

Strategic Supplier Evaluation

Considering environmental aspects

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CEDERROTH



Linköpings universitet
TEKNISKA HÖGSKOLAN

Master Thesis LIU-IEI-TEK-A--10/00974--SE
Department of Management and Engineering
Logistics Management

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Foreword

This report is our master thesis at the Institute of Technology at Linköping University at the Department of Management and Engineering. The master thesis constitutes a specialization within our majors, why this master thesis concerns logistics. The study aims at concluding the master program in Industrial Engineering and Management, where knowledge acquired during the studies together with a scientific approach should be applied to solve a task related to the education. Constituent for the thesis has been Cederroth AB and the study has been conducted at their head office in Upplands Väsby between September and December 2010.

This study would not have been possible without contribution from several persons. First of all we would like to thank our supervisor at Cederroth AB, Purchasing Manager Magnus Andersson, for his consistent support and valuable input throughout the study. Further, the supervisor at Linköping University, Håkan Aronsson, is awarded with many thanks for his wise advises, supportive guidance and helpfulness at any time. Cederroth representatives Mira Ludkiewicz, Monica Engström, Conny Åslund, Joakim Wersén and Mats Björkqvist deserve special thanks for sharing their knowledge and opinions with us as well as thanks to the interviewees and workshop participants for their contribution. Furthermore, the opponents Håkan Henriksson and Michael Niska are appreciated for their critically review of the study and their suggestions of improvement ideas along the way.

Conclusively, we have enjoyed the time spent at Cederroth working with this master thesis.

Upplands Väsby in December 2010

Emma Nordling and Jens Egeröd

Executive summary

Cederroth AB is a Swedish company in the fast-moving consumer goods industry established in 1895. The company manufactures health care, wound care, personal care and household consumer goods with focus on being environmental-conscious and manufacturing environmental-friendly products. In recent years the purchasing function has gotten increased attention as being enabler of accomplishing less environmental impact in business. The purchasing function at Cederroth holds the mission to deliver the lowest total cost of direct and indirect goods and services while supporting the production units and market divisions, which is intended to be extended to include environmental aspects as well. To develop in this direction Cederroth is currently transforming the focus of purchasing from price down to cost down and further to cost cut.

This study aims at presenting a strategic supplier evaluation model that can assist Cederroth in strategic supplier selection and give indications on potential areas for strategic supplier development. The evaluation model aims at assessing supplier performance also with respect to environmental aspects.

The final model has been developed through five steps, five models, with starting point in a theoretical review and basic empirical data constituting the first draft of the model. Following the first draft of the model has been evaluated and definitions of criteria have been determined, resulting in the second draft, which in turn has been evaluated and complemented by criteria descriptions and the third draft was concluded. The third draft of the model has been further developed by assigning weights to all criteria and criteria categories. Finally, the fourth draft has been tested in case studies on three existing strategic suppliers to Cederroth, resulting in the fifth draft which also constitutes the final model.

The final model includes the criteria and criteria categories shown in the table on the next page. The complete final strategic supplier evaluation model can be found in Appendix O, where descriptions for the criteria aiming at assisting the user of the model when interpreting the criteria as well as criteria weights and supplier rating are presented. The supplier will be awarded a score 1 to 5 depending on its performance for respective criterion. The score will thereafter be multiplied with the weight and a total supplier performance score is calculated based on the scores awarded to all criteria, the criteria weights and the criteria category weights. Then the supplier is ranked according to the total score achieved by classifying it into one of four defined classes, visualized below.

Classification	Score (1-5)
Supreme	> 4,60
Standard	3,80 < 4,60
Poor	3,00 < 3,80
Desourced	< 3,00

A challenge of this thesis has been to develop a general model that can be used for all of Cederroth's strategic suppliers despite their diverse characteristics. The model handles this directive by including criteria that cover aspects relevant for the entire spectrum of strategic suppliers and further by using the option of "Not applicable" for criteria that may be impossible to evaluate certain suppliers on. Hence, criteria that are not possible to evaluate a supplier on can be marked "Not applicable" in the

model instead of awarding a score 1-5. In such cases the model reassigns the criteria weights. Thereby the model is general and the output comparable among different strategic supplier categories. Furthermore, the final model is relatively extensive why it is suitable to apply on Cederroth's most strategic suppliers and not on the entire strategic supplier base currently consisting of approximately 40 suppliers.

Criteria category	Criteria
General	
	Uniqueness
	General attention from supplier
Production	
	Condition facilities/equipment
	Tidiness in production facilities
	Production-technical competence
Quality	
	Total value of complaints
	Total value of rejections
	Responsiveness
	Traceability
	Complaints management system
	Quality management system
	General product safety risk
	In process control/inspection
Logistics	
	Responsiveness
	Accuracy in logistics data
	Hitrate - Quantity
	Hitrate - Time
	Lead time reduction
	Short term flexibility in order volume
	IT-maturity
Product development	
	Product documentation
	Responsiveness
	R&D competence
	Technical support
	Product portfolio/Innovation
	Product development process
Purchasing	
	Responsiveness
	Cost reducing initiatives
	Supply chain risk assessment
	Investment plans and future visions
	Capacity for increased demand
	Knowledge about second tier suppliers
	Cost structure
Environment	
	Second tier supplier environmental evaluation
	Location distance
	Environmental management systems
	Compliance to environmental regulations and risk material assessment
	Energy and waste parameters
	Public disclosure of environmental record
	Potential for environmental cooperation
	Package performance

Table of Contents

1	INTRODUCTION.....	1
1.1	BACKGROUND.....	1
1.2	PURPOSE	2
1.3	DEFINITION OF AN ACADEMIC REPORT.....	2
1.4	THE SYSTEMS APPROACH	3
1.5	THE COMPOSITION OF THE REPORT	4
2	CEDERROTH AB	5
2.1	HISTORY	5
2.2	ORGANIZATION	6
2.3	PRODUCTION	7
2.4	LOGISTICS	8
2.5	PURCHASING	8
2.5.1	MISSION AND VISION.....	8
3	THEORETICAL REVIEW.....	15
3.1	SUPPLIER SELECTION CRITERIA	15
3.2	CRITERIA SELECTION	19
3.3	DEFINITIONS OF ENVIRONMENTAL PURCHASING	27
3.4	PURCHASING AND THE ENVIRONMENT	29
3.5	QUALITY MANAGEMENT AND ENVIRONMENTAL PURCHASING	44
3.6	WEIGHTING METHODS FOR SUPPLIER EVALUATION CRITERIA.....	45
3.7	SUPPLIER INFORMATION COLLECTION.....	48
3.8	SUPPLIER RATING.....	49
4	SPECIFICATION OF THE TASK.....	53
4.1	PROBLEM IDENTIFICATION	53
4.2	PROBLEM DISCUSSION	53
4.3	SYSTEM DESCRIPTION	54
4.4	DEFINITION OF ENVIRONMENTAL PURCHASING	55
4.5	PURPOSE BREAKDOWN	56
4.6	SUMMARY OF THE STUDY'S QUESTIONS	60
4.7	DELIMITATIONS OF THE STUDY.....	60
5	METHODOLOGY	63
5.1	SCIENTIFIC APPROACH.....	63
5.2	METHODOLOGY OF THIS INVESTIGATION	65
5.3	CRITICISM OF THE METHODOLOGY.....	72
6	MAPPING AND ANALYSIS OF CURRENT STAND	75
6.1	CRITERIA CATEGORIES IDENTIFIED THROUGH GENERAL INTERVIEWS	75
6.2	SUPPLIER EVALUATION CRITERIA IN EXISTING MODEL.....	77
6.3	CENTRAL CRITERIA IDENTIFIED THROUGH SPECIAL INTERVIEWS	80
7	ANALYSIS OF CRITERIA.....	83
7.1	CREATION OF THE MODEL.....	83

7.2	GENERAL CRITERIA	84
7.3	PRODUCTION CRITERIA.....	85
7.4	QUALITY CRITERIA.....	87
7.5	LOGISTICS CRITERIA	93
7.6	PRODUCT DEVELOPMENT CRITERIA	97
7.7	PURCHASING CRITERIA	102
7.8	ENVIRONMENTAL CRITERIA	107
7.9	CRITERIA INTERCONNECTIVITY	114
8	ANALYSIS OF CRITERIA WEIGHTING	117
8.1	SELECTION OF WEIGHTING MODEL.....	117
8.2	LIKERT SCALE DESIGN	118
8.3	WEIGHTING RESPONSIBILITY	119
8.4	WEIGHTING RESULTS.....	121
9	ANALYSIS OF SUPPLIER EVALUATION.....	125
9.1	SUPPLIER INFORMATION COLLECTION.....	125
9.2	SUPPLIER RATING.....	126
9.3	CASE STUDIES	128
10	CONCLUSIONS AND RECOMMENDATIONS.....	135
10.1	PURPOSE FULFILLMENT	135
10.2	THE STRATEGIC SUPPLIER EVALUATION MODEL.....	138
10.3	DIRECTIVES.....	141
10.4	SUGGESTIONS ON FUTURE ACTIONS	143
10.5	SENSITIVITY ANALYSIS	144
11	DISCUSSION	151
11.1	DELIMITATIONS AND PRIORITIES.....	151
11.2	GENERALNESS.....	151
11.3	CONTRIBUTION	152
12	BIBLIOGRAPHY	153

Table of Figures

FIGURE 1 ORGANIZATIONAL STRUCTURE (CEDERROTH AB, COMPANY PRESENTATION, 2010)	6
FIGURE 2 DESCRIPTION OF THE STRATEGIC PURCHASING ORGANIZATION (CEDERROTH AB, PURCHASING PRESENTATION, 2010)	7
FIGURE 3 INTERPRETIVE STRUCTURAL MODEL (ISM) FOR VENDOR SELECTION CRITERIA (MANDAL & DESHMUKH, 1993).....	19
FIGURE 4 IDENTIFYING THE INFLUENCE OF THE ENVIRONMENTAL STRATEGY ON THE SUPPLIER SELECTION PROCEDURE (NOCI, 1997)	32
FIGURE 5 CLASSIFICATION OF GREEN PURCHASING STRATEGIES (MIN & GALLE, 1997)	33
FIGURE 6 SIX KEY CONCEPTS FOR ENVIRONMENTAL MANAGEMENT, MAKOWER (1994) IN WEE ET AL (2005).....	36
FIGURE 7 SEVEN CRITICAL FACTORS OF ENVIRONMENTAL MANAGEMENT (WEE & QUAZI, 2005)	37
FIGURE 8 FRAMEWORK FOR ENVIRONMENTAL PERFORMANCE ATTRIBUTES (HANDFIELD, WALTON, SROUFE, & MELNYK, 2002).....	42
FIGURE 9 SYSTEM DESCRIPTION	55
FIGURE 10 PURPOSE BREAKDOWN	57
FIGURE 11 ILLUSTRATION OF RELIABILITY AND VALIDITY MEASUREMENTS BASED ON (BJÖRKLUND & PAULSSON, 2003)	64
FIGURE 12 METHODOLOGY PROCEEDING.....	65
FIGURE 13 ACCOMPLISHMENT OF THE PRELIMINARY STUDY.....	66
FIGURE 14 OUTLINE OF THE TASK DEFINITION	67
FIGURE 15 PROCEEDING OF THE MODEL CREATION	68

