.

Service Criterion:

$$(17) \quad V_{Warranties} + V_{Availability} = V_{Service total}, \quad 161 + 142 = 303$$

Weight-ratio *Warranties* - ($WR_{Warranties}$):

$$(18) \quad \frac{V_{Warranties}}{V_{Service total}} = WR_{Warranties} (\%), \quad \frac{161}{303} = 0,531$$

Maximum points for the *Warranty-criteria* - ($Warranties_{Max}$):

$$(19) \quad WR_{Warranties} \cdot Service_{Max} = Warranties_{Max}, \quad 0,531 \cdot 197 = 105 \text{ points}$$

Weight-ratio *Availability* - ($WR_{Availability}$):

$$(20) \quad \frac{V_{Availability}}{V_{Service total}} = WR_{Availability} (\%), \quad \frac{142}{303} = 0,468$$

Maximum points for the *Availability-criteria* - ($Avilability_{Max}$):

$$(21) \quad WR_{Avilability} \cdot Service_{Max} = Avilability_{Max}, \quad 0,468 \cdot 197 = 92 \text{ points}$$

Technical Ability-Criterion:

$$(22) \quad V_{Contrib.} + V_{R\&D} = V_{Techn.ability total}, \quad 184 + 143 = 327$$

Weight-ratio *Contribution* - ($WR_{Contrib.}$):

$$(23) \quad \frac{V_{Contrib.}}{V_{Techn.ability total}} = WR_{Contrib.} (\%), \quad \frac{184}{327} = 0,563$$

Maximum points for the *Contribution-criteria* - ($Contrib._{Max}$):

$$(24) \quad WR_{Contrib.} \cdot Techn. Ability_{Max} = Contrib._{Max}, \quad 0,563 \cdot 206 = 116 \text{ points}$$

Weight-ratio *R&D* - ($WR_{R\&D}$):

$$(25) \quad \frac{V_{R\&D}}{V_{Techn.Ability total}} = WR_{R\&D} (\%), \quad \frac{143}{327} = 0,437$$

Maximum points for the *R&D-criteria* - ($R\&D_{Max}$):

$$(26) \quad WR_{R\&D} \cdot Techn. Ability_{Max} = R\&D_{Max}, \quad 0,437 \cdot 206 = 90 \text{ points}$$

Delivery Criterion:

$$(27) \quad V_{OTD} + V_{LT} = V_{Delivery\ total}, \quad 237 + 137 = 374$$

Weight-ratio *OTD* - (PR_{OTD}):

$$(28) \quad \frac{V_{OTD}}{V_{Delivery\ total}} = WR_{OTD}(\%), \quad \frac{237}{374} = 0,634$$

Maximum points for the *OTD-criteria* - (OTD_{Max}):

$$(29) \quad WR_{OTD} \cdot Delivery_{Max} = OTD_{Max}, \quad 0,634 \cdot 267 = 169 \text{ points}$$

Weight-ratio *Lead Time* - (WR_{LT}):

$$(30) \quad \frac{V_{LT}}{V_{Delivery\ total}} = WR_{LT}(\%), \quad \frac{137}{374} = 0,366$$

Maximum points for the *Lead Time-criteria* - (LT_{Max}):

$$(31) \quad WR_{LT} \cdot Delivery_{Max} = LT_{Max}, \quad 0,366 \cdot 267 = 98 \text{ points}$$

Intervals

According to Volvo Powertrain (2010), performance measurements ought to be divided into intervals, whereas the supplier ends up in any of these intervals depending on individual performance. Tolerances for every performance measurement are set together with the case company¹¹, giving every qualifying criterion an acceptable range – this range is thereafter divided into intervals.

The intervals are in this thesis divided into three, four or five different ones according to the in-house policies and judgments made by the case company, equally large within the tolerance range and according to the linear weighted average model (equal amount of extra points is given for every higher level).

The levels of acceptance for each qualifying criterion are individually set together with the case company¹¹, in-line with their supplier expectations and demands. Levels of acceptance are the lowest possible point given and the lowest level a supplier may end up in – if not, the supplier will not be given any point for that particular criterion.

The results from the point-distribution based upon previous weight calculations, and the division of intervals are presented below in a set of tables (table 1-6), starting with quality.

Qualifying Criteria's

Quality

The intervals of acceptable rejection rate are presented with its aligned points in table 1 below, where the fifth interval represents levels of unacceptance.

Table 1 - Intervals of Rejection Rate

Interval	Rejection Rate (PPM)	Points Given
1	0-325	253
2	326-650	190
3	651-975	127
4	976-1300	64
5	1301-	0

The ISO certification aspect is also divided into different levels, depending on the degree of certification. These levels were decided together with the case company's quality manager⁶.

The intervals accepted by the quality manager are presented in table 2 below:

Table 2 - Intervals of Certification

Interval	Certification Level	Points Given
1	ISO/TS 16949	51
2	ISO 9001	26
3	No certification	0

Delivery

The delivery aspect has two sub-criteria's. Both of these require quantified figures, and just as the rejection rate, these are divided into intervals of acceptance as well. OTD has an acceptance level of 94% and above, according to table 3 presented on the next page.

Table 3 - Intervals of Delivery Precision, OTD

Interval	OTD (%)	Points Given
1	98 and above	169
2	97	135
3	96	101
4	95	67
5	94	34

5 weekdays are the lead time-objective set for the case company when delivering small air-handling units to end-customers, making this an objective for supplier expectations as well. The intervals given in the lead-time aspect are presented in table 4 below:

Table 4 - Intervals of Lead-Time

Interval	Lead-Time (days)	Points Given
1	5-7	98
2	8-14	74
3	15-21	49
4	22-28	25
5	29-	0

For a supplier to be accepted and approved as a qualifying supplier, the supplier must perform within the acceptable intervals. Due to the sub-criteria's independent importance's, approval of a supplier is only achieved if the supplier receives at least 64 points within rejection rate – rejection rate is deemed more important than a certification, and 100 points within delivery (either well-performed precision, or short lead-times will give the supplier sufficient points).

Supporting Criteria's

Due to supporting functions without performance measurements, the supporting criteria's are not further divided into intervals with individual point-ranges. Both technical ability and service have both two sub-criteria's

considered important given the survey results – these two sub-criteria’s give the evaluator the possibility to assess the supplier accordingly, and thereafter answer either yes or no depending on supplier performance. If the evaluator writes “Yes”, the supplier is given points according the survey results. Explanations of every sub-criterion are to be found in the appendix C – the same explanations given to the survey group.

Technical Ability (Technology in the Tool)

The sub-criteria’s evaluated from a technical ability-point of view are contribution and research and development (R&D). If the supplier contributes to the in-house company’s product development, the evaluator writes “Yes” in the text field. If the company experiences no contribution within technical abilities, the evaluator writes “No”.

R&D evaluates if the supplier runs a separate product development-department, with an objective to constantly and continuously improve products purchased by the in-house company. If the supplier fulfils and upholds an R&D-department, the evaluator writes “Yes” in the text field. If not, the evaluator writes “No”.

The sub-criteria’s are given points according to table 5 below.

Table 5 - Points assorted to the technical ability criterion

Sub-Criterion	Points Given if Yes
Contribution	116
R&D	90

Service

In line with the first supporting criterion, service has two sub-criteria’s as well – both availability and warranties are here to be assessed. Availability handles the aspect of whether or not the supplier is available from a service-point of view – available in terms of customer centres, inconvenient work hours and ability to receive emergency orders. If the supplier upholds these service functions, the evaluator writes “Yes” in the text field, just as before.

Warranties handle the matter of how the supplier assures the in-house company of safe purchases. Is the in-house company provided with reasonable terms of payment and proper return-conditions? If the supplier upholds these

functions when purchasing goods, the evaluator writes “Yes” in the text field. The sub-criteria’s are given points according to table 6 on the next page.

Table 6 - Points assorted to the Service criterion

Sub-Criterion	Points Given if <i>Yes</i>
Availability	105
Warranties	92

As a final step, the different categories of criteria’s are outlined together with its individual weight. Supplementary parameters such as supplier name, date and membership within EU are added to the design to make it applicable and user-friendly.

Membership within EU is added due to the case company’s structure with Chinese suppliers – supplying products outside of EU are cost-some, due to additional freight- and toll costs - if a member of EU, an additional logistic cost of 2% of the net price will be added to the total cost, whereas a supplier outside EU will have an additional logistic cost of 8% of the net price. Further explanations and guidelines of how to use the tool are addressed in appendix E.

The final layout and design of the evaluation tool is presented below. Figure 15 represents a simple overall visualization of the spreadsheet.

Evaluation Tool - Existing Suppliers									
Supplier	Name of Supplier		IF QUALIFYING CRITERIAS=		Continue to SUPPORTING CRITERIAS.				
Date	XX/XX-2014		IF QUALIFYING CRITERIAS=		The recommendation is to select another supplier.				
Within EU	Yes/No								
QUALIFYING CRITERIAS									
Quality Max 330 Points			Delivery Max 267 Points			Cost			
Rejection Rate	PPM		OTD	%		Net Price	kr		
ISO 9001	Yes/No	Yes/No	Lead Time	Days		Logistic Cost	kr		
ISO/TS 16949	Yes/No	Yes/No	Total			Total			
SUPPORTING CRITERIAS									
Technology Max 206 Points			Service Max 197 Points						
Contribution	Yes/No	Yes/No	Availiability	Yes/No	Yes/No				
R&D	Yes/No	Yes/No	Warranties	Yes/No	Yes/No				
Total			Total						

Figure 15 – Final layout of the evaluation tool

The grey fields are to be filled in by the evaluator, where after the fields at the end of each column at the qualifying level turns into either red or green, depending on how the assessed supplier performs according to the different criteria’s. Suppliers will be approved and recommended for further collaboration if both the qualifying criteria’s turn green. If any of the two turns

red, the recommendation is to consider another supplier. Figure 16 below presents a brief explanation of how to proceed when the fields of the qualifying criteria's is coloured – this figure is also included in the tool, previously presented in figure 15.

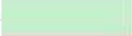

IF QUALIFYING CRITERIAS=		Continue to SUPPORTING CRITERIAS.
IF QUALIFYING CRITERIAS=		The recomendation is to select another supplier.

Figure 16 – A visual recommendation on how to proceed when the qualifying criteria's is coloured in the supplier selection tool.

The cost column will be neither red nor green – it will only display a total cost of the included cost parameters. The total cost given must hereafter be further assessed by the evaluator and compared to other similar products.

6. Test Results

To visualize and display in which criteria's insufficiencies occur, the newly developed tool was applied onto current supplier for the case company. A new potential supplier was exposed to the test as well, answering the last research question. The test also carried a purpose of assessing the actual tool for possible advantages and errors, together with aspects of further improvements that can be made.

6.1. Test - Existing Suppliers

The results from the four different tests are presented in the following four figures (17-20), where after figure 21 summarizes the different results of the supplier evaluation. The test-results from assessing a new potential supplier are presented in the next section.