Table of Tables

TABLE 1 FRAMEWORK FOR SCIENTIFIC APPROACHES BY ABNOR ET AL (1997) IN GAMMELGAARD (2004)	3
TABLE 2 PURCHASING PROCESS DOCUMENTS	11
TABLE 3 GUIDELINES FOR SUPPLIER ATTRIBUTE (MURALIDHARAN, ANANTHARAMAN, & DESHMUKH, 2002)	16
TABLE 4 SIX ATTRIBUTES AND LEVELS OF SUPPLIER PERFORMANCE (MUMMALANENIA, DUBAS, & CHAOC, 1996)	17
TABLE 5 DEFINITIONS OF THE EIGHT METRIC EVALUATION CRITERIA (CAPLICE & SHEFFI, 1994)	18
TABLE 6 CRITERIA CATEGORIES SUGGESTED BY THE LITERATURE	21
TABLE 7 CRITERIA RELATED TO ORGANIZATIONAL ASPECTS	22
TABLE 8 CRITERIA RELATED TO PRODUCTION ASPECTS	22
TABLE 9 CRITERIA RELATED TO QUALITY ASPECTS	23
TABLE 10 CRITERIA RELATED TO LOGISTICS ASPECTS	24
TABLE 11 CRITERIA RELATED TO PRODUCT DEVELOPMENT ASPECTS	25
TABLE 12 CRITERIA RELATED TO PRICE/COST ASPECTS	26
TABLE 13 CRITERIA SUGGESTED IN THE LITERATURE THAT ARE DIFFICULT TO CATEGORIZE	27
TABLE 14 DEFINITIONS OF ENVIRONMENTAL PURCHASING	27
TABLE 15 STRATEGIES FOR ENVIRONMENTAL MANAGEMENT (WALTON, HANDFIELD, & MELNYK, 1998)	33
TABLE 16 SUMMARIZATION OF ENVIRONMENTAL PERFORMING FACTORS DERIVED FROM THE LITERATURE	35
TABLE 17 CRITERIA FOR SUPPLIER ENVIRONMENTAL PERFORMANCE (HANDFIELD, WALTON, SROUFE, & MELNYK, 2002)	41
TABLE 18 ENVIRONMENTAL VARIABLES AFFECTING SUPPLIER SELECTION (MIN & GALLE, 2001)	43
TABLE 19 MULTI - CRITERIA DECISION MAKING APPROACHES DISCUSSED BY (HO, XU, & DEY, 2010), (FACTS NOT DISCUSSED IN THE REPORT ARE MARKED N/A)	46
TABLE 20 PERFORMANCE OF STATE OF THE ART MODELS FOR ENVIRONMENTAL VENDOR RATING SYSTEMS (NOCI, 1997)	47
TABLE 21 SUPPLIER INFORMATION COLLECTION (GORDON, 2005)	49
TABLE 22 SUPPLIER CLASSIFICATION DUE TO SCORING RESULTS (BAYER AG, 2010)	50
TABLE 23 CRITERIA CATEGORIES MENTIONED AS IMPORTANT FOR SUPPLIER EVALUATION	75
TABLE 24 SUMMARIZATION OF CRITERIA IN EXISTING SUPPLIER EVALUATION MODEL, FOR DETAILS SEE APPENDIX D	78
TABLE 25 EXISTING SCALE FOR EVALUATING SUPPLIER PERFORMANCE	79
TABLE 26 CENTRAL CRITERIA IDENTIFIED THROUGH SPECIAL INTERVIEWS	80
TABLE 27 CATEGORIZATION OF ENVIRONMENTAL CRITERIA IN REACTIVE AND PROACTIVE CRITERIA	108
TABLE 28 CRITERIA WEIGHTING RESPONSIBILITIES	120
TABLE 29 WEIGHTING RESULT	123
TABLE 30 SUPPLIER INFORMATION COLLECTION METHODS RECOMMENDED FOR CEDERROTH	126
TABLE 31 BAYER AG SUPPLIER CLASSIFICATION WITH CORRESPONDING PERCENTAL SCORE	128
TABLE 32 SUPPLIER CLASSIFICATION FOR THE EVALUATION MODEL PROPOSED IN THIS STUDY	128
TABLE 33 SCHEME OF CEDERROTH REPRESENTATIVES EVALUATING THE CASE SUPPLIERS	129
TABLE 34 SUMMARIZATION OF CASE SUPPLIERS' TOTAL SCORE	130
TABLE 35 TRADITIONAL CRITERIA CATEGORIES AND CORRESPONDING CRITERIA INCLUDED IN THE MODEL	136
TABLE 36 SPECIFIC CRITERIA CATEGORIES AND CORRESPONDING CRITERIA INCLUDED IN THE MODEL	137
TABLE 37 CATEGORIZATION OF ENVIRONMENTAL CRITERIA IN REACTIVE AND PROACTIVE CRITERIA	137
TABLE 38 CRITERIA AND CRITERIA CATEGORIES INCLUDED IN THE STRATEGIC SUPPLIER EVALUATION MODEL	139
TABLE 39 SUPPLIER CLASSIFICATIONS DUE TO ACHIEVED TOTAL SCORE	140
TABLE 40 TOTAL SCORE CHANGES DUE TO DIFFERENT WEIGHTING METHOD USED	146
TABLE 41 TOTAL SCORES ACHIEVED BY CMCS DUE TO DIFFERENT WEIGHTS USED	147
TABLE 42 CHANGE IN WEIGHTS WHEN ONE CRITERION IS "NOT APPLICABLE"	147
TABLE 43 ANALYSIS OF THE INFLUENCE ON THE TOTAL SCORE FROM EACH CRITERIA CATEGORY	149
TABLE 44 TOTAL SUPPLIER SCORE ACHIEVED WHEN PERFORMING POOR IN ONE CATEGORY RESPECTIVELY. TOTAL SCORE RESULTING IN CLASSIFICATION IN THE SUPREME CLASS IS UNDERLINED; ALL OTHER TOTAL SCORES ARE RESULTING IN STANDARD CLASS.	149

1 Introduction

This chapter aims at presenting the background and purpose of the study to the reader. Additionally, definition of an academic report is described to give the reader an understanding of how the report is structured and why. The approach selected for this study is further discussed in the end of the chapter.

1.1 Background

Today's heightened regulations from governments and a rapidly growing environmental awareness among customer drive companies to undertake initiatives to transform their supply chain processes and together with their suppliers work towards improvement of environmental performance (Lu, Wu, & Kuo, 2007). A survey did show that purchasing managers' second highest rated future concern was the impact of environmental regulation on purchasing activities (Carter & Carter, 1998). Because of the purchasing position in the beginning of the value chain, it does have a large impact on company's environmental performance. To be successful the company needs to incorporate the environmental goals with purchasing operations (Walton, Handfield, & Melnyk, 1998).

The importance of the purchasing function is increasing not only towards becoming a strategic function but also to pay large attention to environmental issues and involve such aspects in decision-making. This results in new problematic concerning how to handle both qualitative and quantitative factors in the supplier selection process and supplier evaluation process. Few firms apply a structured analysis evaluating suppliers in regard of environmental criteria and a methodology for integrating environmental issues in the process is exceedingly needed. (Handfield, Walton, Sroufe, & Melnyk, 2002)

By implementing ISO 14001, supporting continuous improvement of environmental management systems and education programs, a company compounds its environmental awareness and its focus on environmental issues and activities. Studies indicate that environmental performance as well as a company's relative competitiveness in the market increase when getting certified with ISO 14001 (Chen, 2005).

Trend towards larger supplier base in a company's business chain makes the importance of objective assessment of supplier performance higher. A long-term supplier strategy is in many cases essential for a company's development and profitability and a crucial part of the overall business strategy. A supplier of today often needs to fulfill requirements other than just those concerning material and service, such as requirements that prove the supplier's capability and suitability to live up to a company's long-term requirements and needs. It is vital to assure that the supplier can guarantee sustained continuity of supply and to be aware of its performance, strengths and weaknesses. Through implementing a structured approach gathering data of supplier performance strict agreements can be negotiated about improving reject rates, reducing total lead time and contributing to cost reduction. (van Weele, 2005)

Cederroth have recently run an update of the general business plan, which is valid until 2012. The environmental engagement is therein clearly defined as an important part in strengthening the

profile of the company's trademarks, foremost through focusing on sustainable solutions and environmental-caring actions. For the purchasing department this concerns choice of material, transport solutions and continuous improvements by suppliers such as waste handling, energy consumption and recycling. As one step in Cederroth's environmental engagement, the largest production unit in Falun will be certified due to ISO 14001 during the first quarter of 2011. Besides many products have been labeled with the Nordic Ecolabel and the ecolabel of SSNC, Bra Miljöval, and the brand Grumme has been voted for Sweden's greenest brand 2009.(Andersson, 2010)

To continue the development of becoming an even better company from an environmental perspective, Cederroth's purchasing department would like to integrate environmental criteria in the purchasing process as a natural part of the purchasing strategy, especially considering supplier evaluation. Today the process does not take environmental issues into consideration. Furthermore the existing supplier evaluation is based on rather subjective assessment and evaluation performed by the purchasers with support from R&D, logistics and quality department. An expressed issue is the lack of guidelines for how to assess suppliers based on the existing criteria. Cederroth see potential in developing the evaluation process into becoming an objective process with substantial and measurable criteria predominant and supported by clearly defined guidelines for how to perform the assessment, especially for those criteria that cannot be measured. This can help the company keeping better track of principally their strategic suppliers' performance and highlight potential areas for supplier development in a more structured and detailed manner.(Andersson, 2010)

1.2 Purpose

This study aims at presenting a strategic supplier evaluation model that can assist Cederroth in strategic supplier selection and give indications on potential areas for strategic supplier development. The evaluation model aims at assessing supplier performance also including environmental aspects.

1.3 Definition of an academic report

To give the reader a better insight to the structure and the character of this study, the characteristics and requirements of an academic report is presented. This master thesis constitutes an academic report and therefore certain requirements on the report need to be fulfilled. Björklund et al (2003) describes an academic report as a product characterized by:

- A general connection
- Theoretical dimension
- Uses accepted general methods for information collection and analysis
- Gives the reader opportunity to decide stance to the study and its results independently

The first requirement regarding general connection can be described by the fact that the study discusses questions of a certain general interest as well as discussing the generalness of the results. The theoretical dimension includes the aspects that the study has its foundation in academic knowledge and that the results are well-anchored in that foundation. The line of argument should be visible during the entire report in addition to the requirements mentioned. Finally, an academic report has to be verifiable, repeatable and individually independent. (Björklund & Paulsson, 2003)

This report constitutes an academic report, hence these requirements are respected.

1.4 The systems approach

Gammelgaard (2004) discusses the most appropriate approach for logistics research. Due to the author there are three major schools; the analytical school, the systems school and the actors school. The analytical school is built on positivism and based on an objective reality in which patterns and underlying relations can be investigated mainly through research. Further the authors means that the consequence of an analytical approach is the decomposition of the reality into minor parts that will be modified into concepts, which aim at revealing cause-effect-relations primary by testing hypothesis. Overseen in this approach is the interconnectivity and relationship between these decomposed parts. Statistical information and procedures are commonly applied in this school which is characterized by the method of quantitative data analysis. The systems approach is defined by a holistic and contextual view and suggests that the world should be looked upon as consisting of mutually dependent components; hence it constitutes the contrary to the analytical approach. Following the systems approach the researcher tries to identify parts of the system as well as links, goals and feedback mechanisms. The nature of the approach is pragmatic by trying to find a solution that works in practice and not an absolute truth, such as the analytical approach. Preferred method in the systems approach is case studies. The third school, the actors school, differs significantly from those presented. It describes the reality as not objective but rather the result of social structures. To exemplify the definition, reality is found to be a construction and knowledge is interpreted as socially constructed because knowledge creation depends on the interpretation of the researcher. The three approaches are summarized in Table 1. (Gammelgaard, 2004)

Table 1 Framework for scientific approaches by Abnor et al (1997) in Gammelgaard (2004)

	<i>Analytical approach</i>	<i>Systems approach</i>	<i>Actors approach</i>
Theory type	Determining cause-effect relations. Explanations, predictions. Universal, time and value free laws.	Models. Recommendations, normative aspects. Knowledge about concrete systems.	Interpretations, understanding. Contextual knowledge.
Preferred method	Quantitative (qualitative research only for validation).	Case studies (qualitative and quantitative).	Qualitative.
Unit of analysis	Concepts and their relations.	Systems: links, feedback mechanisms and boundaries.	People and their interaction.
Data analysis	Description, hypothesis testing.	Mapping, modelling.	Interpretation.
Position of the researcher	Outside.	Preferably outside.	Inside – as a part of the process.

The author means that logistics is too complex for deriving casual-effect relations and that the systems approach is the most appropriate approach to apply in logistics research when it tends to visualize concrete systems as maps and models. Based on this theory the systems approach is adopted in the logistics research of this study.

1.5 The composition of the report

This chapter aims at giving the reader an understanding of how the report is structured and a brief insight into the content of each chapter.

This first chapter presents the background to the study which consequence in an introduction of the purpose. Additionally, a short discussion about the definition of an academic report and the scientific approach is held. Chapter 2 *Cederroth AB* describes Cederroth's organization and operations in general as well as the purchasing department particularly, when this report especially concerns purchasing. Chapter 3 *Theoretical review* contains theoretical aspects of issues related to the purpose of the study and serves together with chapter 2 as foundation for the task specification. Chapter 4 *Specification of the task* breaks down the purpose in fragments and results in questions which need to be answered to fulfill the purpose defined. The proceeding of the study is described in chapter 5 *Methodology*, where the reader will be introduced to the model creation in five steps. The first draft, model 1, is designed based on the theoretical review and interviews, thereafter modified due to new input from workshops resulting in model 2, which in turn will be modified three times resulting in model 3, model 4 and the final model. Chapter 6 *Mapping of current stand* describes the status quo of the existing strategic supplier evaluation presenting the existing model used by Cederroth and results from interviews. The analysis of criteria included in the strategic supplier evaluation model proposed is to be found in chapter 7 *Analysis of criteria* followed by an analysis of the weighting of the criteria presented in chapter 8 *Analysis of criteria weighting* which motivate weighting model used as well as weighting procedure and responsibility. Chapter 9 *Analysis of supplier evaluation* analyzes the usage of the model proposed, the rating of the suppliers and finally the outcome of the case studies performed. At last the conclusions and recommendations are presented in chapter 10 *Conclusions and recommendations*. Initially the chapter assures the reader that the purpose is fulfilled, thereafter the final model is presented and directions for how to use the model. Finally the chapter includes a sensitivity analysis of the strategic supplier evaluation model proposed. Chapter 11 *Discussion* contains discussions about the generalness of the study, theoretical contribution and delimitation and priorities made are addressed. The final version of the model can be found in Appendix O.