Evaluation Tool - Existing Suppliers									
Supplier	Supplier A		IF QUALIFYING CRITERIAS=		Continue to SUPPORTING CRITERIAS				
Date	2/5/2014		IF QUALIFYING CRITERIAS=		The Supplier is insufficient, the recommendation is to select another supplier				
Within EU	No								
QUALIFYING CRITERIAS									
Quality Max 330 Points Rejection Rate PPM 0 253p ISO 9001 Yes/No No ISO/TS 16949 Yes/No No Total 253p			Delivery Max 267 Points OTD % 88 p Lead Time Days 50 p Total p			Cost Net Price kr 37,02 k Logistic Cost kr 39,98 k Total 77,00 k			
SUPPORTING CRITERIAS									
Technology Max 206 Points Contribution Yes/No - R&D Yes/No - Total p			Service Max 197 Points Availability Yes/No - Warranties Yes/No - Total p						

Figure 17 - Test: Supplier A

Evaluation Tool - Existing Suppliers									
Supplier	Supplier B		IF QUALIFYING CRITERIAS=		Continue to SUPPORTING CRITERIAS				
Date	2/5-2014		IF QUALIFYING CRITERIAS=		The Supplier is insufficient, the recommendation is to select another supplier				
Within EU	Yes								
QUALIFYING CRITERIAS									
Quality Max 330 Points Rejection Rate PPM 0 253p ISO 9001 Yes/No Yes 26 ISO/TS 16949 Yes/No No - Total 279p			Delivery Max 267 Points OTD % 95 67p Lead Time Days 5 90p Total 165p			Cost Net Price kr 682,00 k Logistic Cost kr 695,64 k Total 1 377,64 k			
SUPPORTING CRITERIAS									
Technology Max 206 Points Contribution Yes/No Yes 116p R&D Yes/No Yes 90p Total 206p			Service Max 197 Points Availability Yes/No Yes 105p Warranties Yes/No Yes 92p Total 197p						

Figure 18 - Test: Supplier B

Evaluation Tool - Existing Suppliers									
Supplier	Supplier C		IF QUALIFYING CRITERIAS=		Continue to SUPPORTING CRITERIAS				
Date	2/5/2014		IF QUALIFYING CRITERIAS=		The Supplier is insufficient, the recommendation is to select another supplier				
Within EU	Yes								
QUALIFYING CRITERIAS									
<u>Quality</u>			<u>Delivery</u>			<u>Cost</u>			
Rejection Rate	Max 330 Points		OTD	Max 267 Points		Net Price	kr		
ISO 9001	PPM	0	%		99	Logistic Cost	kr		
ISO/TS 16949	Yes/No	Yes	Lead Time	Days	5				
	Yes/No	No			99p				
		Total			267p			Total	69,61 kr
		279p							
SUPPORTING CRITERIAS									
<u>Technology</u>			<u>Service</u>						
Contribution	Max 206 Points		Availability	Max 197 Points					
R&D	Yes/No	Yes	Warranties	Yes/No	Yes				
	Yes/No	No		Yes/No	Yes				
		Total			197p				
		116p							

Figure 19 – Test Supplier C

Evaluation Tool - Existing Suppliers										
Supplier	Supplier D			IF QUALIFYING CRITERIAS=						
Date	2/5-2014			Continue to SUPPORTING CRITERIAS						
Within EU	No			IF QUALIFYING CRITERIAS= The Supplier is insufficient, the recommendation is to select another supplier						
QUALIFYING CRITERIAS										
Quality Max 330 Points			Delivery Max 267 Points			Cost				
Rejection Rate	PPM	4600	-	OTD	%	95	67p	Net Price	kr	194,30 kr
ISO 9001	Yes/No	No	-	Lead Time	Days	45	p	Logistic Cost	kr	209,84 kr
ISO/TIS 16949	Yes/No	No	-	Total		67p		Total		404,14 kr
SUPPORTING CRITERIAS										
Technology Max 206 Points			Service Max 197 Points							
Contribution	Yes/No	Yes/No	-	Availability	Yes/No	Yes/No	-			
R&D	Yes/No	Yes/No	-	Warranties	Yes/No	Yes/No	-			
Total		p		Total		p				

Figure 20 - Test: Supplier D

In figure 21, the test result of the four different suppliers are summarized and compared according to each other.

<p><u>SUPPLIER A</u></p> <p>Product Type: Strap</p> <p>Country: Norway & Germany</p> <p>Contract? No</p> <p>Quality (p): 253</p> <p>Delivery (p): 0</p> <p>Cost (SEK): 78</p> <p>Approved? No</p>	<p><u>SUPPLIER B</u></p> <p>Product Type: Rotor</p> <p>Country: Sweden</p> <p>Contract? Yes</p> <p>Quality (p): 279</p> <p>Delivery (p): 165</p> <p>Cost (SEK): 1378</p> <p>Approved? Yes</p>
<p><u>SUPPLIER C</u></p> <p>Product Type: Sheet Metal</p> <p>Country: Sweden</p> <p>Contract? Yes</p> <p>Quality (p): 279</p> <p>Delivery (p): 167</p> <p>Cost (SEK): 70</p> <p>Approved? Yes</p>	<p><u>SUPPLIER D</u></p> <p>Product Type: Rotor Engine</p> <p>Country: China</p> <p>Contract? No</p> <p>Quality (p): 0</p> <p>Delivery (p): 0</p> <p>Cost (SEK): 988</p> <p>Approved? No</p>

Figure 21 - Summarization of the test results

According to the test applied onto the case company's different value-bringing suppliers within the investigated area, two suppliers are insufficient and are not qualified to the next level of assessment. Quality certified suppliers achieved results of approval according to the test made, while suppliers without certification, or poor delivery performance were not recommended for further collaboration.

The lack of good quality is clearly a result due to insufficiently supplied products from suppliers with poor performance measurements or with poor delivery performance.

6.2. RQ₃

- Can/Cannot the Newly Developed Tool Evaluate both New and Current Suppliers - and if so, how?

A potential, new supplier was exposed to the test, to assess whether or not the tool can be used for both new and existing suppliers. The result is presented below in figure 22:

Evaluation Tool - New Suppliers									
Supplier	Name of Supplier	IF QUALIFYING CRITERIAS=		Continue to SUPPORTING CRITERIAS					
Date	XX/XX-2014	IF QUALIFYING CRITERIAS=		The recommendation is to select another supplier					
Within EU	Yes/No								
QUALIFYING CRITERIAS									
Quality		Max 330 Points		Delivery		Max 267 Points		Cost	
ISO 9001	Yes/No	Yes/No		Lead Time	Days			Net Price	kr
ISO/TS 16949	Yes/No	Yes/No						Logistic Cost	kr
		Total				Total		Total	
SUPPORTING CRITERIAS									
Technology		Max 206 Points		Service		Max 197 Points			
Contribution	Yes/No	Yes/No		Availiability	Yes/No	Yes/No			
R&D	Yes/No	Yes/No		Warranties	Yes/No	Yes/No			
		Total				Total			

Figure 22 – Result of the evaluation of a new supplier with the existing supplier spreadsheet

The test displayed unsatisfactory results – both new and existing suppliers cannot be evaluated according to the developed tool, since included sub-criteria's, such as rejection rate and OTD, are performance measurements in need of performance history. According to Ordoobadi and Wang (2011), utilization of the different models is dependent of three different parameters, whereas one parameter is the amount of information available on the performance of the supplier evaluated. New suppliers have unfortunately no performance history, since these suppliers are still assessed for future collaboration – attainable performance information is therefore very low.

Due to this result, minor changes of the tool's included criteria's were made and put into a new, different spreadsheet in the excel-document. The design of this sheet, applicable for new suppliers, is presented in figure 23 below:

Evaluation Tool - Existing Suppliers									
Supplier	Potential New Supplier	IF QUALIFYING CRITERIAS=		Continue to SUPPORTING CRITERIAS					
Date	2/5-2014	IF QUALIFYING CRITERIAS=		The Supplier is insufficient, the recommendation is to select another supplier					
Within EU	Yes								
QUALIFYING CRITERIAS									
Quality		Max 330 Points		Delivery		Max 267 Points		Cost	
Rejection Rate	PPM	?	-	OTD	%	?	-	Net Price	kr
ISO 9001	Yes/No	Yes	26	Lead Time	Days	5	98p		kr
ISO/TS 16949	Yes/No	No	-					Logistic Cost	kr
		Total				Total		Total	
		26p				98p		88,27 kr	
SUPPORTING CRITERIAS									
Technology		Max 206 Points		Service		Max 197 Points			
Contribution	Yes/No	Yes	116p	Availiability	Yes/No	Yes	105p		
R&D	Yes/No	Yes	90p	Warranties	Yes/No	Yes	92p		
		Total				Total			
		206p				197p			

Figure 23 - The design of the New Supplier Spreadsheet

To verify this new design applicable for new suppliers, another test was conducted with a potential, future supplier. The result from the test is presented in figure 24 below.

Evaluation Tool - New Suppliers										
Supplier	Potential New Supplier		IF QUALIFYING CRITERIAS=		Continue to SUPPORTING CRITERIAS					
Date	2/5-2014		IF QUALIFYING CRITERIAS=		The Supplier is insufficient, the recommendation is to select another supplier					
Within EU	Yes									
QUALIFYING CRITERIAS										
Quality Max 330 Points			Delivery Max 267 Points			Cost				
ISO 9001	Yes/No	<input type="text" value="Yes"/>	110p	Lead Time	Days	<input type="text" value="5"/>	267p	Net Price	kr	<input type="text" value="43,70 kr"/>
ISO/TS 16949	Yes/No	<input type="text" value="No"/>	-					Logistic Cost	kr	<input type="text" value="44,57 kr"/>
Total			110p	Total			267p	Total		88,27 kr
SUPPORTING CRITERIAS										
Technology Max 206 Points			Service Max 197 Points							
Contribution	Yes/No	<input type="text" value="Yes"/>	116p	Availiability	Yes/No	<input type="text" value="Yes"/>	105p			
R&D	Yes/No	<input type="text" value="Yes"/>	90p	Warranties	Yes/No	<input type="text" value="Yes"/>	92p			
Total			206p	Total			197p			

Figure 24 - Result from the test of the new supplier spreadsheet

As visualized, the new spreadsheet is applicable for new suppliers, however assessed according to fewer criteria's. The tool with its two different spreadsheets can therefore be applied when evaluating both new and existing suppliers, although the spreadsheet evaluating new suppliers include fewer sub-criteria's to assess.

As a final application, an additional spreadsheet was added to the tool, giving the evaluator a summarized overview of the suppliers evaluated. According to this summarization, the evaluator is given the opportunity to compare the different suppliers – if more than one supplier is assessed. The overview is presented in figure 25 below.