For the reader who solely wants to review the result of the study, chapter 10.2 and chapter 10.4 are recommended. For the reader who wants to use the strategic supplier evaluation model, chapter 10.3 is suggested. When developing the model in the future, chapter 3, 7, 8, 9 and 10.4 is suggested to be of high relevance.

2 Cederroth AB

The chapter presents the case company, Cederroth AB, to the reader in detail by initially giving a short historical review of the company, following presenting the organization with focus on purchasing and briefly on logistics and production and finally describing the purchasing processes as well as focusing on environmental aspects associated with purchasing. A discussion about Cederroth's strategic suppliers will further be held to increase the understanding of their characteristics.

2.1 History

Cederroth is a company with a long history that stretches back to 1895. At that time Christian Cederroth founded the company Cederroth's Technical Factory in Gävle. The initial product produced was a malt coffee named St Bravo with a Viking chosen as logotype. In 1900 the new product "Amerikanske Jernextrakt Samarin" was introduced beside the coffee. It was a health compound and told to "give health and power to everyone" and became predecessor to the popular Samarin. Because of its success Christian Cederroth decided to drop all other products in the range and exclusively back up Samarin. 1925 Samarin was introduced on the Norwegian market and furthermore produced and sold on license in Finland. Still the complete production process is made by hand. After the Second World War Cederroth wanted to sell a product that is classified as a war requisite and consequently the plaster Salveplast takes place in the product portfolio, later on renamed Salvequick, which also became the hot item. The modern Salvekquick was launched in 1953 and differed from previous products when it was a pre-cut bandage. Shortly after Salvefix was introduced, the first adhesive plaster tape and later followed by Sajp which had a role with a serrated dispenser edge. (Cederroth AB)

Establishment of subsidiaries in Finland and Denmark and of Cederroth International S A in Geneva indicates a distinct expansion in Scandinavia and Europe during the 1950s. Plaster is produced in Stockholm and the cleansing wipe Savett and the product Topz enter the market during the 1960s. The company growth induced a new, modern production plant in Upplands Väsby 1973 and a R&D-company named Innovia was established in 1970. An explanation to the increased sales was that sales not only were directed towards consumers but also to companies, organizations and healthcare industry. Sales of first aid products primary to the industry started 1975. (Cederroth AB)

A significant growth follows in the 1980s when the company takes over distribution rights of Sweden's best-selling liquid soap and by including health food products and natural medicines in the product portfolio. 1991 a large part of Cederroth Nordic AB is bought by the American Alberto-Culver Company and in connection with the buy the company name changes to Cederroth International. The new owner's hair product brand V05 is now distributed by Cederroth. (Cederroth AB)

An environmental approach was recognized in 1993 when the first eco-friendly plaster was launched. Another milestone in Cederroth's history is the purchase of Mölnlycke Toiletries Group which made Cederroth one of Sweden's largest chemical engineering companies. Products within the personal care and household sector that previously belonged to Mölnlycke were transferred to Cederroth. In the 2000s significant market changes have been observed and a trend toward including beauty products is identified. Additionally the weight loss program Allevo is develop and launched. The companies Soraya in Poland and Paramedical in Denmark have been acquired as well as the Norwegian brand Vitaplex and contribute considerably to the expansion. (Cederroth AB)

The investment company CapMan did acquire the majority interest in Cederroth in 2008 with Finnish Litorina as minority shareholder (Cederroth AB, Company Presentation, 2010). 2009 there was another name change from Cederroth International to Cederroth AB, which is the current name of the company. Net sales 1 Oct 2008 – 31 Dec 2009 was 2 284 MSEK. Today Cederroth AB is the parent company in the Cederroth AB corporate group which except from the parent company consists of business-driving affiliates. The corporate group pursues development, manufacturing, marketing and sales of personal care, healthcare, household, first aid and wound care products with sales primary through the affiliates. Where geographical representation is missing Cederroth AB sell their products through distributors. Additionally the corporate group is responsible for distribution of numeral external brands and manages contract manufacturing of medical products and personal care products for a number of customers. (Cederroth AB, Annual report 2009)

2.2 Organization

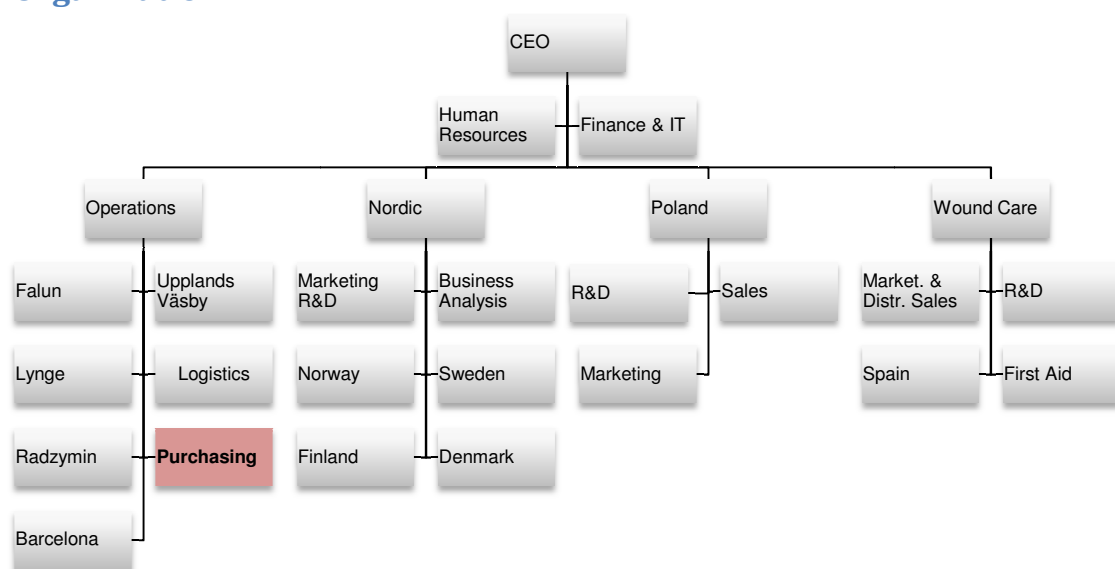


Figure 1 Organizational structure (Cederroth AB, Company Presentation, 2010)

Today Cederroth have approximately 800 employees in seven countries in Europe. The organizational structure of the company is visualized in Figure 1. The structure is consisting of four different divisions; Operations, Nordic, Poland and Wound Care. Human Resources and Finance & IT are central departments covering all four divisions. Purchasing is a function under Operations and manages strategic purchasing activities and decisions for the entire company, hence purchasing can be seen as a centralized function within Cederroth (Cederroth AB, Company Presentation, 2010). The cities named under Operations represent the production departments whilst logistics and purchasing for these production sites are centrally coordinated from the head quarter in Upplands Väsby. The remaining three divisions Nordic, Poland and Wound Care mainly concern R&D, sales and marketing activities and no operations activities.

2.2.1 Strategic purchasing organization

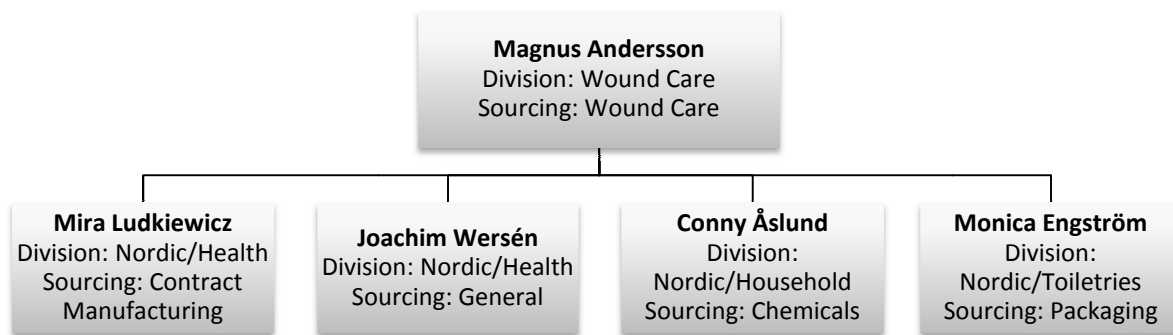


Figure 2 Description of the strategic purchasing organization (Cederroth AB, Purchasing presentation, 2010)

Five persons work with purchasing within Cederroth on a strategic level. Responsibilities are categorized after division and sourcing area. Magnus Andersson is Purchasing Manager and chief for the purchasing department as well as additionally responsible for the wound care sourcing category and division. Mira Ludkiewicz, Senior Buyer, is responsible for the Nordic/Health division and for the sourcing category Contract Manufacturing. Joachim Wersén, project manager sourcing, is belonging to the division Nordic/Health and liable for sourcing category General and currently working with supplier development and consolidation projects. Magnus Andersson, Mira Ludkiewicz and Joachim Wersén are positioned in the head quarter in Upplands Väsby. Conny Åslund, Senior Buyer, and Monica Engström, Senior Buyer, are additionally members of the purchasing team but located in Falun. Conny Åslund belongs to the division Nordic/Household and purchases primary chemicals, though occasionally responsible for sourcing of transportation services. Monica Engström works within the Nordic/Toiletries division and responsible for sourcing category Packaging. The organizational structure within strategic purchasing department is visualized in Figure 2. (Cederroth AB, Purchasing presentation, 2010)

2.3 Production

There are five production plants within Cederroth located in Poland, Denmark, Spain and Sweden, where two are to be found in Upplands Väsby and Falun respectively. The production plant in Falun is the largest producing personal care, household and wound care products exemplified by the brands Grumme, Salvekwick, HTH, Bliw and Family Fresh. The plant is ISO 9001:2000 certified and further holds an additional ISO 13485:2003 certification for wound care products. A laboratory and a department for development are located in Falun and there is a central warehouse for goods distribution and export in close connection to the plant location.

In Upplands Väsby there is a minor production plant specialized in manufacturing of powder products such as Seltin and Samarin. Packaging of these products is also performed at the plant. In Denmark the Paramedical production plant manufactures health food products like vitamins, minerals and dietary supplements. Just like the production plant in Falun this site as well as the Soraya plant in Poland are extended with a development department and a laboratory. Extraordinary for the paramedical plant is the contract manufacturing of pharmaceuticals for international customers. In Poland the plant primary produces cosmetic products under the brand Soraya and is characterized by high flexibility due to products that require packaging that differs to large extent

from each other. The products manufactured at the Soraya plant are primary for the Polish market and a distribution centre is located in Warsaw. The latest acquired production plant is the one in Spain where wound care products are manufactured.

2.4 Logistics

Cederroth have a long-term production plan that stretches three months forward in time. However, this production plan is broken down into weekly production plans that are daily modified due to unforeseen changes and sudden obstacles. Goal is to work with a more or less fixed production plan for products with high frequency while a flexible production plan is acceptable for products with lower frequency. To achieve this goal the same requirements on a fixed production plan need to be transmitted to the suppliers and their production plan. Today, the production plan is sent to the suppliers to inform them about the upcoming demand. By having a fixed production plan for high-frequent products the stock levels can be reduced. (Björkqvist, 2010)

Cederroth experience that their customers are tightening delivery parameters in their work towards lean processes. A good example is ICA, who has set a fixed time window for delivery from Cederroth to +/- 15 minutes. When Cederroth deliver too late or too early the delivery is denied by ICA. Just like ICA Cederroth want to develop in the same direction, making their logistic processes leaner hence tightening their delivery parameters towards their own suppliers. To succeed, Cederroth need to start collecting and assuring that data regarding logistics from their suppliers are correct and registered. Mats Björkqvist suggests that data related to how the goods are handled, stored and transported need to be checked on accuracy. These data can be defined as (Björkqvist, 2010):

- Tagging of goods
- Volume of goods
- Weight of goods
- Quantity/pallet

It is a fact that Cederroth need to put pressure on their suppliers and make them follow guidelines regarding how to package the goods. This will enable changes in the goods handling such as double palleting. (Björkqvist, 2010)

Incoterms for packaging materials constitute about 70 % of purchased material ex works (EXW) while 30 % of purchased packaging material is delivered due to the incoterm delivered duty paid (DDP). For chemicals the proportion is reverse and about 80 % are delivered with DDP and 20 % EXW. Conny Åslund, Senior Buyer at Cederroth, is responsible for transport contracting but hands over the responsibility for transportation when the contracting process is completed. (Åslund, 2010)

2.5 Purchasing

2.5.1 Mission and vision

The purchasing mission is formulated by Cederroth as “to deliver the lowest total cost of direct and indirect goods and services while supporting the production units and the market divisions within Cederroth AB”. To fulfill the mission, the approach applied is having a competent purchasing organization whose primary goals are to identify commercial opportunities and further build partnerships with strategic suppliers. The intended strategy is to define customized purchasing strategies for every specific product category and strive for consolidation volumes within the entire

company where possible. Cederroth are aiming at holding a high-performing and competitive supplier base, a goal that will be reached through continuous category evaluations performed on regular basis. The supplier base will continuously be analyzed to perform adjustments and optimization of the number of suppliers per category. (Cederroth AB, Purchasing presentation, 2010)

Another highlighted issue is supplier relationships, which will be taken to the next level with a selected number of strategic suppliers in order to reach quality improvements, cost eliminations and to drive innovation. Regarding the supplier category chemicals, there is a call for qualification of alternative sources to gain leverage and reduce single sourcing within the category. Currently costs are mainly reduced by regular forecasting, capacity commitment, VMI and common projects. (Cederroth AB, Purchasing presentation, 2010)

Cederroth's owner, CapMan, have suggested Cederroth to reduce their supplier base and reduce number of products in the product portfolio to achieve greater leverage and easier handling. (Andersson, 2010)

2.5.2 Strategic purchasing activities

Strategic purchasing includes all activities starting from supplier selection activities to the moment when the first order is executed. Thereafter local purchasers take responsibility for running orders. The local purchasers follow up occasional delivery problems but when repeated the issue is redirected to the strategic suppliers. Cost control, supplier development, agreement negotiation and re-negotiation and definition of safety stock levels are example of activities performed by the strategic purchasers. Audits are further performed by teams where strategic purchasing department is represented. (Ludkiewicz, 2010)

Movex is Cederroth's ERP-system, in which Hitrate is an affiliate program where strategic suppliers' delivery accuracy and delivery security are stored and monthly evaluated. Delivery accuracy shows within which time frame the supplier delivers and delivery security measures the quantity of correct deliveries. When using Hitrate one should be aware of the inaccuracy that may occur if warehouse personnel do not update the system on time when a delivery is correctly delivered. In such cases it can appear as if a delivery is delayed even though it has arrived at Cederroth on time. The apparent delay is then caused by warehouse personnel. (Ludkiewicz, 2010)

2.5.3 Purchasing process

A bid package is an enquiry to new and existing suppliers. This can result in consolidation of existing materials bought, but does not have to. First, specification of which material that is to be purchased has to be defined and described. Regarding chemicals, this can for example be bulk chemicals with a certain annual purchase volume. The restrictions result in a limited group of chemicals and a certain number of existing and potential suppliers to which the bid package will be sent. Normally the bid package is sent to all existing and to approximately a handful of new suppliers when regarding sourcing of chemicals. (Åslund, 2010)(Engström, 2010)

Negotiable conditions are not taken under consideration in the bid package but left out until the final negotiation process. The final quote is attached as appendix to the supplier agreement. Standard agreements are commonly used. In connection with signing the agreement a supplier audit is performed by representatives from strategic purchasing and quality department. Lack of resources

results in that audits approximately are performed every second year, though optimal would be to execute supplier audits annually. (Ludkiewicz, 2010)

In the decision-making process price is an essential criterion but delivery time is also important to remark. At present, the low capital cost in relation to expensive freight reduces this criterion to a second priority. Volumes ordered too early constitute another problem when the available warehouse space is strictly limited. In this case packaging causes larger problems than chemicals. (Åslund, 2010)

New suppliers or distributors of chemicals are fairly seldom taken into the supplier base, for new material though this occurs more frequently. Potential new suppliers are identified on fairs, Internet and by sales representatives etc. When a new material will be used, exhaustive tests must be performed and finally the material has to be approved by R&D. Since one year a deeper cooperation between R&D and purchasing are carried out focusing on prioritizing qualification of new material within Cederroth. The purpose is to create a common agenda for both departments and reach effectiveness by working towards one common goal. (Åslund, 2010)(Engström, 2010)

Purchase of material to the production is supplied by the process described in Appendix B. Need for material is identified and leads to a question if agreement already exists or not. When there is no articulated need for new agreement, another process for new agreement/new supplier is started, described in Appendix A. Briefly presented, when need for new agreement or new supplier has aroused a decision has to be made whether a new agreement has to be negotiated or if volume can be adjusted in current agreement. When volume at existing supplier can be adjusted a supplier assessment will be executed. First, if the supplier is a strategic supplier the supplier assessment document, to be found in Appendix C, needs to be completed. If the volume adjustment instead concerns a non-strategic supplier a less exhaustive assessment will be applied. For strategic suppliers, additionally a supplier evaluation has to be executed according to Appendix D, also mentioned as the existing supplier evaluation model in this study. When this evaluation is satisfactory completed price negotiations can take place and finally the existing agreement will be changed accordingly to the results of the negotiations and registered into the ERP-system Movex.(Andersson, 2010)

When a completely new agreement or supplier is required, the document presented in Appendix E is applied. It is a process description for purchasing preparations and describes among other things what should be included in the quotation. Potential suppliers from which to purchase from have to be identified and subsequently the quotation will be sent out. Incoming responses on the quotation need to be reviewed and next assessment, evaluation and selection can be performed. For strategic suppliers the document BLA 12 02 03 is used for qualification and BLA 12 02 07 for deeper evaluation. The last steps in the process handles agreement details such as signing and reviewing. For a brief description of purchasing process documents mentioned see

Table 2.(Andersson, 2010)

Table 2 Purchasing process documents

Document	Description	Appendix
PRO 02 12 01	Request for new agreement/new supplier	Appendix A
PRO 02 12 02	Purchase of material to production	Appendix B
BLA 12 02 03	Supplier qualification for strategic suppliers	Appendix C
BLA 12 02 07	Supplier evaluation for strategic suppliers	Appendix D
RUT 12 01 01	Purchase preparation	Appendix E

2.5.4 Strategic suppliers

Cederroth have approximately 40 suppliers listed as strategic suppliers. A strategic supplier is by Cederroth defined as a supplier with large volume or purchasing value and/or with high strategic importance for Cederroth. This can be the situation for products where single sourcing is applied or when few suppliers on the market can offer the product requested by Cederroth due to high customization. Strategic suppliers are generally categorized into three major supplier categories; packaging supplier, chemicals suppliers and contract manufacturers. Besides there is a small number of additional strategic suppliers that are not included in one of the three main categories mentioned supplying raw material for plaster production. Among these there are a few suppliers with high degree of customization or an advantageous location close to Cederroth's production sites that are classified as strategic suppliers.(Andersson, 2010)

2.5.4.1 Packaging suppliers

Product packaging can be split into two main categories, standard packaging and special packaging. Special packaging is produced by one or two suppliers and with tools owned by Cederroth. Close relationships are required with these suppliers due to the customized products and intensive product development together with the supplier. Suppliers of packaging materials are Swedish companies located in Sweden. There are four different product categories within the general packaging category; capsules, pumps, labels and corrugated cardboard. In general, a purchasing procedure is performed every third year when potential suppliers are competing for a contract. This procedure takes about three months to execute, where one month consists of preparations, offer response period of three to four weeks and finally approximately one month is required to compile the offerings and make a selection. It is of importance that this procedure is performed quickly due to the risk for offerings becoming obsolete. Many of Cederroth's packaging suppliers have deep relationships not exclusively with Cederroth's purchasing department but also with marketing and R&D department. The packaging life cycle is relatively short and stretches from three months to one year and about 1/3 of the packaging assortment is annually replaced and brings on frequent re-launches. (Engström, 2010)

2.5.4.2 Chemicals suppliers

Purchase of chemicals is not traditionally performed through ordinary suppliers but purchased through national distributors. Many of the distributors have monopoly on certain chemicals, which strongly reduces the number of distributors to choose from when searching for suppliers. Distributors on the Swedish market are mainly Swedish companies, while chemicals producers which supply the distributors primary are global suppliers situated in Europe or even in other continents due to extremely small scale of manufacturing of chemicals in Sweden. Chemicals have to be thoroughly approved to be used in Cederroth's products. Such an approval is only valid for the

particular combination of one supplier and distributor due to high quality requirements. New approval is therefore requested when purchasing the same chemical from the same supplier but through a new distributor. Extraordinary for the chemicals industry is further the fact that subcontractors to a large extent are confidential. The purchasing procedure for chemicals is similar to the one for packaging with an exception that the one for chemicals often requires a longer time limit than the one for packaging due to the requirement of more exhaustive tests. Thereafter approximately four to six months additionally is required to test a new supplier. (Åslund, 2010)

2.5.4.3 Contract manufacturers

This supplier category consists of about 30 suppliers wherein eight suppliers are classified as strategic. The contract manufacturers vary significantly in size and Cederroth's share of the supplier's turnover varies in the range of 1-20%. The contract manufacturers are geographically spread between Finland, Sweden, Norway, Denmark and Germany. Cederroth engage contract manufacturers to handle products that require manufacturing capabilities outside of the existing plants. Therefore it is also of importance that the supplier can assist in product development on Cederroth's request. Suppliers are generally selected based on competence and equipment relevant for the products Cederroth want to produce. The partnership started 1998 and concerns wet wipes. CMCS has assisted Cederroth in the product development and made specialized investments aimed at obeying Cederroth's requests. Three aspects that should be considered in negotiation and supplier selection of contract manufacturers are:

- If Cederroth can enable the Swedish market
- Product development possibilities
- Brand name

These aspects can attract both Cederroth and the supplier to make business regardless of the purchasing volume. (Ludkiewicz, 2010)

2.5.5 Environmental purchasing engagement

Acting as an environmental-friendly company is a central issue for Cederroth as well as market themselves as a green company to their customers. Environmental awareness and strategy is indicated in the company's mission statement *"Producing products that create wellbeing in people's everyday lives, both on the inside and outside"* and the vision to be the number one local challenger (Cederroth AB, Company Presentation, 2010). The environment is seen as a source of inspiration for product development which is clearly reflected in the end products. The entire value chain is taken under consideration when it comes to environmental-caring actions and improvements, directly and indirectly. The environmental aspect primary make itself visible though strive for local production and continuous reduction of environmental impact. The main driving force for environmental engagement within the company is the demand for products with minimal environmental impact from the consumers. Cederroth clearly express that they do work with sustainable solutions and environmental-friendly arrangements to fulfill the consumer requirements. Explicitly, regarding products this means selecting raw material with minor environmental impact when available and usage of recyclable environmental-friendly packaging. Local raw material is preferred to minimize transportation and environmental-certified forwarding agents are hired for large volumes of transportation services. Company cars are to a large extent clean vehicles and the company is aiming at transform the complete fleet to clean vehicles. Focus is further on energy efficiency and actions

taken to minimize the usage of energy are for example long-distance heating, emission cleaning and recycling of material. Well-known brands are certified with the Nordic Ecolabel and Good Environmental Choice. Environmental management is practiced due to ISO 14001 and the largest production site of Cederroth in Falun will be certified according to ISO 14001 in January 2011. (Cederroth AB, Code of Conduct)

A practical example of action taken by Cederroth to improve environmental performance is change of powder supplier. Previous a foreign supplier supplied powder to Cederroth, but a decision was reached to change powder supplier to a Swedish company aiming at reducing transportation distance and hence reduce environmental impact and transportation costs at the same time. Before the change, the capsule in which the powder was packaged was produced in Sweden. That resulted in transportation of the capsules from Sweden to Denmark, where they were filled with powder from the Danish supplier and then transported back to Cederroth's central warehouse in Falun. Today, both liquid detergents and powder are manufactured in the south of Sweden, hence the long distance between capsules production and powder production is reduced and also the distance between the final transportation of the product to Falun. The main driving force behind this supplier change was striving for local production. (Ludkiewicz, 2010)

2.5.6 Suppliers' environmental engagement

Another step for improved environmental performance is the questionnaire aimed to strategic suppliers concerning the suppliers' environmental engagement. It consists of five questions regarding how the suppliers' work with environmental issues. The purpose of the questionnaire is to gain information about the suppliers' environmental efforts and include the information in the supplier evaluation (Andersson, 2010). The questionnaire has recently been sent out and therefore many suppliers have not yet replied. An identified problem is the fact that among the answers that already have been received, there is a large diversity of degree of detail and accuracy. Some suppliers, especially chemicals suppliers, have responded with very exhaustive answers covering a couple of hundred pages. (Åslund, 2010)

Characteristic for chemical suppliers are that they tend to be global suppliers. Hence they also tend to be heavily environmental engaged, which can be considered to be especially important when working in an extremely environmental-impacting business. Regarding suppliers of chemicals and the environment it is of larger interest to investigate how the distributors work with the environment rather than how the suppliers handle environmental issues. Possibilities for environmental improvements can be found within the areas of transportation filling degree, CO₂-emissions, environmental-friendly packaging and purchasing volume. Cederroth purchase 14-15 chemicals in bulks instead of minor packages to improve the environmental performance and gain cost advantage. (Åslund, 2010)

Packaging suppliers' environmental focus tends to vary a lot. Larger suppliers do have a detailed environmental management system and work consistently for improving environmental performance, whilst small local supplier, often family-run companies, do not have the resources needed for large engagement in environmental issues. New print techniques and water-based colors help driving the packaging business towards becoming more environmental-friendly and particularly water-based colors can be considered as standard today. Trays for cans and paperboard are primary

made by return wrapping material, though disposable materials are still to be used as well. (Engström, 2010)

Many minor Swedish companies have been certified according to ISO 14001 but when asking environmental-related questions numerous do not seem to have any deeper knowledge within the subject (Engström, 2010)(Åslund, 2010).