Evaluation Tool - Results				
Supplier	Existing Supplier	New Supplier 1	New Supplier 2	New Supplier 3
Quality	p	p	p	p
Delivery	p	p	p	p
Technology	p	p	p	p
Service	p	p	p	p
Total	p	p	p	p
Cost	0,0 kr	0,0 kr	0,0 kr	0,0 kr

Figure 25 - Overview of the result-spreadsheet

6.3. Result Summary

Quality and the quality concept is the outmost important criterion to consider when evaluating a supplier and supplier performance. Research question one investigated and answered which aspects to consider when evaluating suppliers according to quality – Volvo Powertrain served as an industrial example of quality excellence and how to assess quality according to rejection rate, delivery precision and ISO certifications. Lindgren and Sandell (1994) also showed that assessing suppliers according to in-house performance measurements are preferable, avoiding confusion and frustration between actors in the supply chain.

Research question two elaborated and designed a simple evaluation tool, applicable for first-time users and companies planning to introduce a structured approach for supplier selections. The evaluation tool developed and designed included criteria's derived from both research question one and the survey results. The criteria's were structured hierarchal according to Raut et al (2010), since his study was proven successful. The tool was also divided into two different levels – a qualifying one and a supporting one according to Dickson's (1966) foundation. The qualifying level included the most vital criteria's to evaluate from a supplier selection point-of-view according to the survey – *quality* (supported by previous research question), *delivery* and *cost*, whereas the supporting level involved criteria's of importance but ranked lower according to the survey made – *Technical ability* and *Service*. These criteria's were divided into intervals base on the Industrial example represented by Volvo Powertrain and given individual points according to weights calculated from the survey result, representing the different importance of the criteria's.

The third and final research question answered whether or not the same tool could be applied onto both new and existing suppliers. The result given, after extensive testing of both the case company's suppliers and a potential future supplier, showed that the same tool could *not* be applied onto new suppliers. To alleviate and render the tool into applicable use of new suppliers as well, a complementary spreadsheet was designed and added. Due to the complementary sheet added, the tool – with two different spreadsheets, can be applied onto both new and existing suppliers, however somewhat differently. To summarize the tool and the different spreadsheets, a *result-sheet* was added to the front of the tool, giving the evaluator an overall visualization of every supplier, either new, existing or both.

7. Analysis

Analysis of the study made will be presented as two parts – the first part will elaborate and analyse the data given from the survey and the selection of criteria's evaluated in the tool.

The second part of the analysis will link empirical results together with the theoretical framework and previous research made. This part will be presented according to the numbering of the research questions investigated.

7.1. Data Analysis

In-depth analysis of the criterion-selection process will be further elaborated and explained below. Possible risks and benefits with the applied procedures will also be discussed.

The process of differentiate and select which of the head-criteria's in the survey that ought to be applied further onto the evaluation tool, together with the amount of criteria's to select, was complicated – due to the distinct difference between five specific head-criteria's and the rest of the head-criteria's, the selection of those five particular ones felt as an accepted approach. These five criteria's have also been enlightened in previous studies (Raut et al. 2010; Sim et al. 2010; Sen et al. 2008), and the qualifying criteria's are announced as critical aspects to consider, if assessing a supplier for future, or current collaboration according to Dickson (1966). Due to supportive factors from previous studies within supplier selection research and the in-line survey result, these five criteria's were selected for the evaluation tool.

The head-criteria's chosen for further elaboration in the evaluation tool has assigned sub-criteria's – due to elimination of some head-criteria's, aligned sub-criteria's were eliminated as well. Disadvantages with this approach are the sub-criteria's considered important, but removed due to an unimportant head - criterion. These situations were luckily uncommon, however with a few exceptions - emergency orders were considered as an important sub-criterion to further assess, but flexibility as a head-criterion was not considered equally important, and therefore also removed. To remedy this situation, emergency orders as a sub-criterion were included in the *service criterion* as the *availability* to receive orders at inconvenient working hours – all according to and approved by the plant manager and the case company.

The amount of criteria's applied and elaborated on in the evaluation tool was not a pre-decided approach – due to the survey result, motivation and support of selecting fewer criteria's, such as three criteria's had been hard, since the difference between the first three and the next two criteria's were small. Previous studies also state that support from approximately five to seven criteria's are prosperous from an evaluation perspective (Labib 2010; Ordoobadi 2009a; Sen et al 2008). There are also risks involved when considering too many criteria's as a first step towards a supplier evaluation, - especially for a company not currently considering other criteria's than price. The case company's situation is therefore in-line with Labib's (2010) statement - too many criteria's are disadvantageous, being too time-consuming and tiresome, leading to an unused tool.

Previous studies and previous supplier selection models present different methods of how to apply a quantitative approach onto every criterion in the selection stage. Through linear weights, Taguchi loss functions or fuzzy membership figures (Ordoobadi & Wang 2011) – importance lies however within the quantified field. A quantified approach was enabled through weights from the survey made – weights are calculated from a total amount of votes given from only adding the involved five criteria's maximum votes. Head -criteria's were numbered with numbers from one to eight, and the same number could only appear once in the same level – the criterion given number one received eight points in the survey result (inverted procedure, enabling the highest ranked criteria's to receive high scores/votes). By assigning the most important criteria's a higher score in an inverted order, the result directly displayed which criteria's considered most important from a supplier evaluation point-of-view. According to the linear weighted model, weights are assigned to criteria's in an increasing linear order. These weights are thereafter multiplied with a figure called criterion importance, assessed by the evaluator (Ordoobadi 2009a) – our evaluation tool combines these two factors in the weight distribution, since the weights are given to criteria's according to individual importance. By assorting weights to criteria's according to this procedure, the criteria's further involved in the evaluation tool is ranked only according to the survey result, and therefore also the case company's expectations of suppliers. No subjective feelings or thoughts govern the weights, making the tool applicable by everyone in the company.

Points are given to the criteria's according to the different assigned weights. The points serve as a quantitative aid, giving the evaluator figures of individual performance, enabling comparison of several suppliers. The fault of the procedure of assigning points, are however the difficulty of determine where the limits of acceptance are – which amount of points for this particular criterion are acceptable from an evaluating point-of-view? Are there different acceptable limits for different criteria's? Due to these problems, different intervals, where a supplier can end up in any of these intervals are created, based upon the industrial example represented by Volvo Powertrain. The different intervals and given points are decided upon together with the case company, according to their expectations and in-house objectives.

The quality criterion is of major importance, both from a company perspective, but from a supplier evaluation point-of-view as well, enabling the case company a proper quality assessment of suppliers. Volvo Powertrain serves as an industrial example of quality excellence – both from a supplier assessing perspective and from a company delivering high quality every time. The quality criterion is therefore divided into sub-criteria's according to the Volvo-way and the survey results – both certifications and performance measurements are given individual points within divided intervals.

The points are assigned the different sub-criteria's according to what is deemed important. Rejection rate is of vital importance, both according to the case company and Volvo. Rejection rate is therefore ranked highest from a quality evaluation perspective and therefore also given highest points. Certifications are given approximately one third of the points assigned to the quality criterion – according to the case company, certifications are not considered important enough. Bergman and Klefsjö (2010) state the opposite – to able to assess quality from a fundamental level, certifications must be included.

Both certifications and rejection rate are evaluated when the tool handles existing suppliers - a supplier will however not be quality approved if the rejection rate is too high, although being certified according to the ISO standards. A certification is not good enough, if the rejection rate is insufficient. The supplier will therefore not be quality approved, and as an extension – not approved by the evaluation tool. New suppliers will however only be assessed according to certifications - Ordoobadi and Wang (2011) states that utilization of different supplier selection models are dependent of three different parameters, whereas one is the supplier performance

information attainable. New suppliers have no performance information attainable due to inexistent collaboration between suppliers and customers. Certifications are the only parameter attainable, and therefore also the sub-criterion assessed. The recommendation is therefore to only select and collaborate with suppliers with quality certifications, in-line with Volvo Powertrains manager and supplier vision.

Delivery is assessed according to two sub-criteria's as well – on time delivery and lead-time are both considered important for the case company. Points assigned to these two are individually set according to a procedure similar to the quality criterion. On time delivery (OTD) and lead-time are linked together – if the supplier has short lead-times, the goods can be delivered frequently and if there is a problem with a delivery, the supplier can be flexible due to short lead-times. High OTD is therefore not equally important if short lead-times, due to the flexibility parameter. If the supplier is located far away, OTD is considered more important. Ability to be flexible if having long lead-times is difficult – high OTD together with long lead-times are therefore important. The case company must have the ability to collaborate with suppliers with long lead-times, but they must also be able to trust the supplier and an accurate delivery. The case company is today adding lead-time when ordering goods from China – this procedure is, according to the authors, an unacceptable approach, which is why the score setting of the different sub-criteria's are dependent of either high OTD or short lead-times. The tool will approve suppliers with OTD-levels higher than 96% - if lower than this percentage, the supplier must collect points from the lead-time aspect as well, since acceptance level is set to a minimum amount of 100 points.

New suppliers are only evaluated according to lead-time, due to the same reason stated regarding rejection rate. Delivery precision is unattainable if inexistent partnership. Suppliers located far away will therefore receive a zero-score, which might be questionable, since foreign suppliers may be just as good as domestic suppliers. New suppliers will therefore only be assessed according to their geographical position. New suppliers and the assessment-sheet of new, potential suppliers to evaluate are an area where improvements must be made. The spreadsheet is only a foundation and an indicator whether or not the supplier is considering good-enough quality and where the supplier is situated geographically. Further investigation is recommended and absolutely necessary.

The cost criterion has been separately handled – cost is one of three qualifying criteria's according to the case company. Division of the cost criterion is however complicated, since no acceptance level can be estimated - the general approach of evaluating any supplier will be compromised if an acceptance level of which cost that ought to be seen as acceptable is set. Acceptance is set according to the case company's financial objectives, the type of product supplied and the situation given at the evaluation moment. The cost criterion is therefore only calculated according to a set of sub-criteria's derived from the case company. Criteria's evaluated according to different costs instead of points would have been a best-practice approach – every criterion is given a specific cost due to different losses and risks occurred if the supplied products contain insufficiencies, visualizing how cost-some faulty products, and as an extension, faulty suppliers are. This approach demands further assessment and further investigation of in-depth situations, if ability to create different cost-situations is to be enabled. An overall cost approach will therefore be suggested as a further study.

The qualifying criteria's are assessed according to performance measurements, giving both quality and delivery a specific amount of points, distributed to the evaluated supplier. The third qualifying criterion states the different costs occurred when purchasing goods from the same supplier – costs and points must therefore be considered and evaluated. Points are not comparable with a cost – risks of subjectivity are therefore quite high, since the evaluator must consider the cost of a specific good, while still assess the point given from the qualifying criteria's. Insufficiencies may occur when the cost is extremely low and the point given to the supplier is just below acceptance – the balance between how many points a specific cost is worth will always be up to the evaluator. The benefit is however the visualization given from the evaluation with both points and costs – the evaluator is given an opportunity to picture the supplier according to these criteria's, and the evaluator must therefore also find the specific information required to make an evaluation.

7.2. Academic Analysis

In-depth academic analysis of the three different research questions will below be further elaborated and explained. Theories will be linked to the corporate description of the case company and the results given from the empirical study, together with a critical discussion.