3 Theoretical review

Together with chapter 2, describing Cederroth, this chapter will constitute the foundation for the specification of the task presented in chapter 0. The theoretical review aims at presenting theory relevant for fulfillment of the purpose of the study and presents a broad spectrum of aspects concerning supplier selection, supplier evaluation criteria, weighting methods, supplier rating as well as environmental purchasing and environmental criteria. Since environmental criteria differ from traditional criteria they are discussed separately in this chapter.

3.1 Supplier selection criteria

In the literature it is clarified that vendor selection has a multi-objective nature implying that several criteria need to be considered in the supplier selection decision (Dickson, 1966; Weber, Current, & Benton, 1991). On the other hand, improving performance to moderate levels on all attributes is preferable to high performance on a few (Mummalanenia, Dubas, & Chaoc, 1996). This issue regarding how many criteria that should be included in supplier evaluation ought to be considered as a highly important aspect influencing the supplier evaluation criteria development. Research of existing supplier selection literature mainly covers four areas: problem formulation, formulation of criteria, pre-qualification of potential suppliers and final selection of suppliers (de Boer, Labro, & Morlacchi, 2001). This chapter specifically aims at presenting literature research about formulation of criteria. Since scientific research covering this area still can be found to be rather shallow, supplier evaluation criteria frequently to be found in case studies and further research will be discussed as well. The first step when evaluating suppliers is to select what criteria should constitute basis for the evaluation. Poorly selected criteria often mislead the decision-maker when final decision for selecting the most suitable supplier will be conducted. Another negative effect deduced to poor criteria is the waste of time and resource (Celebi & Bayraktar, 2008).

3.1.1 Quantitative and qualitative criteria

Methods used to assess supplier performance vary from company to company and can be differentiated in subjective and objective methods. Example of a subjective method is when companies evaluate supplier through personal judgments. Objective methods, on the contrary, try to quantify the supplier's performance. (van Weele, 2005)

Noci (1997) means that three factors must be taken into consideration when choosing a suitable model for supplier environmental assessment. First, the type of information that will be included in the evaluation process must be analyzed and take both qualitative and quantitative criteria into consideration. Secondly, the completeness of the evaluation, which describes the capacity of the model to include environmental aspects, needs to be defined. Finally, objectivity is a vital factor with substantial influence on the assessments quality. The evaluation procedure needs to be objective to represent a support for purchasing managers in the supplier selection. These three factors are all important to pay attention to not just only when including environmental aspects in the supplier evaluation but also in general supplier evaluation processes. (Noci, 1997)

Qualitative criteria can be defined in several ways with scales varying both in definition and in number of options. The type of scale, with one definition on each end of the scale, gives the respondent space for subjective judgment while a scale with clearly defined alternatives can result in more objective answers according to the predefined alternatives. (Hartley & Betts, 2010)

A Likert scale is commonly used in questionnaires to measure qualitative facts. Rensis Likert invented the scale with the purpose of using it within psychology and it can be designed as a 5-, 7- or even a 10-point scale. Typical for a Likert scale is that the respondents specify their level of agreement to a statement. Rating scale is a more common term also including scales with criteria of what should be accomplished to receive a specific score. (Kumar R. , 2008)

Muralidharan et al (2002) suggest guidelines for comparing supplier attribute shown in Table 3. The scale is a five-point rating scale with predefined descriptions of each alternative. Judging whether a supplier has met the company's expectations or not is not always an easy task if there are no clear statements declaring what the company's expectations are. (Muralidharan, Anantharaman, & Deshmukh, 2002)

Table 3 Guidelines for supplier attribute (Muralidharan, Anantharaman, & Deshmukh, 2002)

Point	Grade	Description
5	Exceptional	Demonstrates substantially excellent performance, and has been in the excellence category for last 12 months
4	Excellence	Exceeds company's and customer's expectations, demonstrates extra effort, and is superior to vast majority of suppliers
3	Good	Meets the company's expectations
2	Acceptable	Meets company's minimum requirements
1	Poor	Does not meet the company's and customer's minimum acceptable level

Mummalanenia et al (1996) introduce an example of how to define attributes for criteria on a three-point scale visualized in Table 4. The attributes were results from analysis of six articles in the subject. The authors believe that the brief explanations presented in parenthesis in this exhibit on attribute level, create a common frame of reference for the respondents evaluating them. This specificity helps respondents interpret the intended meaning of the attribute. As a result the validity of the attributes can be secured. (Mummalanenia, Dubas, & Chaoc, 1996)

Table 4 Six Attributes and Levels of Supplier Performance (Mummalanenia, Dubas, & Chaoc, 1996)

Six attributes and levels of supplier performance	
On-time delivery	Seldom/Few times Most times Almost always
Quality	Poor (more than 5 % defective) Good (2%-5% defective) Excellent (less than 2 % defective)
Price/Cost	5 % above target price Approximately at target price 5 % below target price
Professionalism of salesperson	Not highly professional Highly professional
Responsiveness to customer needs	Low level of responsiveness (Late, not satisfactory) Moderate level of responsiveness (Average) High level of responsiveness (Quick and satisfactory)
Quality of relationship with supplier	Poor Good Excellent

3.1.2 Criteria characteristics

There are many ways of measuring the performance of a system or of a supplier. Table 5 on the next page, presents a model from Caplice et al (1994) for how to evaluate the performance of measurement. The method is intended for evaluation of measurements for a logistics system as a whole and is based on a comparison between six other articles, each suggesting criteria for evaluating logistics metrics. (Caplice & Sheffi, 1994)

Table 5 Definitions of the eight metric evaluation criteria (Caplice & Sheffi, 1994)

Criterion	Description
Validity	Metric accurately captures the events and activities being measured and controls for any exogenous factors. Segmentation the metric over haul length, mode of transport and lead-time would make the metric valid.
Robustness	Metric is interpreted similarly by the users, is comparable across time, location, & organizations, and is repeatable. A measure that is not very robust is the direct labour cost of logistics, often used as a measure of input. It is not comparable across firms since the definition of direct labour differs widely between firms.
Usefulness	Metric is readily understandable by the decision maker and provides a guide for action to be taken. A metric combining several factors into a single index is on the contrary less useful since the method to calculate the index becomes unclear. The index as an abstract value, does not supply the decision maker with any specification about what action to take.
Integration	Metric includes all relevant aspects of the process and promotes coordination across functions, divisions and firms across the supply chain. Measures coordination between the players involved in the process.
Economy	Benefits of using the metric outweigh the costs of data collection, analysis, and reporting. Has more of a judgmental character than a strict cost-benefit comparison. Should be used to select between potential metrics rather than for the decision of whether to use any metric at all.
Compatibility	Metric is compatible with the existing information, material, and cash flows and systems in the organization. While compatibility has some overlap with the economy criterion, any system can be made to be compatible to a metric if the needed time and money is given. Metric which is economical in terms of collecting and reporting data might not be compatible with the existing flow of information.
Level of Detail	Metric provides sufficient degree of detail or aggregation to be useful to the decision maker. Level of detail needed is highly dependent on the user.
Behavioural Soundness	Metric minimizes incentives for counter-productive acts or game-playing by those people or organizations being measured, and is presented in a useful form. Metrics that are insufficiently integrative, in that they only include a single function's activities, will almost always not be behaviorally sound. The way a metric is reported can influence behavior.

Caplice et al (1994) further point out that it is impossible to design criteria that excel in each and every criterion mentioned in Table 5. The first four criteria; validity, robustness, usefulness, integration and economy tend to be interconnected. The other four, however, are considered to be more independent. The first trade-off indicates that as a metric becomes more inclusive it loses its direct usefulness. The second trade-off implies that detailed and complex metrics come at the price of lowered comparability. (Caplice & Sheffi, 1994)

3.1.3 Criteria interconnectivity

Criteria for supplier evaluation can be defined at different levels, hence there is an immediate risk that they interfere with each other. For example, if one tries to minimize cost, quality will sooner or later be reduced. (Sen, Basligil, Sen, & Baracli, 2008)

Mandal et al (1993) investigate linkage between some common supplier selection criteria through Interpretive Structural Modeling (ISM), see Figure 3. For example the criteria *Price*, *After-sales service* and *Delivery* are dependent and also the criteria most likely to be measured. However, findings by Mandal et al (1993) state that a purchaser who wants to develop a supplier should focus more on the underlying independent criteria such as *Technical capability*. *Price* could be an effect of other criteria such as *Quality*, *Delivery* and *After-sales service*. Hence, a purchaser should check the suppliers' ability to fulfill these criteria first, and then select the supplier offering best price. The same yields for the criterion *Attitude and willingness to do business* in this specific example. (Mandal & Deshmukh, 1993)

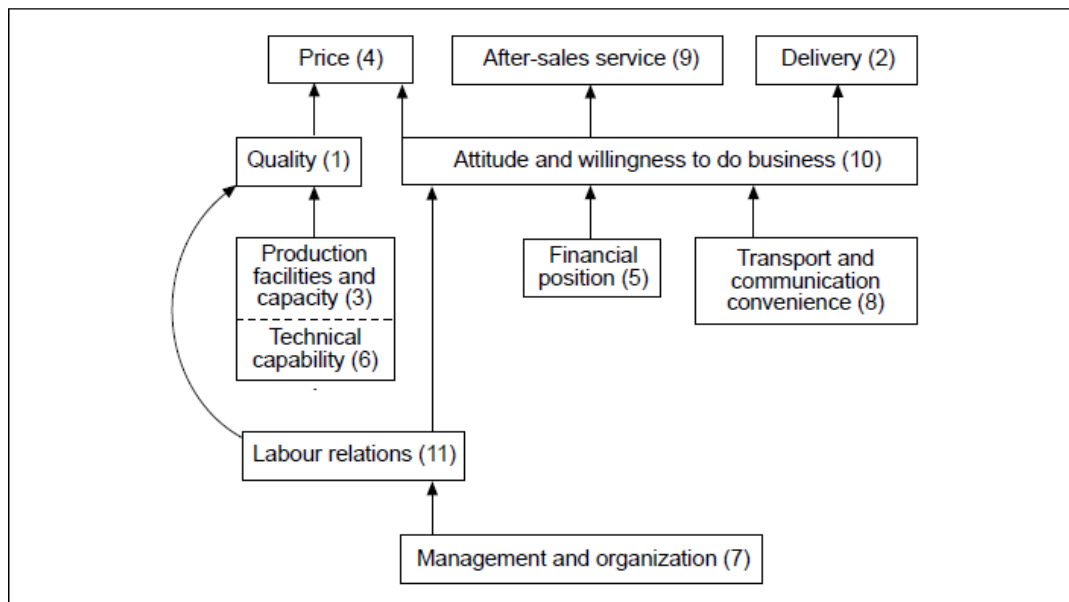


Figure 3 Interpretive structural model (ISM) for vendor selection criteria (Mandal & Deshmukh, 1993)