7.2.1. RQ₁

- **What aspects must be considered and involved from an evaluating perspective, if assessing a supplier according to quality?**

The quality concept is an imperative necessity for companies to consider when assessing suppliers, if maintaining a competitive edge and advantage on the market (Kermani et al. 2011). The case company is today victims of poor quality – they are also an example of a company only selecting suppliers according to price, leaving the quality concept behind for further evaluation. Poor quality is therefore a result of an insufficient supplier selection-approach. Parameters and aspects that must be assessed if evaluating a supplier from a first-time perspective are therefore elaborated on in the first research question.

Quality is defined according to Bergman and Klefsjö (2010) as the *ability to satisfy or preferably exceed the needs and expectations of the customer* – but to actually meet expectations set by the customer is a difficult task to comprehend for the supplier. The quality concept is today a widespread concept, but expectations may vary between individuals and companies. Acceptable levels for someone might not be enough for someone else. Luckily, these indifferences and gaps are met through usage of performance measurements (ISO 2013a). The result given from the literature study and through the industrial example represented by Volvo Powertrain, presented a few different aspects to consider when assessing supplier quality, and also different useful quality performance measurements. Quality performance measurements are considered as fundamental, since these enables the evaluator to visualize quality through numeric figures. Certification according to the ISO system is considered fundamental as well (Bergman & Klefsjö 2010; Lindgren & Sandell 1994; ISO 2013a) – certifications are today utilized globally (ISO 2013c), enabling evaluation of any supplier – domestic or foreign. The findings also presented how to make these measurements and how to set an acceptable level in numeric terms (Volvo 3P 2010) – if evaluating a supplier according to quality, the acceptable levels must be just as high as the in-house company's own objectives (Lindgren & Sandell 1994). The in-house company can therefore not expect higher acceptance levels of quality than individually put levels.

Qualitative parameters that ought to be considered as well as fundamental, if requiring better quality from suppliers, are shared quality visions and a quality-committed in-house management team. Satisfied customers are achieved through fulfilled or exceeded quality expectations and needs (Bergman &

Klefsjö 2010) – the case company are providing the real estate- and building market with ventilation systems and air-handling units, making the case company an actor in one of the last links in the supply chain. Lindgren and Sandell (1994) believes a shared quality-vision is imperative – the case company are refining and assembling supplier-products to the end-customer, and if poor quality is delivered due to deviant quality objectives from the supplier, the case company will be severely affected.

A quality-committed management team is also of great importance (ISO 2013b, Bergman & Klefsjö 2010; Lindgren & Sandell 1994) – the management team are the ones representing the company on the market, but also the ones setting a leading example of how the quality concept ought to be treated in every department at the company. According to the empirical study made within the quality department through semi-structured interviews, the case company has unfortunately not fully grasped the quality concept. Assemblymen are dissatisfied with the quality management- and the quality aspects set at the company.

According to Lindgren and Sandell (1994), separate opinions regarding quality and the quality aspect occurs on the market and within companies. Management team believes quality-systems are too time-consuming and too cost-some – quality could just as well be controlled and govern without stated quality objectives and systems. The case company fits well into that description – the board considers quality management systems as unnecessary and not useful; why change something already working so well? The case company has therefore no implemented quality system; they are not certified according to ISO or equivalent quality standard, however working with a quality KPI (unfortunately insufficiently measured since the wrong factors are compared). A study made in England and reviewed by Lindgren and Sandell (1994) criticizes the standardized system of ISO – according to the study, the certification policies has cost the English government billions of Swedish crowns, and as many as 80 % of the companies implementing the standard has failed to deliver satisfactory quality. The study claim and almost accuse the ISO system of fraud due to severe company failure and money loss. Bergman and Klefsjö (2010) answers to the critics reviewed by Lindgren and Sandell (1994) - they believe it is important to remember that no standard can ever create business success or quality excellence – success is due to how the standard, as well as supportive tools, are applied by the management team onto the company, how the tools are used in the daily operative work, together

with long-term strategic decisions. And according to Lindgren and Sandell (1994), quality management systems may not be the only solution towards a structured quality approach, but a company lacking a quality system will have bigger variations on produced goods and services, leading to high amounts of waste, claims, rework, decreasing product prices and higher warranty costs. Standardized approaches through ISO certifications provide the company with continuity, decreasing the variety of goods and services. The quality systems-aspect is a foundation and a critical parameter to consider when evaluating supplier quality. Opinions are however separate, judging from investigations made by both Lindgren and Sandell (1994) and Bergman and Klefsjö (2010). Our developed tool is therefore provided with a certification aspect in the quality criterion, but the weights are assigned so points given to the supplier are only approximately one third of maximum points.

The case company are aware of the insufficient quality aspects – but instead of changing the supplier responsible for poor quality, larger volumes are purchased, consequentially increasing buffers and in-house stock levels. The decisions made regarding quality and the suppliers supplying non-conforming products are a deliberate choice, since the case company makes no effort or work towards improved quality. Evaluation of supplier-quality will therefore be compromised, since quality demands and expectations ought to be set according to in-house standards. If any evaluation tool within quality should be usable, an in-house quality system must therefore firstly be implemented, judging from above reasoning and Bergman & Klefsjö (2010) and Lindgren and Sandell (1994).

7.2.2. RQ₂

- **How can a simple supplier selection tool be designed according to a company planning to introduce a structured approach for supplier selection?**

A simple supplier selection tool has been designed according to both previous studies, and with an investigation made in a case company planning to introduce a structured approach for supplier selections. Criteria's further involved in the evaluation tool were selected through a survey, applied onto every department in the case company. According to a study made by Sen et al (2008), a hierarchal structuring of the evaluation tool is preferable, giving the evaluator an image of which criteria's to firstly assess in a supplier structure –

the tool therefore structures and categorizes criteria's according to two levels; qualifying and supporting criteria's.

Assessing suppliers according to different criteria's is a complex procedure – depending on the market segment, different evaluation criteria's are brought to light. According to Sen et al. (2008), criteria's put forward varies depending on the product category, while still serving the same purpose of optimizing the supply chain through successful supplier selections. One linkage can however be drawn between different market segments and critical criteria's a supplier must be assessed to. The study by Sen et al. (2008) presented satisfactory results of how an evaluation tool with a hierarchal structure with three qualifying criteria's can lead to successful supply chain management in the electronics business – the electronic business is however slightly different, but interestingly enough, the qualifying criteria's are the same as the ones given in the empirical result from the case company.

Other studies made by both Raut et al. (2010) and Labib (2010) within the petrol industry and within the vending market, where quality, delivery and cost are considered critical evaluation factors, showed positive and satisfactory results after implementation of the supplier evaluation tool – according to these studies, criteria's considered important are not market segment specific, supply chain-position specific or company specific. The result given in this master thesis therefore presents the same conclusion as Dickson (1966) in the late 1960s – quality, delivery and cost-considerations are not dependent on the company or the market segment, but accepted as the foundation and a qualifying base for supplier selections.

According to Raut et al. (2010), mathematical programming models are the most utilized approaches for supplier selections and supplier evaluations – These models are however very mathematical and complex, narrowing the usefulness and easiness down into only a small group of applicants. The implementation of the tool will also be compromised, if the tool is too complex (Sen et al. 2008). The design of the tool must therefore be simple, enabling implementation and first-time users the ability to assess suppliers. The tool must also be able to assess more than two suppliers at a time, since the dimensional analysis proved unsatisfactory results due to an extremely time-consuming process, limiting the evaluator through 'indifferences' about which supplier to select (Ordoobadi & Wang 2011).

Creating simplicity is however a subjective manner (Ordoobadi 2009b) – what someone considers simple, might be difficult according to someone else. Applications from the categorical model are therefore used, however somewhat differently – the categorical model uses grading's of the different suppliers according to a few stated criteria's (Ordoobadi & Wang 2011). Our tool uses a quantitative grading system through points, but the evaluator answers with categorical terms (YES or NO). The evaluator is therefore provided with a tool with both measureable qualifying criteria's and supportive criteria's with categorical, simple answers. Too subjective criteria's can therefore not be involved in the tool, since a simple-answer proceeding would be difficult to adapt.

Too few performance measurements might however compromise the evaluation through subjective manners – According to Ordoobadi (2009b), subjective manners must be captured in an evaluation situation, since numeric figures limits the evaluator and imprecision associated with perceptions are lost. Including subjective judgments in the evaluation might however be disadvantageous - a study made by Ordoobadi and Wang (2011) states that that an evaluation with too many categorical terms leaves too much to the subjective judgment, with consequences of letting previous experiences affect the supplier assessment.

One can establish that the subjective topic is a hot research field – researchers argue for both sides, whether or not subjective judgments should be a part of the evaluation. Due to divergent opinions regarding subjective considerations, the tool developed deviates from previous research results. Previously established models either includes subjective manners in the model, or prevents it – our tool combines criteria's with performance measurements and criteria's where a subjective answer is expected. Performance measurements, requiring quantified answers, are included in the qualifying criteria's; the supporting criteria's are subjectively answered by the evaluator by either *Yes or No*.

According to Sen et al. (2008), most attention of the recently paid within supplier selections has so far been upon the very choice of the supplier. Due to this situation, Sen et al. (2008) study presents a framework for how to approach a supplier problem structurally. Depending on the time and effort spend on the phases before the actual supplier selection, decides the final outcome of the selection. This master thesis excludes the final fourth phase of the actual supplier selection – ability to assess the tool is therefore difficult,

since an actual implementation of the tool must be made. Previous studies present results of successful implementations of different models and techniques – comparison of these results are unfortunately difficult, since no implementation has been made. The criteria's are however the same as in the studies presenting satisfactory results within supply chain management, giving reason to believe positive result for this tool as well. The significance of continuous improvements of both the tool and the case company's suppliers are also an essential aspect to consider when the tool has gone through the fourth and final phase of Sen et al. (2008) problem formulation. According to Bergman and Klefsjö (2010) and ISO (2013b), continuous improvements are vital from a certification and quality systems point-of-view in several parameters that must be fulfilled – these aspects must also be applied onto the tool. The authors are therefore emphasizing the importance of how the newly developed tool must be improved on a continuous basis according to the fluctuating and ever-changing case company expectations and needs. According to Volvo Powertrain, continuous follow-ups and evaluations of suppliers during existing collaborations are also necessary – growing together with your supplier will provide the company with high-quality products through mutual understandings (Bergman & Klefsjö 2010; Volvo 3P 2010).

The tool is designed as an aid towards a structured supplier selection approach – the tool is only designed with objectives to help the case company to select suppliers according to other criteria's than lowest price. The tool visualizes where the supplier performs well or where improvements must be made, according to the tools recommendations due to different acceptance levels. It also enlightens different quality aspects not previously considered by the case company – the selection of a final supplier is however still only according to the case company's intuition and gut feeling.

7.2.3. RQ₃

- **Can/Cannot the newly developed tool evaluate both new and existing suppliers –and if so, how?**

The third and final research question investigated whether or not both new and existing suppliers could be evaluated according to the tool newly developed – to be able to assess the research question, a test were conducted by the authors within the investigated business area. The test had a two-folded purpose; visualize and display which suppliers, and especially which criteria's, that are insufficiently performed. Secondly, the test evaluated if a combination

of both new and existing suppliers could be evaluated according to the same design.