3.2 Criteria selection

De Boer (1998) illustrates the supplier selection framework as matrix of criteria selection phases and type of purchase. The criteria selection phases are presented as *Problem definition*, *Formulation of criteria*, *Qualification* and *Selection* on the y-axis. The different types of purchasing, *New task*, *Modified rebuy (leverage items)*, *Straight rebuy (routine items)* and *Straight rebuy (strategic/bottleneck)* are visualized on the x-axis. The article reviews methods supporting supplier selection and classify them according to the matrix explained above. In the phase of criteria formulation Vokura et al (1996) present a prototype expert system for evaluation and selection of potential suppliers. Their method sorts the purchase by asking questions about the nature of the purchased product etcetera. They conclude that such a system is possible to use for supplier selection and that various sets of criteria are needed for different purchases. (de Boer L. , 1998) (Vokura, Choobineh, & Vadi, 1996)

A common method used for identifying supplier selection criteria in the literature is to search for criteria frequently appearing in literature reviews of previous studies in the area. Inemak et al (2009) propose ten theoretical factors for supplier evaluation through classification and consolidation of 44 identified criteria. The 44 criteria were initially identified from a literature review based on three articles highlighting specific criteria. Inemak et al (2009) also imply that the most common criteria are easy to select through this method but that critical criteria for the specific purchaser need a more in-depth analysis. Govindan et al (2010) employ the same method to identify criteria for their analysis in the area of supplier development. Awasthia et al (2010) begin the identification process by reviewing other literature, continue in discussion with supply chain experts and to consult their personal practical experience as to select the most relevant criteria. Kuo et al (2010) utilize literature studies to identify common supplier evaluation indicators. Articles cited by these researchers have all applied the structure of analyzing other papers or they analyze other papers themselves. Method suggested is to form a cross-functional team, collect as wide range of possible supplier selection criteria from literature, structure the selection criteria into a hierarchy and finally calculate percentage based and relative importance degrees for all main and sub-criteria (Sen, Basligil, Sen, & Baracli, 2008). Conclusively, literature studies are a widespread method used in the first step of identifying what criteria to select and evaluate the suppliers on. (Inemak & Tuna, 2009) (Govindan, Kannan, & Haq, 2010) (Awasthia, Chauhanb, & Goyal, 2010) (Kuo, Wang, & Tien, 2010)

Sen et al (2008) mean that companies' displayed purchasing behavior change depending on the circumstances. Flexibility in what criteria to consider in each specific situation would therefore turn out to be beneficial. Sen et al (2008) intend to create a framework for defining both qualitative and quantitative supplier selection criteria. The intended usage of this framework is to evaluate what selection criteria are right for the level of integration with the specific supplier. By identifying appropriate criteria instead of using all available criteria, the number of comparisons and the related computational effort will be reduced. Risk for assessment biases will also be eliminated or reduced. In conclusion, by reducing the amount of measured criteria both time and effort spent on evaluation can be reduced. (Sen, Basligil, Sen, & Baracli, 2008)

3.2.1 Criteria categories

Supplier selection literature structures criteria either by categories of what they evaluate or listed. In the early study of Dickson (1966) 23 criteria were identified to be of importance in order to evaluate supplier performance. The most important criteria are suggested to be quality, delivery, performance history, warranties and claim policies, production facilities and capacity. Price comes first on the sixth place, which is an interesting result compared to today's business environment where price focus tend to be central. Weber et al (1991) performed a review of 74 related articles published since 1966. Between 1966 and 1990 the vendor selection process changed significantly, resulting in increased quality guidelines, improved computer communications and increased technical capabilities. The most frequently occurring criteria in the 74 reviewed research papers during that time period are net price, delivery and quality, discussed in 80%, 59% and 54% of the papers respectively. Among the criteria addressed in the 13 articles specifically looking into JIT, quality, delivery and net price occur most often and geographical location is the fourth most occurring criterion. (Dickson, 1966) (Weber, Current, & Benton, 1991)

Weber et al (1991) point out that it is surprising how little attention has been paid to application of quantitative methods in the literature discussing vendor selection. The article suggests that multi-

objective programming could be a fruitful area for further research. Possibilities to execute such programming have increased as a result of the increased access to computer power to execute complicated equations. (Weber, Current, & Benton, 1991)

Neeraj (2004) clarifies that the supplier selection literature has traditionally held quality, delivery, service, and price as the main choice criteria utilized in supplier selection and evaluation. He also concludes that ranking of the criteria has undergone a change throughout the years and points out that focus on quality and service has increased. This is proven by a literature review of four publications stretching back from 1974 to 1984, which can be considered as a rather narrow time frame. It is further discussed that criteria should be chosen and ranked depending on both industry and product type, as to address the features that is most relevant for the specific company and product.(Neeraj, 2004)

Different articles describe and include criteria groups differently. Hence, for comprehensive interpretation it is necessary to look on the entire model. Some authors for example express cost through price aspects, others as cost structure or including several underlying criteria resulting in total cost. Criteria categories presented by five authors are therefore presented in Table 6.

Table 6 Criteria categories suggested by the literature

Author	(Sen, Basligil, Sen, & Baracli, 2008)	(Kuo, Wang, & Tien, 2010)	(Neeraj, 2004)	(Min, 1994)	(Inemak & Tuna, 2009)
Criteria category	Cost Quality Service Reliability Management and organization Technology	Cost Quality Service Delivery Environment Corporate Social Responsibility	Cost Quality Service Delivery	Financial terms Quality assurance Perceived risks Service performance Buyer-supplier partnerships Cultural and communication barriers Trade restrictions	Organizational strategy Technical capability Delivery capability Logistics Financial and political stability Commitment and trust Continuous improvement capability Quality Long-term supply capability Price

As seen in Table 6 a single article suggests up to ten criteria categories which are presented in detail in the following sections. Since categories are named differently between articles while the content can stay the same, the categories have been sorted based on the content to increase the comparability.

3.2.1.1 Organization

Among the five articles presented in Table 6, three articles suggest a category that can be described as *Organization*. The articles define the category as *Management and organization*, *Cultural and communication barriers* and *Organizational Strategy* respectively and the criteria suggested under

each category can be seen in Table 7. It can be noticed that both Min (1994) and Inemak et al (2009) suggest *EDI-capability* or *IT-capability* to be sorted under this category. (Min, 1994) (Inemak & Tuna, 2009)

Table 7 Criteria related to organizational aspects

Author	(Sen, Basligil, Sen, & Baracli, 2008)	(Min, 1994)	(Inemak & Tuna, 2009)
Criteria	Cultural similarity Communication system Reputation and position in industry Speed in development Desire of business Reciprocal arrangements	Cultural similarity Ethical standards EDI-capability	Purchasing strategy Relationships with second tier suppliers Organizational structure and system Cultural match Management capability Environmental awareness Work force skills Investment records and plan Production cost (cost structure, decreasing cost) Financial position IT-capability

3.2.1.2 Production

In the articles presented in Table 6, there is one category whose criteria aim at assessing a supplier's production capabilities. Among the criteria in Table 8, presented below, there are some criteria such as *Financial history* and *Financial position* that assess other aspects of a supplier than pure production capabilities.

Table 8 Criteria related to production aspects

Author	(Sen, Basligil, Sen, & Baracli, 2008)
Criteria	Process capability Process flexibility Amount of past business Supplier's expertise Performance history Financial history Financial position Impression Labor relation record

3.2.1.3 Quality

As seen in Table 9, presented below, the criteria in the category *Quality* are fairly diverse and vary widely between different authors. One can still see that a measurement of defects/reject rate is the basic metric that the category intends to measure.

How to calculate the quality for a supplier delivering several products and what percentage levels to set as acceptable is additionally up for discussion in the article. The literature tends to discuss definitions both on strategic level and product level. Some definitions for the quality category suggested by Kuo et al (2010) are further introduced below: (Kuo, Wang, & Tien, 2010)

Reject rate – Number of rejected incoming material detected by quality control

Management commitment to quality – Degree of importance given to quality function in management and organization, quality systems

Process improvement – The application of process improvement activities

Warranties and claim policies – Existence of warranties and claim policies by supplier

Quality assurance – The attainment of quality assurance such as certificates

Table 9 Criteria related to quality aspects

Author	(Sen, Basligil, Sen, & Baracli, 2008)	(Kuo, Wang, & Tien, 2010)	(Neeraj, 2004)	(Min, 1994)	(Inemak & Tuna, 2009)
Criteria	Defects Quality of support services Packaging ability Quality systems used by supplier Quality team visits Operational controls	Reject rate Management commitment to quality Process improvement Warranties and claim policies Quality assurance	The supplier's product quality (i.e., performance and functionality) The condition of supplier's products on arrival (i.e., defect rates)	Quality control Quality team visits	Quality system certifications/certificates Product quality Process quality Continuous improvement capability: Continuous improvement Willingness to information sharing

3.2.1.4 Logistics

Theory on how to measure logistics or delivery is found to be extensive. Suggestions in Table 10 include lead time, order fulfill rate, order frequency etcetera. Oskarsson et al (2006) mention delivery service as a measurement that can be found to include the delivery service elements lead time, delivery reliability, delivery security, information, flexibility/customer adaptability and stock availability which are defined as:(Oskarsson, Aronsson, & Ekdahl, 2006)

Lead time – The time period from order to delivery.

Delivery reliability – The reliability in lead time explained by how reliable the supplier delivers in the specified time frame of delivery. As a consequence for companies that intend to reduce their number of warehouses, delivery reliability will become even more important than lead time. Not only can late deliveries result in problems and costs. When space in warehouse is becoming more optimized, early deliveries can also cause problems.

Delivery security – The correct item in the correct amount. Most customers expect delivery security to be high, close to 100%, but routines in handling orders and documentation can also affect delivery security.

Information- The information exchange becomes more important while requirements according to time increase. It is important for the supplier to know the customers demand in an early stage. For the customer it is important to know what delivery service the supplier can offer. The customer could for example demand information regarding the supplier's amount in stock, the supplier's ability to deliver or the availability to monitor an order in process.

Flexibility/Customer adaptability- The customer could demand a specialized delivery, e.g. shorter lead time, express transportation, specialized packaging or other form of tagging the goods.

Stock availability - Stock availability is share of order or order lines that can be delivered right away when ordered from the customer.

Sen et al (2008) include the criteria *Production facilities and capacities*, *Repair service*, *Training aids*, *Warranties and claims* and *Attitude* in this category, see Table 10. (Sen, Basligil, Sen, & Baracli, 2008)

Table 10 Criteria related to logistics aspects

Author	(Sen, Basligil, Sen, & Baracli, 2008)	(Kuo, Wang, & Tien, 2010)	(Neeraj, 2004)	(Min, 1994)	(Inemak & Tuna, 2009)
Criteria	Delivery Production facilities and capacities Response to changes Repair service Training aids Ability to fill emergency orders Warranties and claims Attitude	Order fulfill rate Lead time Order frequency	The supplier's order cycle time The supplier's on-time delivery performance The supplier's ability to fill our emergency orders The supplier's accuracy in our filling orders The supplier's accuracy in billing and credit	On-time delivery Technical assistance	Lead time Delivery on time Quick response Flexibility to volume changes Product manufacturing time Geographic location Logistics cost Transport infrastructure

3.2.1.5 Product development

For a company that produces products of parts bought from suppliers it is important to value the collaboration of development of new products correctly. Three of the articles introduced in Table 6 assess a supplier's ability to assist in product development and the criteria suggested to evaluate a supplier's ability in this category is presented in

Table 11 on the next page.

Table 11 Criteria related to product development aspects

Author	(Sen, Basligil, Sen, & Baracli, 2008)	(Neeraj, 2004)	(Inemak & Tuna, 2009)
Criteria	Supplier's technological system Technical capacity Future technology development Design/process improvement Future manufacturing capabilities	The supplier's post sales assistance and support The supplier's ability and willingness to assist with the design process	Engineering and design capability Research and development capability Flexibility to design changes Potential for Innovation Manufacturing capability

Further it is suggested that following aspects should be considered in the evaluation: (Kumar & Kopitzke, 2008)

- Ability and attitude to produce prototypes
- Partnering in product development
- Supplier investment in R&D
- Availability of development tools such as CAD/CAM, FEA

3.2.1.6 Purchasing

Central to evaluate from a purchaser's perspective is price or cost, depending on the definition, which is visualized in Table 12 below. Determining the price of goods is a complex issue for the supplier, who generally considers the following factors when determining the selling price: (van Weele, 2005)

- The expected demand for his product
- The number of competitors in the market
- The expected development of the cost price per product unit
- The customer's order volume
- The importance of the customer to the supplier
- The value of the product to the customer

There are several methods to apply when structuring the pricing. In practice the following methods are distinguished: (Kotler & Bloom, 1984)

- *Cost-plus pricing* – A fixed mark-up percentage is added to the cost price
- *Target-profit pricing* – The price is determined based on the amount of profit that should be realized.
- *Pricing based on the buyer-perceived value* – The price is determined as the price that the purchaser is expected to be willing to pay for the item.
- *Pricing based on competitors' prices* – When a market is influenced by an oligopoly or similar the price for products generally follow the oligopoly's pricing.
- *Tender-based pricing* – The job is awarded to the contractor who submits the lowest bid.

It is complicated for the purchaser to track down the pricing method used by the supplier, but the following factors is suggested to help the purchaser in gaining insight in the supplier's pricing: (van Weele, 2005)

- *Materials costs* – To be itemized according to the major components.
- *Direct labor costs* – Information about labor costs can often be obtained by consulting the collective labor agreement for that particular industry.
- *Transportation costs*
- *Indirect costs* – These can often be divided into general management, overheads and sales costs.

Another important factor to consider for purchasers of industrial goods is the discount policy adopted by the supplier. Examples of discount policies are cash discount, quantity discount, bonus agreement, geographical discount, seasonal discount and promotional discount. Lean and Six sigma are commonly adopted strategies to reduce costs in manufacturing that focuses on management technique rather than on specific actions. If a manager can get the entire company to focus on cost reduction by waste elimination the effect will be high. (van Weele, 2005)

Table 12 Criteria related to price/cost aspects

Author	(Sen, Basligil, Sen, & Baracli, 2008)	(Kuo, Wang, & Tien, 2010)	(Min, 1994)
Criteria	Net price Price breaks Bidding procedural compliance Operating cost Geographical location Maintenance cost Order cycle time Foreign exchange rate Export taxes	Price performance value Compliance with sectoral price behavior Transportation cost	Cost Freight terms Payment terms Financial stability Negotiability

3.2.1.7 Other categories

In this category the categories suggested by authors not directly related to other categories or seen to be general over several categories are introduced. For example the criteria *Stock management* and *Design Capability*, presented in Table 13, suggested by Kuo et al (2010), can be placed under the categories *Logistics* and *Product development* respectively.

Collaboration and service-mindfulness is a category also introduced by Kumar et al (2008) that is relevant to discuss here. Supplier's willingness to collaborate in unforeseen events or special projects is of importance for the purchaser to analyze, especially if products ordered are considered to be key components or if special delivery is requested. These authors argue that measuring of following definitions concerning collaboration and service-mindfulness should be performed: (Kumar & Kopitzke, 2008)

- Project capability
- Willingness to cooperate. Are the supplier's and the purchaser's expectations uniform?

- Level of activity. What kind of system and routines for product development and product enhancement during the product lifecycle exists?
- Dependency on the purchaser. A decent aim is about 10 – 30 % of the supplier's volume.
- Secrecy in handling of blueprints and specifications given by the customer.
- Modes of contact, phone calls, email, speed of reply.

Table 13 Criteria suggested in the literature that are difficult to categorize

Author	(Kuo, Wang, & Tien, 2010)	(Min, 1994)	(Inemak & Tuna, 2009)
Criteria	<i>Service:</i> Responsiveness Stock management Willingness Design Capability	<i>Perceived risks:</i> Political stability Foreign exchange rate Legal claims Labor disputes Local price control <i>Trade restrictions:</i> Tariffs and customs duties Countertrade	<i>Communication and trust:</i> Commitment Trust Country regulations and standards <i>Long-term supply capability:</i> Past relationships Past performance Long-term supply potential

Pearson et al (1995) compare frequency of participation in the selection and evaluation of suppliers by the functions purchasing, engineering, production/operations, R&D, general management, marketing and accounting/finance. Their investigation shows that participation from most functions is higher in supplier selection than in supplier evaluation. (Pearson & Ellram, 1995)

3.3 Definitions of environmental purchasing

Environmental friendly purchasing is described and defined in many different ways in the literature, see Table 14. This section aims at highlighting the most relevant definitions of the expression for this study and compares the definitions to each other.

Table 14 Definitions of environmental purchasing

Author	Definition
(Mulder, 1998)	The practice of public authorities or private companies taking supplier environmental product and process performance into account when purchasing products and services.
(Handfield, Walton, Sroufe, & Melnyk, 2002)	The process of formally introducing and integrating environmental issues and concerns into the purchasing process.
(Carter & Carter, 1998)	The purchasing's involvement in supply chain management activities in order to facilitate recycling, reuse and resource reduction.
(Zsididin & Siferd, 2001)	The set of purchasing policies held, actions taken, and relationships formed in response to concerns associated with the natural environment. These concerns relate to the acquisition of raw materials, including supplier selection, evaluation and development;; suppliers' operations; in-bound distribution; packaging; recycling; reuse; resource reduction; and final disposal of the firm's products.
(Min & Galle, 2001)	An environmentally-conscious purchasing practice that reduces sources of waste and promotes recycling and reclamation of purchased materials without adversely affecting performance requirements of such materials.

Björklund (2010) elucidates the issue that even though environmental purchasing is an established concept there is no common definition available. Mulder (1998) has formulated a definition that is commonly referred to, which describes environmental purchasing as “the practice of public authorities or private companies taking supplier environmental product and process performance into account when purchasing products and services.” The definition is general to its formulation and does not give any specific indications about which activities environmental purchasing may include. (Björklund M. , 2010) (Mulder, 1998)

Handfield et al (2002) discuss the concept of Environmentally Conscious Purchasing (ECP), which they describe as “the process of formally introducing and integrating environmental issues and concerns into the purchasing process”. ECP constitutes a part of the Environmental Conscious Enterprise (ECE), which is a more exhaustive system that also includes parts such as environmentally responsible manufacturing and industrial ecology. The mission of this corporate system is to spread awareness and integrate environmental issues into all possible divisions of the company. Accounting for the environment and product design, production planning and control that are environmentally responsible are vital parts of the ECE system. The purpose is to identify costs and benefits associated with environmental related performance, identify opportunities to manage and/or reduce waste and reduce and eliminate waste within the system and simultaneously maximize resource efficiency. (Handfield, Walton, Sroufe, & Melnyk, 2002)

“The purchasing’s involvement in supply chain management activities in order to facilitate recycling, reuse and resource reduction” is another definition of the concept of environmental purchasing applied by Carter et al (1998). They also include material substitution in the term and give an example of an outdoor clothing manufacturer that identified alternative environmental friendly sources of inputs and then gave their engineers the mission to develop products that were made from material which had high environmental performance and were recyclable. Converting material used to recycled input is considered to be a characteristic activity of environmental purchasing. (Carter & Carter, 1998)

Zsididin et al (2001) suggest an extension to the definition of Carter et al (1998) and use the term Environmental Purchasing (EP) contradictory to Handfield et al (2002) who names it ECP. They define EP, from the view of an individual firm, as “the set of purchasing policies held, actions taken, and relationships formed in response to concerns associated with the natural environment. These concerns relate to the acquisition of raw materials, including supplier selection, evaluation and development;; suppliers’ operations; in-bound distribution; packaging; recycling; reuse; resource reduction; and final disposal of the firm’s products.” Compared to the definition of Carter et al (1998) this is more holistic and takes a life cycle perspective. Beginning in the design phase and covering the product during its life cycle until disposal of the product. The concreteness in the definition of Handfield et al (2002) can be considered as low whilst it grow stronger in the definition of Carter et al (1998) and finally is very tangible when EP is defined by Zsididin et al (2001). (Zsididin & Siferd, 2001) (Carter & Carter, 1998) (Handfield, Walton, Sroufe, & Melnyk, 2002)

Green purchasing is another appearance of the same idea as previous authors have discussed and is considered to be “an environmentally-conscious purchasing practice that reduces sources of waste and promotes recycling and reclamation of purchased materials without adversely affecting performance requirements of such materials” (Min & Galle, 2001). In contrast to previous authors

these also mention the quality aspect in their definition. The relationship between quality and environmental purchasing will be discussed further in chapter 3.5.

3.3.1 Definition of environmental purchasing in this study

The definition of environmental purchasing adopted in this study will be the definition of Zsididin et al (2001):

“The set of purchasing policies held, actions taken, and relationships formed in response to concerns associated with the natural environment. These concerns relate to the acquisition of raw materials, including supplier selection, evaluation and development;; suppliers’ operations; in-bound distribution; packaging; recycling; reuse; resource reduction; and final disposal of the firm’s products.”

When it is an extended version of the definition by Carter et al (1998) and taking on a holistic perspective it is considered as the definition most appropriate for the study, which has a comprehensive approach creating a supplier evaluation model with environmental criteria included. The adopted definition is applicable when it describes environmental purchasing from a broad perspective including soft aspects such as relationships, policies and response to concern as well as tangible operations such as packaging, recycling, reuse and resource reduction. Moreover, supplier selection, evaluation and development are explicitly mentioned in the definition. (Carter & Carter, 1998)

3.4 Purchasing and the environment

Global warming is one example of significant environmental challenges that the world is facing today (Jabbour & Jabbour, 2009). This fact together with a growing concern for the quality of our eco system has implicated an upturn of awareness of environmentalism. Traditionally, purchasing managers have neglected environmental impacts but cannot accept it anymore thus have to adjust purchasing strategies to this new situation (Min & Galle, 1997). Because of such climate threats, during the last decades organizations have been forced primarily by green movements, institutions and governments (Noci, 1997). Increased environmental expectations of the customers have also influenced organizations in the work towards more environmentally friendly solutions (Walton, Handfield, & Melnyk, 1998). A tendency towards more stringent customer requirements and companies which increase their customer focus is further noticeable (McIntyre, Smith, Henham, & Pretlove, 1998). Realizing the new requirement mentioned above, companies have to contribute towards reduction in environmental impacts from their supply chains and stimulate improvements in their suppliers’ environmental performance, which can be seen as directly related to the capacity of their suppliers to become environmentally fit (Handfield, Walton, Sroufe, & Melnyk, 2002).

Carter et al (1998) point out that environmental issues are considered as interesting not only to business management but also to purchasing particularly, when purchasing managers have rated environmental regulations on purchasing activities as their second future concern. Previously purchasing department has been considered a non-strategic function but this is currently changing. Purchasing is becoming to play a more strategic role in an organization and this development is supposed to only grow and actions or lack of actions taken by purchasing managers have direct impact on the natural environment (Zsididin & Siferd, 2001). The authors explain the statement by highlighting that purchasers have important influence on decisions regarding material procured, based on defined criteria such as price, quality and delivery. Procured materials have a straight

impact on characteristics of scrap, which subsequently can be discarded to waste disposal sites or recycled. In many cases purchasers also take responsibility for equipment selection which directly impact energy consumption and air, water and ground emissions, to only mention some impact areas. (Carter & Carter, 1998)

Further, purchasing is able to identify environmental friendly packaging such as packaging that easily can be recycled or reused (Carter, Kale, & Grimm, 2000), which can have large positive environmental impact when Min et al (1997) have identified packaging materials as the largest part of municipal waste stream. Carter et al (1998) support this statement meaning that because of purchasing's favorable position located at the beginning of the forward flow of materials within an organization, purchasing have a good starting position for implementing resource reduction activities. Purchasing managers have now a significant influence with respect to modifying procurement specifications and substitute materials to more environmental friendly alternatives (Carter & Carter, 1998). Depending on which products the purchasing managers decide to buy, the level of waste and pollution can be affected. There is a difference in pollution impact regarding if it is direct or indirect. Direct pollution increase for example waste during storage, transportation and processing while indirect pollution can be described as waste streams associated with the production (Handfield, Walton, Sroufe, & Melnyk, 2002). This is an obvious example of how the complexity of the purchasing process heavily has increased when taking environmental aspects into consideration. (Min & Galle, 1997) (Carter & Carter, 1998)

Purchasing's position at the beginning of the supply chain also forces the company to integrate the environmental goals with purchasing actions, otherwise environmental marketing efforts will not be effective. Environmental factors must therefore be taken into consideration in the supplier selection (Min & Galle, 1997). An introduction of new environmental aspects into purchasing activities complicates the decision-making process and new trade-offs will appear. Besides, environmental criteria require integration of both qualitative and quantitative factors which makes the decision-making process even more complex (Handfield, Walton, Sroufe, & Melnyk, 2002). No analysis or work has been performed regarding development and validation of a set of critical factors of environmental management and a lack of performance measures for such factors has been identified (Wee & Quazi, 2005).