According to the test made, 50% of the suppliers within the investigated area are insufficient according to any of the qualifying criteria's.

The approved suppliers were both quality certified and presented satisfactory performance statistics. According to Lindgren and Sandell (1994) and a survey made in England, 60% of certified suppliers showed satisfactory performances. Giving the test made at the case company, certified suppliers presented acceptable results of performance as well. The lack of good quality is therefore clearly a result due to insufficiently supplied products from suppliers with no certification, poor performance measurements or with poor delivery performance. Attention towards ISO certifications, according to ISO (2013a; 2013b) and Bergman and Klefsjö (2010) are therefore supported by this master thesis investigation within quality expectations and supplier selections.

Another conclusion drawn from the test made, are the approval of suppliers with a given contract or where an agreement has been established between the actors – an agreement between two parts in the supply chain is a representative collaborative partnership. According to Bergman and Klefsjö (2010), a collaborative partnership with your supplier may lead to a better price, while still receiving the same, high quality. Collaborative partnerships are therefore helpful and necessary if attaining satisfactory suppliers. These results are therefore in line with previous research and theories presented by Bergman and Klefsjö (2010).

The market moves towards collaborative partnerships where the supplier and the purchasing company help one another – according to Waters (2003), single source situations are therefore more frequently used within the supply chain. These collaborative partnerships could however affect judgment in an evaluating situation - the situation may seem comfortable, and answering against the supplier in specific criteria's may therefore be difficult. The case company deals with several single sourcing situations – one of major importance is the situation in China. Problems with the Chinese supplier are due to a single sourcing situation, and assessing the supplier might therefore also be difficult. The tool leaves room for subjective assessments in the two supporting criteria's – evaluating for the suppliers account might therefore be a repeated risk.

The second purpose of the test was the answering of the actual research question. Models provided by Raut et al. (2010), by Ordoobadi (2009a) or by Sen et al. (2008) are unclear whether both new and existing suppliers can be evaluated with the same tool, or if there is a need for a distinction between models used and suppliers evaluated – the authors therefore found a research gap, where an investigation of categorization of new and existing suppliers ought to be made. According to the test made where both existing and potentially new suppliers were assessed, a few sub-criteria's cannot be fully evaluated when the evaluator considers new, potential suppliers. According to Ordoobadi and Wang (2011), performance information determines how well established the assessment models are. The result given is therefore fully acceptable, since the sub-criteria's that are impossible to evaluate are both rejection rate and delivery precision. These two performance indicators are usually based upon historic figures and performance information – new suppliers have no measured figures, due to an inexistent partnership.

As a clarification to previous studies made by (for instance) Raut et al. (2010) and as an answer to the third research question, both new and existing supplier cannot be evaluated according to the same tool. The same hierarchal levels can still be applied onto new suppliers, but due to inexistent performance information about new suppliers (Ordoobadi & Wang 2011), the design of the tool developed by the authors had to change. The new design included a new tag in the spreadsheet, enabling the evaluator to either evaluate an existing supplier or a new one – this application and spreadsheet is however insufficient and must be improved with further studies. According to the new spreadsheet made by the authors, new suppliers can only be evaluated from a certification- and geographically point-of-view. The certification-aspect is proven a divided aspect from a company-point-of-view (Lindgren& Sandell 1994), making the new spreadsheet faulty and scarce. Volvo Powertrain are assessing their suppliers according to an individually designed supplier selection tools, making them not only an example of quality excellence on the market, but also a company worth benchmarking within supplier selection methods for future studies.

A third tag were also added to the tool, summarizing the different evaluations of both new and existing suppliers, giving the evaluator a summarized and overall picture of the supplier situation on the market. The tag concludes points given to the different suppliers, together with the total cost calculated.

When evaluating several suppliers, one must remember to assess suppliers within the same market segment – suppliers supplying the company with different products cannot be evaluated simultaneously, due to inaccuracy and an inconsequential manner. Comparing sheet-metal to rotor engines gives a skew picture of the supplier structure, and the prices are not at all comparable. The comparison must therefore be made with suppliers within the same market segment and field, if making proper use of the evaluation tool.

This new and adapted design enables the evaluator to assess different suppliers, both new and existing ones, however according to an insufficient additional spreadsheet. The provision of a concluded comparison of all the evaluated suppliers enables the evaluator to compare the different suppliers, either new or existing ones – the comparison might however be unsatisfactory, since the additional spreadsheet must be complemented with further studies within performance information, according to Ordoobadi and Wang (2011) studies.

The design of the tool given from the thesis provides the evaluator with an opportunity to visualize and compare existing suppliers according to five criteria's including cost, together with an additional spreadsheet put forward as a foundation and an indicator if new suppliers are considering quality on a basic level.

8. Conclusions & Further Studies

This master thesis handles supplier selections and quality expectations in the supply chain. The purpose of studying basic quality expectations and thereafter design a simple supplier evaluation tool for first-time applicants were therefore put forward in two initial research questions, filling the first research gap found. A third and final research question investigated the gap of assessing both new and existing suppliers with the same tool.

The first research question found its answers in quality management systems and quality performance measurements, since these are considered as fundamental aspects to consider when assessing a supplier. Only acceptable levels of performance measurements are therefore approved by the tool – these acceptance levels are set according to in-house objectives and KPI's, fulfilling quality expectations while avoiding confusion and frustrations between actors in the supply chain. If any evaluation tool within quality should be usable, an in-house quality system must therefore first be implemented by the in-house company – a notable improvement recommended to the case company.

Research question two, were a simple supplier selection tool was designed according to a company planning to introduce a structured approach for supplier selections, proposed a tool that visualizes and enables the evaluator to assess and quantitatively compare different existing suppliers.

The third and final research question investigated the possibility of evaluating both new and existing suppliers with the same, developed tool. The study concluded an unsatisfactory evaluation when evaluating new suppliers, due to inexistent performance information. The authors therefore designed another, additional spreadsheet so new suppliers can be evaluated as well. This spreadsheet is however faulty due to few sub-criteria's, leading to unsatisfactory and insufficient results. The spreadsheet can therefore only be considered as an indicator of supplier quality in evaluations of new suppliers.

Contributions made to the research field are the combination of both assessing criteria's according to performance measurements and subjective manners. The hierarchal structure with three qualifying criteria's are representative and in-line with Dickson's (1966) initial studies, where quality, delivery and cost are considered as fundamental and qualifying criteria's to consider, independently of the market. The first level of the evaluation tool for

existing suppliers is therefore not typical for the case company – it can be considered as a general design for any company planning to introduce a structured approach within supplier selections.

Suggestions of directions of future studies within first-time supplier selections are made as well; one direction is the follow-up study after an implementation of the tool in the case company and the consequential effects on other sections within the company, such as inventory and production. Another direction is the development of cost-based considerations and the development of cost-aspects on every criterion, instead of a point-score system. With a representative criterion-cost, disadvantages with poorly supplied quality are visualized as a direct loss for the company, emphasizing the importance of high quality.

Further complementing studies within evaluation of new suppliers are recommended and considered essential, if proper comparisons of both new and existing suppliers ought to be evaluated with the same selection tool.

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Appendices

This last chapter is an extension of the master thesis – additional materials such as guides to both semi-structured and unstructured interviews, additional material to the survey and a map over the business area are provided.

Appendix A – Semi-Structured Interview-Guide

Questions:

Q1: How is the products handled at arrival?

Q2: Is there any kind of quality inspection?

Q3: What are the procedures for dealing with non-conforming products?

Q4: Is there any special treatment of products from certain suppliers, from a quality perspective

Q5: Are there any differences distinguishing suppliers according to a quality perspective?

Q6: How much effort is put on handling non-conforming products?

Q7: The warehouse in China has introduced quality controls, is this noticeable?

Q8: Other comments?

Respondent 1: Floor Manager UNI3/UNI4 – Date of interview 23/4-2014

Q1	The products are not always treated gently. EU-pallets and boxes are unloaded and are positioned directly in stock. No further handling, besides replenished when necessary.
Q2	No.
Q3	The insufficient products are sorted out on a trolley, and the part number and cause of error is reported on a paper copy. The trolley is thereafter moved to the inventory office who documents it in a computer log. There are no routines for handling quality deficiencies.
Q4	If a supplier has delivered multiple deliveries containing many insufficiencies, it may happen that the future delivery's is stopped on arrival for a quality control. This occurs only at the initiative of the assembler.
Q5	Deliveries from China are usually of poor quality and contain higher amounts of non-conformities. Other suppliers are generally good, and especially those from the Nordic countries.
Q6	Approximately 10 minutes per person and week.
Q7	No, nothing that has been noticeable so far.
Q8	-

Respondent 2: Assembly man UNI3 – Date of interview 23/4-2014

Q1	The products are unloaded and placed in storage.
Q2	Don't know.
Q3	Deficient products caused by the supplier are placed on a trolley. Control of the pallet/box containing the non-conforming product is done, to ensure that no more products are defective.
Q4	Don't know.
Q5	It is pretty good quality in general.
Q6	Not often.
Q7	No
Q8	-

Respondent 3: Assembly man UNI3 – Date of interview 23/4-2014

Q1	Don't know.
Q2	No.
Q3	A claim of the insufficient product is left in a box on a trolley. There is no examination on the entire delivery but control of the pallet/box containing the deficient product is done.
Q4	No.
Q5	There are huge quality issues regarding the rotor engines.
Q6	Not significantly.
Q7	It used to be hopeless but improvements are perhaps made.
Q8	Introduce quality controls! There is no monitoring of rejected products from Flexit today. They do not examine whether the fault is due to insufficient products from suppliers or if it due to the assembly work.

Respondent 4: Assembly man UNI3 – Date of interview 23/4-2014

Q1	The products are positioned directly in stock.
Q2	No.
Q3	Non-conforming products are placed on the claim-trolley. The trolley is sent to the inventory office once a week.
Q4	No.
Q5	No, but the rotor engines tend to be of poor quality. Sometimes the rotor engine works in the pre-assembly, but when the final test of the finished air-handing unit is made, something is wrong with the engine anyway.
Q6	A fairly amount of time. It is included in my work procedures.
Q7	No. The handling of defective products is incredibly bad. Deficient engines can return to the assembly-line three times before these are discarded.
Q8	Introduce random inspections of the incoming deliveries.

Respondent 5: Temporarily at UNI3, otherwise at the electricity department – Date of interview 23/4-2014

Q1	The products are positioned directly in stock.
Q2	No.
Q3	There are no routines for handling deficient products. The floor manager is informed.
Q4	Don't know.
Q5	There are often quality problems with the supplier providing rotor engines.
Q6	It don't take much time.
Q7	Don't know.
Q8	There is a risk of insufficient, undiscovered products during assembly, making Flexit deliver non-conforming products to its customer.

Respondent 6: – Temporarily at UNI3, otherwise at other unit – Date of interview 23/4-2014

Q1	The products are positioned directly in stock.
Q2	No.
Q3	There are no routines for handling insufficient products – the products are placed in a box with a note.
Q4	No.
Q5	It is hard to know which supplier supplying a specific product. The products delivered from China are of very bad quality!
Q6	Not so much, only when there is a lot of quality insufficiencies.
Q7	No.
Q8	Errors are normal and sometimes occurring, but the amount of non-conforming products from China is unacceptably large. The deficiencies can follow the process all the way to the delivered end-product.

Respondent 7: – Assembly man UNI3 – Date of interview 23/4-2014

Q1	The products are positioned directly in stock.
Q2	No. Only the assembler detects insufficiencies.
Q3	There are no routines for handling non-conforming products. The floor manager is informed. A quick control of the pallet/box including the deficient product is made, to ensure that no more products are defective.
Q4	No.
Q5	There are often quality problems with the rotor engine.
Q6	Less than once a day.
Q7	No.
Q8	There should be a person responsible for quality issues in the factory. The assembler might miss hidden insufficiencies.

Appendix B – Unstructured Interview-Guide

Title: Purchasing Assistant, Norway & European Union

Interviewee: Jörgen Berglund

Date of Interview: 2014-02-06

Title: Plant Manager Sweden & Overall Logistics Manager

Interviewee: Ulf Jonsson

Date of Interview: 2014-02-06

Title: Production Manager Sweden

Interviewee: Mikael Lindeberg

Date of Interview: 2014-02-12

Title: Sub Ordering Assistant, Purchasing Norway & European Union

Interviewee: Conny Edvinsson

Date of Interview: 2014-02-12

Title: Manager China Relations

Interviewee: Petter Buer

Date of Interview: 2014-03-07

Title: Sub Ordering Assistant, Purchasing China

Interviewee: Roger Braarud

Date of Interview: 2014-03-07

Title: Quality Manager

Interviewee: Anders Larsson

Date of Interview: 2014-04-10

Appendix C – Distributed Survey Material

This is a survey of which criteria's YOU consider most important when selecting suppliers to Flexit. Below is a clarification of the different criteria's to evaluate.

Cost

Net price – Is the net price of big importance? (Net price = price excluding VAT)

Logistic cost – Is low logistic cost of big importance?

Quality

ISO Certification – Is it important that the supplier is ISO certified within Quality?

Rejection Rate – Is it important that the supplier provides products with low rejection rate?

$$Rejection\ Rate = \frac{Non-conforming\ products}{Delivered\ products}$$

Service

Warranties – Is it important that the supplier can offer warranties?

Education – Is it important that the supplier can offer education?

Support – Is it important that the supplier offers support?

Reparation – Is it important that the supplier offer reparation possibilities?

Availability – Is it important that the supplier is available from a service-point of view, available in terms of customer centres, inconvenient working hours and ability to receive emergency orders.

Management & Organisation

Reputation – Is it important that the supplier has a good reputation?

Financial position – Is it important that the supplier has a stable economy?

Technical Ability

Contribution – Is it important that the supplier has good technical capacity?

R&D – Is it important that the supplier is dedicated to research and development?

Delivery

Delivery Precision, OTD – Is it important that the delivery comes with the right quantity of products at the right time?

$$Delivery\ Precision, OTD = \frac{Orders\ Delivered\ in\ time}{Total\ Delivered\ Orders}$$

Lead-time – Is it important with short lead-times? (Lead-time = time from order to delivery)

Geographic location – Is it important where the supplier is located?

Flexibility

Special request – Is it important that the supplier can meet special requests?

Emergency orders – Is it important that the supplier can receive emergency orders?

Sustainability

Environment – Is it important that the supplier takes responsibility for the environment?

Recycled materials – Is it important that the supplier offers recyclable materials?

Please number all Head-Criteria's with numbers 1-8.

1 - Is the most important criterion.

8 - Is the least important criterion.

Please number the sub-criteria with the numbers 1-21

1- Is the most important sub criterion.

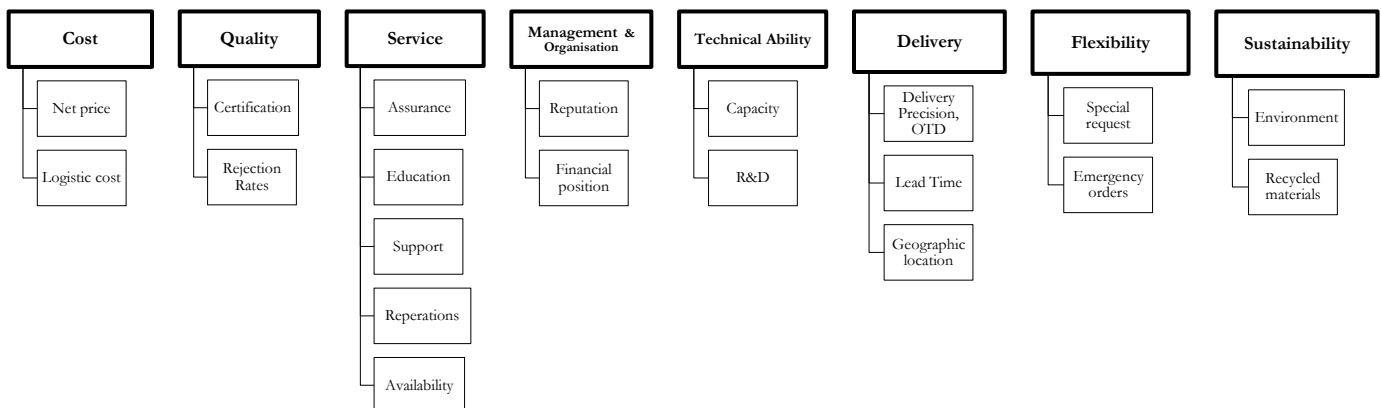
21 - Is the least important sub criterion.

If you think some sub criteria's is completely irrelevant, please put an “-“instead of a number –This criterion will thereafter receive 0 points.

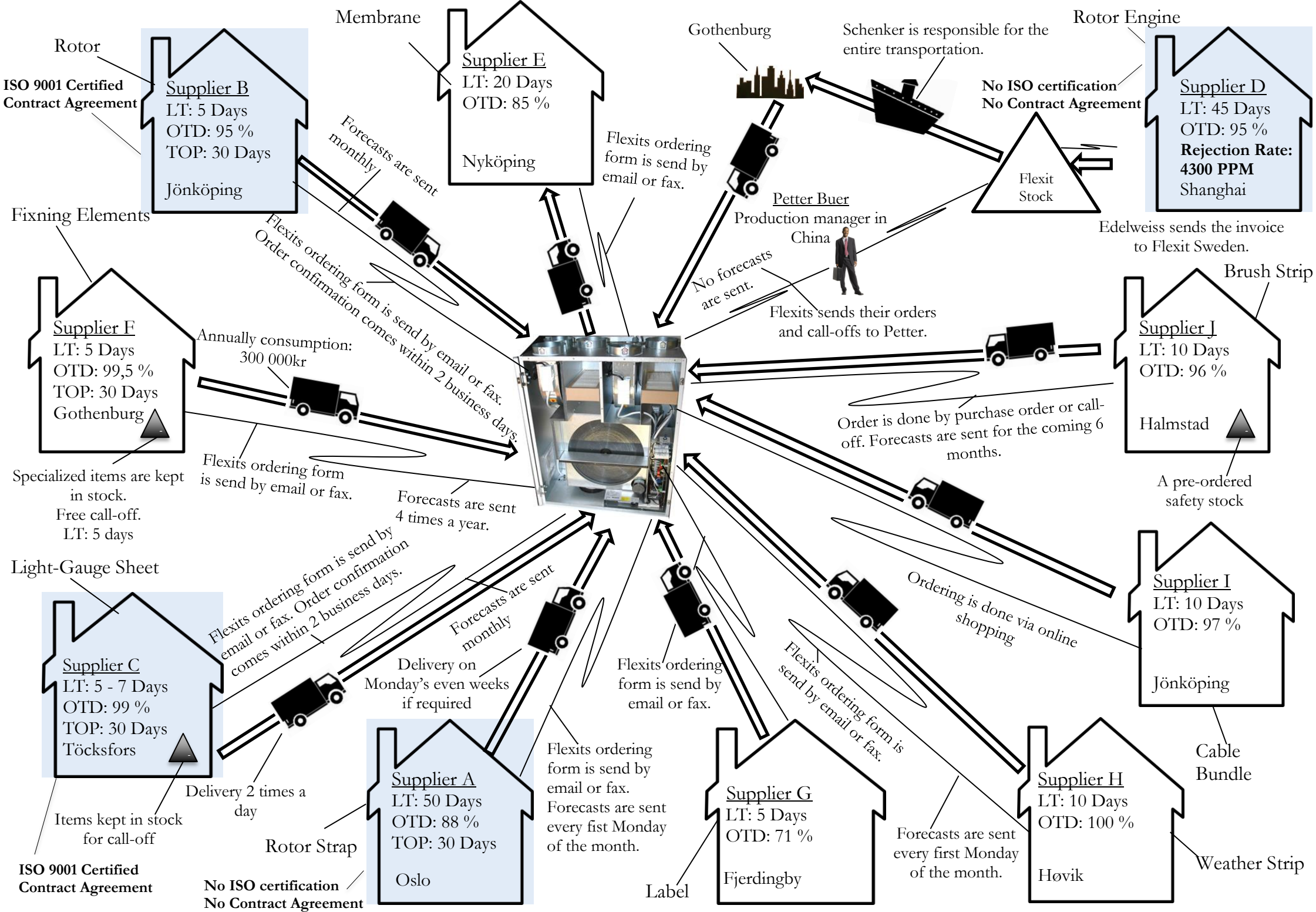
You are not allowed to put the same number twice within the same level!

Head Criteria's

Sub Criteria's



Appendix D – Value Stream Mapping



Supplier Selection TOOL

- User Guide

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Introduction

The design of the supplier evaluation tool is based upon previous research of existing methods, in order to create an evaluation of suppliers. The design is focused towards simplicity and for first-time users.

The *Supplier Selection Tool* is composed of three different spreadsheets - *Existing Suppliers*, *New Suppliers* and *Results*.

Their correct use will be explained in their respective chapter.

Evaluation Tool - Existing Suppliers									
Supplier	Name of Supplier	IF QUALIFYING CRITERIAS=		Continue to SUPPORTING CRITERIAS.					
Date	XX/XX-2014	IF QUALIFYING CRITERIAS=		The recommendation is to select another supplier.					
Within EU	Yes/No								
QUALIFYING CRITERIAS									
Quality Max 330 Points			Delivery Max 267 Points			Cost			
Rejection Rate	PPM		OTD	%		Net Price	kr		
ISO 9001	Yes/No	Yes/No	Lead Time	Days		Logistic Cost	kr		
ISO/TS 16949	Yes/No	Yes/No	Total			Total			
SUPPORTING CRITERIAS									
Technology Max 206 Points			Service Max 197 Points						
Contribution	Yes/No	Yes/No	Availiability	Yes/No	Yes/No				
R&D	Yes/No	Yes/No	Warranties	Yes/No	Yes/No				
Total			Total						

Evaluation Tool - New Suppliers									
Supplier	Name of Supplier	IF QUALIFYING CRITERIAS=		Continue to SUPPORTING CRITERIAS					
Date	XX/XX-2014	IF QUALIFYING CRITERIAS=		The recommendation is to select another supplier					
Within EU	Yes/No								
QUALIFYING CRITERIAS									
Quality Max 330 Points			Delivery Max 267 Points			Cost			
ISO 9001	Yes/No	Yes/No	Lead Time	Days		Net Price	kr		
ISO/TS 16949	Yes/No	Yes/No	Total			Logistic Cost	kr		
Total			Total						
SUPPORTING CRITERIAS									
Technology Max 206 Points			Service Max 197 Points						
Contribution	Yes/No	Yes/No	Availiability	Yes/No	Yes/No				
R&D	Yes/No	Yes/No	Warranties	Yes/No	Yes/No				
Total			Total						

Evaluation Tool - Results				
Supplier	Existing Supplier	New Supplier 1	New Supplier 2	New Supplier 3
Quality				
Delivery				
Technology				
Service				
Total				
Cost				

Existing Suppliers

Evaluation Tool - Existing Suppliers									
Supplier	Name of Supplier		IF QUALIFYING CRITERIAS=		Continue to SUPPORTING CRITERIAS.				
Date	XX/XX-2014		IF QUALIFYING CRITERIAS=		The recommendation is to select another supplier.				
Within EU	Yes/No								
QUALIFYING CRITERIAS									
Quality Max 330 Points			Delivery Max 267 Points			Cost			
Rejection Rate	PPM		OTD	%		Net Price	kr		
ISO 9001	Yes/No	Yes/No	Lead Time	Days		Logistic Cost	kr		
ISO/TS 16949	Yes/No	Yes/No	Total			Total			
SUPPORTING CRITERIAS									
Technology Max 206 Points			Service Max 197 Points						
Contribution	Yes/No	Yes/No	Availability	Yes/No	Yes/No				
R&D	Yes/No	Yes/No	Warranties	Yes/No	Yes/No				
Total			Total						

Existing Supplier has been developed to evaluate suppliers currently used by the case company.

The first step when using the tool is to **name the supplier** to be evaluated.

The date when the evaluation is done should be noted, to keep track of when it was done and when the next evaluation should be placed.

Supplier	Name of Supplier
Date	XX/XX-2014
Within EU	Yes/No

Depending on if the supplier is a **member of EU** or not, different tax costs will be added to the Logistic cost.

QUALIFYING CRITERIAS									
Quality Max 330 Points			Delivery Max 267 Points			Cost			
Rejection Rate	PPM		OTD	%		Net Price	kr		
ISO 9001	Yes/No	Yes/No	Lead Time	Days		Logistic Cost	kr		
ISO/TS 16949	Yes/No	Yes/No	Total			Total			

The evaluation of an existing supplier starts with the **Qualifying Criteria's** – *Quality, Delivery & Cost*.

QUALITY

The Quality Criteria is evaluated through sub criteria's: - *Rejection Rate, ISO 9001 & ISO/TS 16949*. The Supplier can receive a maximum of 330 points.

Rejection Rate:

The rejection rate is the ratio between the number of defected products and the total quantity of delivered products.

Quality			Max 330 Points
Rejection Rate	PPM		
ISO 9001	Yes/No	Yes/No	
ISO/TS 16949	Yes/No	Yes/No	
Total			

$$\text{Rejection Rate (PPM)} = \frac{\text{Non – conforming Products}}{\text{Total Quantity of Delivered Products}}$$

The results must be replied in parts per million, PPM, and this value should be entered in the top grey square.

The Rejection Rate must reach a minimum value of 64 points, if the supplier is to be seen as suitable. A Rejection Rate higher than 1300 PPM is not acceptable and therefore also visualized in the Supplier Selection Tool, see picture below.

Quality			Max 330 Points
Rejection Rate	PPM	1300	64p
ISO 9001	Yes/No	Yes/No	-
ISO/TS 16949	Yes/No	Yes/No	-
Total			64p

Quality			Max 330 Points
Rejection Rate	PPM	1301	-
ISO 9001	Yes/No	Yes/No	-
ISO/TS 16949	Yes/No	Yes/No	-
Total			p

When the total points of the Rejection Rate criteria are $\geq 64p$, the square representing the total score becomes **GREEN**. This indicates that the evaluated Supplier is suitable and the evaluation should continue.

When the total points of the Rejection Rate criteria are $< 64p$, the square representing the total score becomes **RED**. This indicates that the evaluated Supplier provides an unaccepted quality level and should therefore be replaced if possible! This is visual in the Supplier Selection Tool, see picture below.

IF QUALIFYING CRITERIAS=		Continue to SUPPORTING CRITERIAS.
IF QUALIFYING CRITERIAS=		The recomendation is to select another supplier.

The Supplier can receive a maximum of 253 points in the Rejection Rate criteria.

ISO 9001 & ISO/TS 16949:

In addition to the Rejection Rate, two other sub-criteria's are taken into consideration – two different certification levels; ISO 9001 and ISO/TS 16949.

These are of less importance than the Rejection Rate and are therefore only a Yes-or No question, to be answered in the two lower squares in the Supplier Selection Tool, see an example in the figure below.

Quality		Max 330 Points	
Rejection Rate	PPM	1300	64p
ISO 9001	Yes/No	Yes	26
ISO/TS 16949	Yes/No	No	-
Total			90p

The Supplier can receive a maximum of 77 points in the Certification criteria's in total.

DELIVERY

If the Quality criterion is approved, next to evaluate is the Delivery criterion, consisting of sub criteria's *On Time Delivery* (OTD) & *Lead Time*. The Supplier can receive a maximum of 267 points.

On Time Delivery, OTD:

On Time Delivery displays the Suppliers ability to deliver accurate products in time. The OTD is the ratio between the products delivered as expected and the total delivered products.

Delivery		Max 267 Points	
OTD	%	?	169p
Lead Time	Days	45	p
Total			169p

$$OTD = \frac{\text{Orders Delivered in Time}}{\text{Total Quantity of Delivered Orders}}$$

The results must be replied in precents % - this value should be entered in the top grey square.

The Supplier can receive a maximum of 169 points in the OTD criteria.

Lead Time

Lead Time describes the time from when an order is placed at the Supplier office, until it arrives to the ordering company.

The results must be replied in days, and this value should be entered in the lowest grey square.

The Supplier can receive a maximum of 98 points in the Lead Time criteria.

The Delivery criterion must reach a **minimum value of total 100 points** for the supplier to be seen as suitable.

When the total points of the Delivery Criterion are $\geq 100p$, the square representing the total score becomes **GREEN**. This indicates that the evaluated Supplier is suitable and the evaluation should continue, see picture below.

Delivery		Max 267 Points	
OTD	%	96	101p
Lead Time	Days	45	p
Total			101p

When the total points of the Delivery Criterion are $< 100p$, the square representing the total score becomes **RED**. This indicates that the evaluated Supplier provides an unaccepted delivery level and should therefore be replaced if possible! This is visual in the Supplier Selection Tool, see picture below.

Delivery		Max 267 Points	
OTD	%	93	p
Lead Time	Days	5	98p
Total			98p

COST

When both the Quality and Delivery criteria's are approved, the Supplier has passed the minimum requirements and should therefore be seen as a qualified supplier.

The last of the Qualifying criteria's are Cost. This criterion is not valued like the other criteria's. Instead of gathering points, the cost criteria is valued after the combined cost involving the actual product delivered of the Supplier evaluated.

The sub criteria's belonging to the Cost criterion are *Net Price* & the *Logistic Cost*.

Net Price

Net Price is the price of a product excluding VAT. This value should be entered in the top grey square.

Logistic Cost

Cost	
Net Price	kr
Logistic Cost	kr
Total	
	0,00 kr

Logistics Cost is based on the Net Price and calculated thereafter – there if therefore no need to filled it in.

The calculation of the Logistic Cost is the Net Price multiplied with the size of the tax-cost.

- A Supplier with a membership in EU has an additional logistic charge of 2% calculated from the net price. The calculation of the Logistic Cost is:

$$\text{Logistic Cost} = \text{Net Price} \cdot 1,02$$

- A supplier without a membership in EU had an additional logistic charge of 8%, calculated from the Net Price. The calculation of the Logistic Cost is:

$$\text{Logistic Cost} = \text{Net Price} \cdot 1,08$$

This calculation is done automatically if the question “Within EU” is answered in the beginning of the Supplier Selection Tool.

The total Cost is the sum of the *Net Price* and the *Logistic Cost*:

$$\text{Total Cost} = \text{Net Price} + \text{Logistic Cost}$$

SUPPORTING CRITERIAS					
Technology Max 206 Points			Service Max 197 Points		
Contribution	Yes/No	yes	Availability	Yes/No	Yes/No
R&D	Yes/No	Yes/No	Warranties	Yes/No	Yes/No
Total			Total		

The next step for the approved Suppliers is to evaluate the **Supporting Criteria's** – Technology & Service. All of the sub criteria's consist of Yes or No statements. If **Yes** - the maximum points is awarded to the Supplier. A **No-answer** gives 0 points.

TECHNOLOGY

The Technology Criterion is evaluated through sub criteria's - *Contribution & R&D*.

The Supplier can receive a maximum of 206 points.

Technology Max 206 Points		
Contribution	Yes/No	Yes/No
R&D	Yes/No	Yes/No
Total		

Contribution

The contribution criterion is a measurement of the Suppliers input to the in-house company's product development.

If the Supplier has the capacity to contribute with product development to the in-house products, the answer in the Supplier Selection Tool is **Yes**, giving the Supplier 116 points.

Technology Max 206 Points		
Contribution	Yes/No	Yes 116p
R&D	Yes/No	Yes/No
Total 116p		

Research & Development, R&D

The R&D criterion evaluates if the supplier runs a separate product development-department, with an objective towards continuously improvements.

If the Supplier is working with R&D, the answer in the Supplier Selection Tool is **Yes** giving the Supplier 90 points.

Technology Max 206 Points		
Contribution	Yes/No	-
R&D	Yes/No	Yes 90p
Total		90p

SERVICE

The Service Criterion is evaluated through the sub criteria's - *Availability & Warranties*.

The Supplier can receive a maximum of 197 points.

Service Max 197 Points		
Availability	Yes/No	Yes/No
Warranties	Yes/No	Yes/No
Total		

Availability

Availability handles the aspect of whether or not the supplier is available from a service-point of view – available in terms of customer centres, inconvenient working hours and ability to receive emergency orders.

If the Supplier fulfils this, the answer in the Supplier Selection Tool is **Yes**, giving the Supplier 105 points.

Service Max 197 Points		
Availability	Yes/No	Yes 105p
Warranties	Yes/No	Yes/No
Total		105p

Warranties

Warranties handle the matter of how the supplier assures the in-house company of safe purchases. Is the in-house company provided with reasonable terms of payment and proper return-conditions?

If the Supplier fulfils this, the answer in the Supplier Selection Tool is **Yes**, giving the Supplier 92 points

Service Max 197 Points		
Availability	Yes/No	Yes/No
Warranties	Yes/No	Yes 92p
Total		92p

New Suppliers

New Supplier has been developed to evaluate new, potential suppliers. It is not possible to evaluate Existing Suppliers & New Suppliers in the same spreadsheet. due to lack of information of new suppliers, compared to existing ones. Rejection

Evaluation Tool - New Suppliers									
Supplier	Name of Supplier		QUALIFYING CRITERIAS=		Continue to SUPPORTING CRITERIAS				
Date	XX/XX-2014		QUALIFYING CRITERIAS=		The recommendation is to select another supplier				
Within EU	Yes/No								
QUALIFYING CRITERIAS									
Quality Max 330 Points			Delivery Max 267 Points			Cost			
ISO 9001	Yes/No	Yes/No	Lead Time	Days		Net Price	kr		
ISO/TS 16949	Yes/No	Yes/No			Total	Logistic Cost	kr		
		Total						Total	
SUPPORTING CRITERIAS									
Technology Max 206 Points			Service Max 197 Points						
Contribution	Yes/No	Yes/No	Availability	Yes/No	Yes/No				
R&D	Yes/No	Yes/No	Warranties	Yes/No	Yes/No				
		Total						Total	p

Rate and OTD is data collected continuously during a collaborative partnership with existing suppliers, but are not documented for potentially new suppliers.

The first step when using the tool is to **name the supplier** to be evaluated.

The date when the evaluation is done should be noted, to keep track of when it was done and when the next evaluation should be placed.

Supplier	Name of Supplier
Date	XX/XX-2014
Within EU	Yes/No

Depending on if the supplier is a **member of EU** or not, different tax costs will be added to the Logistic cost.

QUALIFYING CRITERIAS									
Quality Max 330 Points			Delivery Max 267 Points			Cost			
Rejection Rate	PPM		OTD	%		Net Price	kr		
ISO 9001	Yes/No	Yes/No	Lead Time	Days		Logistic Cost	kr		
ISO/TS 16949	Yes/No	Yes/No			Total			Total	
		Total							

The evaluation of the existing supplier starts with the **Qualifying Criteria's** – Quality, Delivery & Cost.

QUALITY

The Quality Criteria is evaluated through sub criteria's: *ISO 9001* & *ISO/TS 16949*. The Supplier can receive a maximum of 330 points.

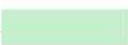

<u>Quality</u>		Max 330 Points
ISO 9001	Yes/No	Yes/No
ISO/TS 16949	Yes/No	Yes/No
Total		

<u>Quality</u>		Max 330 Points
ISO 9001	Yes/No	Yes 110p
ISO/TS 16949	Yes/No	No -
Total		110p

<u>Quality</u>		Max 330 Points
ISO 9001	Yes/No	No -
ISO/TS 16949	Yes/No	No -
Total		0p

When the total points of the Quality criteria are ≥ 110 p, the square representing the total score becomes **GREEN**. This indicates that the evaluated Supplier is suitable and the evaluation should continue.

When the total points of the Quality criteria are < 100 p, the square representing the total score becomes **RED**. This indicates that the evaluated Supplier provides an unacceptable quality level and should therefore be replaced if possible! This is visual in the Supplier Selection Tool, see picture below.

IF QUALIFYING CRITERIAS=		Continue to SUPPORTING CRITERIAS.
IF QUALIFYING CRITERIAS=		The recommendation is to select another supplier.

The recommendation is therefore not to use any Suppliers without any ISO certification regarding quality.

ISO 9001

If the Supplier possesses the ISO 9001 certification, the answer in the Supplier Selection Tool is **Yes**, giving the Supplier 110 points.

<u>Quality</u>		Max 330 Points
ISO 9001	Yes/No	Yes 110p
ISO/TS 16949	Yes/No	Yes/No
Total		110p

ISO/TS 16949

If the Supplier possesses the ISO/TS 16949 certification, the answer in the Supplier Selection Tool is **Yes**, giving the Supplier 220 points.

<u>Quality</u>		Max 330 Points
ISO 9001	Yes/No	Yes/No
ISO/TS 16949	Yes/No	Yes 220p
Total		220p

DELIVERY

If the Quality criterion is approved, the Delivery criterion is next to be evaluated, consisting of one sub criteria - *Lead Time*. The Supplier can receive a maximum of 267 points.

Delivery	Max 267 Points
Lead Time	Days <input type="text"/>
Total	

Lead Time

Lead Time describes the time from when an order is placed at the Supplier until it arrives to the ordering company.

The answer must be replied in days.

When the total points of the Delivery criteria are ≥ 133 p, the square representing the total score becomes **GREEN**. This indicates that the evaluated Supplier is suitable and the evaluation should continue.

Delivery	Max 267 Points
Lead Time	Days <input type="text" value="21"/>
Total	
	133p
	133p

When the total points of the Delivery criterion are < 66 p, the square representing the total score becomes **RED**. This indicates that the evaluated Supplier provides an unacceptable delivery rate and should therefore be replaced if possible!

Delivery	Max 267 Points
Lead Time	Days <input type="text" value="22"/>
Total	
	66p
	66p

The recommendation is therefore not to use any Suppliers requiring lead times longer than 22 days.

COST

When the Quality & Delivery criteria's are approved, the Supplier has passed the minimum requirements and should therefore be seen as a qualified supplier.

The last of the Qualifying criteria's are Cost. This criterion is not valued like the other criteria's. Instead of gathering points, the cost criteria is valued after the combined cost involving the actual product delivered of the Supplier evaluated.

The sub criteria's included in the Cost criterion are the *Net Price* & the *Logistic Cost*.

Net Price

Net Price is the price of the product excluding VAT. This value should be entered in the top grey square.

Logistic Cost

<u>Cost</u>		
Net Price	kr	
Logistic Cost	kr	0,00 kr
Total		0,00 kr

The Logistics Cost is calculated based on the Net Price, and therefore no need to be filled.

The calculation of the Logistic Cost is the Net Price multiplied with the size of the tax-cost.

- A Supplier with a membership in EU has an additional logistic charge of 2% of the Net Price. The calculation of the Logistic Cost:

$$\text{Logistic Cost} = \text{Net Price} \cdot 1,02$$

- A supplier without a membership in EU had an additional logistic charge of 8% of the Net Price. The calculation of the Logistic Cost:

$$\text{Logistic Cost} = \text{Net Price} \cdot 1,08$$

This calculation is done automatically if the question “Within EU” is answered in the beginning of the Supplier Selection Tool.

The total Cost is the sum of the Net Price and the Logistic Cost:

$$\text{Total Cost} = \text{Net Price} + \text{Logistic Cost}$$

SUPPORTING CRITERIAS					
Technology Max 206 Points			Service Max 197 Points		
Contribution	Yes/No	<input type="text" value="yes"/>	Availability	Yes/No	<input type="text" value="Yes/No"/>
R&D	Yes/No	<input type="text" value="Yes/No"/>	Warranties	Yes/No	<input type="text" value="Yes/No"/>
Total			Total		

The next step for approved Suppliers is the evaluation of the **Supporting Criteria's** – *Technology & Service*. These entire sub criteria's consist of Yes or No statements - If **Yes**, the maximum points is awarded to the Supplier. **No-answers** give 0 points.

TECHNOLOGY

The Technology Criterion is evaluated through sub criteria's - *Contribution & R&D*.

The Supplier can receive a maximum of 206 points.

Technology Max 206 Points		
Contribution	Yes/No	<input type="text" value="Yes/No"/>
R&D	Yes/No	<input type="text" value="Yes/No"/>
Total		

Contribution

The contribution criterion is a measurement of the Suppliers input to the in-house company's product development.

If the Supplier has the capacity to contribute with product development, the answer in the Supplier Selection Tool is **Yes**, giving the Supplier 116 points.

Technology Max 206 Points			
Contribution	Yes/No	Yes	116p
R&D	Yes/No	Yes/No	
Total			116p

Research & Development, R&D

The R&D criterion evaluates if the supplier runs a separate product development-department, with an objective towards continuously improvements.

If the Supplier is working with R&D, the answer in the Supplier Selection Tool is **Yes**, giving the Supplier 90 points.

Technology Max 206 Points			
Contribution	Yes/No	-	
R&D	Yes/No	Yes	90p
Total			90p

SERVICE

The Service Criterion is evaluated through sub criteria's - *Availability & Warranties*.

The Supplier can receive a maximum of 197 points.

Service Max 197 Points			
Availability	Yes/No	Yes/No	
Warranties	Yes/No	Yes/No	
Total			

Availability

Availability handles the aspect of whether or not the supplier is available from a service-point of view – available in terms of customer centres, inconvenient working hours and ability to receive emergency orders.

If the Supplier fulfils this, the answer in the Supplier Selection Tool is **Yes**, giving the Supplier 105 points.

Service Max 197 Points			
Availability	Yes/No	Yes	105p
Warranties	Yes/No	Yes/No	
Total			105p

Warranties

Warranties handle the matter of how the supplier assures the in-house company of safe purchases. Is the in-house company provided with reasonable terms of payment and proper return-conditions?

If the Supplier fulfils this, the answer in the Supplier Selection Tool is **Yes**, giving the Supplier 92 points

Service Max 197 Points			
Availability	Yes/No	Yes/No	
Warranties	Yes/No	Yes	92p
Total			92p

Results

The spreadsheet *Results* has been developed to facilitate the comparison between the different Suppliers evaluated, both new and existing ones. This worksheet summarizes the points from the other spreadsheets *Existing Supplier* and *New Supplier* as well– Making it visual and easy to select the best suitable Supplier.

Evaluation Tool - Results				
Supplier	Existing Supplier	New Supplier 1	New Supplier 2	New Supplier 3
Quality	p	p	p	p
Delivery	p	p	p	p
Technology	p	p	p	p
Service	p	p	p	p
Total	p	p	p	p
Cost	0,0 kr	0,0 kr	0,0 kr	0,0 kr

The design of the Evaluation Tool consists of one *Existing Supplier* -worksheet and three *New Supplier*-worksheets:

Results	Existing Suppliers	New Supplier 1	New supplier 2	New supplier 3
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This design is easy to change and can be tailored according to specific organisational needs.

To give an example of how the Result-sheet can be displayed, two different suppliers offering the same type of product has been compared – see figure below.

Evaluation Tool - Results				
Supplier	Existing Supplier A	New Supplier A	New Supplier 2	New Supplier 3
Quality	279p	110p	p	p
Delivery	267p	267p	p	p
Technology	206p	206p	p	p
Service	197p	197p	p	p
Total	949p	780p	p	p
Cost	69,6 kr	88,3 kr	0,0 kr	0,0 kr

According to this situation, one existing supplier is compared to one new supplier. The outcome shows that the existing supplier is the better choice, since both the price is lower and the points are higher than the points given to the new supplier.

In a situation like this, the company can be satisfied with the existing supplier used. **The importance of continuing evaluation of approved suppliers, to verify that the standard continues, is NOT to forget.**