Mulder (1998) states that green purchasing effectiveness has a large potential for improvement if only criteria and specifications would be harmonized and if purchasing managers would help their suppliers by providing them with more guidance on evaluation methods and feedback on their actual performance. One conclusion the author makes is that the effect of green purchasing could be improved by purchasing managers using simple and straightforward questions and request understandable and relevant information from the suppliers. (Mulder, 1998)

Government agencies are generally seen as the main force for actions and activities aimed at improving the environmental performance (Carter & Carter, 1998), which also is examined in earlier research (Green, Morton, & New, 1998) (Murphy, Poist, & Braunschweig, 1995). Later investigations concerning how sectors in the interorganizational environment affects environmental purchasing have been executed and findings point out that the output sector consisting of downstream members of the supply chain such as customer, marketing and distribution etcetera has the highest influence. Suggestions are made that environmental management of the supply chain can and also

should make more efforts than just be sure to fulfill the governmental regulations to be able to achieve competitive advantages. Such efforts should include investigating and identifying capabilities for environmental performance of supply chain members. The cost focus is mentioned by Murphy et al (1995) as a substantial driver for establishing environmental policies behind governmental regulations and is visible through an articulated controlling of environmental-related costs and minimizing the liability for lawsuits. Social expectations contribute to drive environmental performance forward and so do strive for keeping up with competitors as well. A profit opportunity from improved environmental performance is only analyzed to be a minor driver. (Murphy, Poist, & Braunschweig, 1995)

3.4.1 Environmental management strategies

The result of a sharpened environmental focus has been different environmental programs, which can be split into three categories (Noci, 1997). The first category is the implementation of end-of-the-pipe programs aimed at reducing air emissions, solid wastes, waste water and energy consumption of plants. The second phase can be described as introduction of clean technologies and programs for reducing a company's impact on the state of natural resources in the leading steps of the production process, continued by the third category which changed operating procedures and introduced eco-auditing frameworks for modifying products and services (Noci, 1997). The author means that nowadays the development has reached a fourth category when large companies and multinational corporations are developing green programs to assure that supply value chains are eco-efficient. Companies with a proactive environmental approach strive for cooperation with especially small and medium-sized supply chain partners to, for example, commonly develop new green products.

In a framework the author have chosen to consolidate the four identified categories into two strategies; reactive and proactive environmental strategy. The reactive strategy aims at aligning environmental performance with regulations and legislation, while the proactive strategy is aiming at increasing competitiveness through anticipating competitors by product and process innovation. The authors argue that this is an advantage way of classification compared to other models describing environmental strategies. The main advantages are the clear description and distinguish between the two main strategies and the identification of two basic aspects that the purchasing team should analyze in order to manage the environmental issues in an efficient manner. The supplier's compliance to regulations is vital to supervision and a key requirement for the reactive strategy. An analysis must also be performed to investigate whether a supplier will be able to develop green product and process innovations in the future. In other words, environmental standard of regulations need to be identified and the supplier's environmental performance assessed due to the regulations. Suppliers to a company that have take on a proactive strategy must be able to support the company in the introduction of new green products and make sure that the environmental performance of the end-product is improved and the recycling eased, but also to quickly respond and adjust to the company's environmental requirements. This discussion is visualized in Figure 4 on the next page.

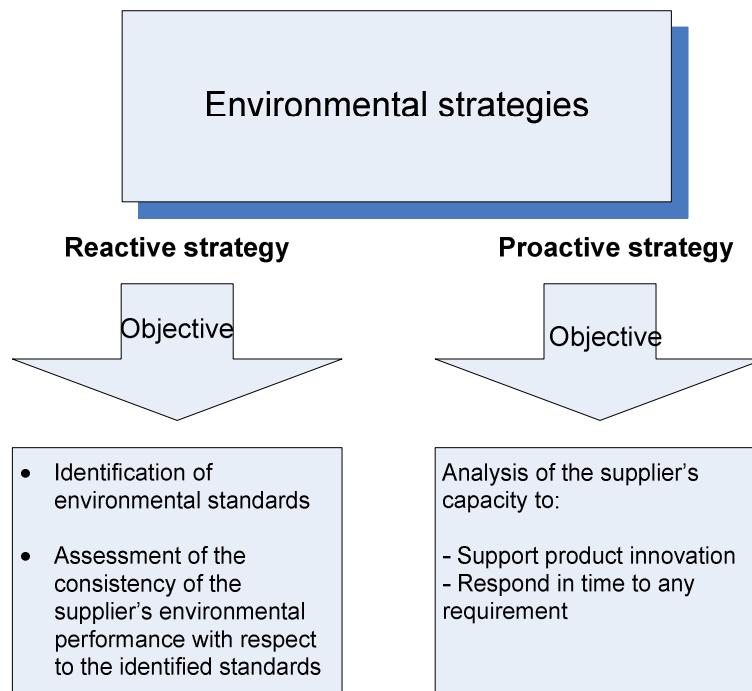


Figure 4 Identifying the influence of the environmental strategy on the supplier selection procedure (Noci, 1997)

Walton et al (1998) discuss the topic of approaches to environmental management. Resistant adaption to environmental issues is described as companies' unwillingness to prevent or eliminate waste but rather pollute the environment and pay a fine to the government due to violated restrictions and regulations. Compliance to the legislation but not integrating environmental policies in the company is also considered characteristic for the resistant adaption approach. The next level is the reactive approach. Reactive indicates that a firm is willing to accept the goals of minimizing waste, though there are no initiatives taken to eliminate the source of the waste. Waste is created in the same pace as before and focus is on storing and cleaning up the waste already produced. End-of-the-pipe solutions are these kinds of actions named by Winsemius et al (1995). The authors mean that without changing current processes and use innovative solutions the end-of-the-pipe solutions often are narrow and incremental. Reason for this attitude is that the companies do not realize the potential of increased competitiveness that follows with implementation of environmentally-friendly practices. The receptive approach is defined as willingness to make small changes aimed at optimizing current processes and a constructive approach constitute a small development of the receptive approach by striving for finding and eliminating sources of waste. There is a focus on the value in processes and products realized when product planning can be integrated with environmental planning. The authors analyze these environmental management responses presented and conclude that they all lack of focus on external functions, but only take internal functions in consideration. They emphasize that only a proactive response can make a company succeed paying attention to all of its stakeholders and integrate total quality management into planning and operations processes. Without cooperation with suppliers the fulfillment of being environmental friendly and make the supply chain green will not be reached. Strategies for dealing with environmental issues defined by Walton et al (1998) are visualized below in

Table 15. (Walton, Handfield, & Melnyk, 1998) (Winsemius & Guntram, 1995)

Table 15 Strategies for environmental management (Walton, Handfield, & Melnyk, 1998)

Strategy	Location of action	Responsible party	Goal of activity
<i>Resistant adaption</i>	End-of-pipe	External consultants	Minimize exposure
<i>Embracing without innovating</i>	End-of-pipe	External consultants and internal specialists	Minimize exposure
<i>Reactive</i>	End-of-pipe	Internal specialists	Minimize exposure
<i>Receptive</i>	Process change	Managers	Optimize process
<i>Constructive</i>	Product change	Industry	Quantum leap
<i>Proactive</i>	Needs assessment	Society	Create a new vision

Green purchasing strategies are divided into two categories by Min et al (1997), source reduction and waste elimination, which can be studied below in Figure 5. They point out that implementation of an environmental program within a company should begin with source reduction of solid wastes such as packaging materials, metal scrap, food waste, yard waste etcetera. Hence packaging material is the largest single component and implementing a green packaging program is required to succeed with a business-general environmental management program. A conclusion that is drawn by the authors is that environmental purchasing plays a core role in efficient handling of environmental issues by waste prevention and control at the source. Source reduction is broken down into recycling, reuse and source changes and control, whilst waste elimination concerns biodegrading, nontoxic incineration and scrapping or dumping. Source reduction can here be interpreted as the proactive approach that Walton et al (1998) and Noci (1997) discuss previously in this chapter, whilst waste elimination can be compared to the definitions of the reactive approach. (Min & Galle, 1997) (Walton, Handfield, & Melnyk, 1998) (Noci, 1997)

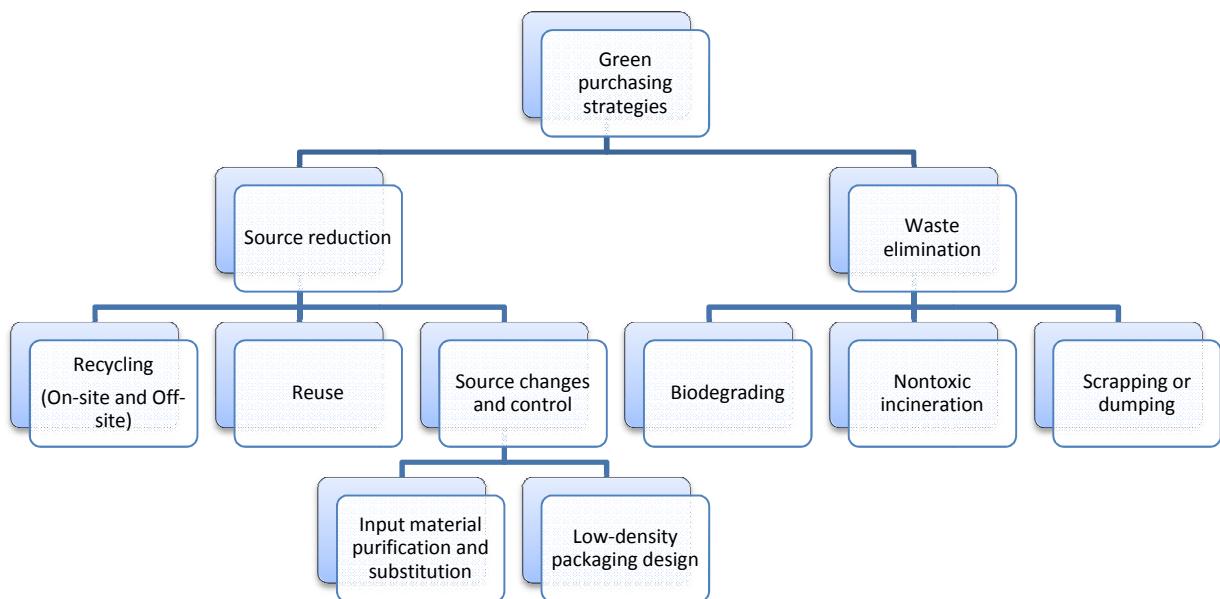


Figure 5 Classification of green purchasing strategies (Min & Galle, 1997)

Three increasing stages of environmental management strategies are presented by Jabbour et al (2009). Reactive is the lowest stage which describes goals and actions exclusively aimed at meeting legislation and are separated from the organizational context. The second stage, preventive, characterizes a company which shows an increasing awareness and interest for environmental issues beyond meeting legislation but the environmental engagement has still not reached recognition of strategic importance. Finally, the proactive stage is reached when all of a company's areas systematically seek to explore competitive advantages through environmental management. This categorization into three steps is not identical to the classifications presented above, when none of them consists of three stages but two, four and six stages. On the other hand, all of them use the terms reactive and proactive approach and the only significant difference is the level of detail. The content is more or less similar and the stages of environmental management are increasing in all concepts. (Jabbour & Jabbour, 2009)

Makower (1994) in Wee et al (2005) does mention two goals of being environmental-friendly, which are reducing waste and maximizing resource efficiency. No discussion is made regarding level of environmental strategy, but these goals can be taken into the perspective of reactive and proactive environmental strategies as presented by different authors previously in this chapter. The goal of reducing waste is then comparable with the reactive strategy and the goal of maximizing resource efficiency can be considered as a proactive strategy. (Wee & Quazi, 2005)

3.4.2 Environmental performing factors

In the literature there are plenty of suggestions and perspectives of what being environmental friendly means and what goals should be aimed at to fulfill that mission. The goals and performing factors mentioned in the literature are described on different levels when presented by different authors. Some suggest detailed performing factors while others prefer describing more general goals and factors, therefore no categorizations into levels of performance factors will be presented in the end of the chapter but a summarization based on author. The review will elucidate environmental performing factors on many levels to illustrate the diverseness within this relatively new topic and aims at presenting a broad perspective which will be used for further discussion and analysis in this report. A summarization of environmental performing factors derived from the literature is presented in Table 16 on the next page.

Table 16 Summarization of environmental performing factors derived from the literature

Author	Performing factors
Noci (1997)	Current environmental performance of supplier's production process Life cycle costs Green competencies Current environmental efficiency Supplier's green image Net life cycle costs
Makower (1994) in Wee et al (2005)	Economics Enforcement Empowerment Education Efficiency Excellence
Wee et al (2005)	Top management commitment to environmental management Total involvement of employees Training Green product/process design Supplier management Measurement Information management
Jabbour et al (2009)	Environmental costs (effects of pollution) Environmental costs (environmental improvement) Management competencies Environmental image Design for environment Environmental management systems Environmental competencies
Carter et al (1998) Carter et al (2000) Murphy et al (1995)	Resource reduction Product reuse Recycling
Min et al (2001)	Environmental liability and penalty Supplier's environmental commitment Environmental costs
Handfield et al (2002)	Product attributes Waste management Labeling/certification Packaging/reverse logistics Compliance to governmental regulations Environmental programs at the supplier's facilities
Min et al (1997)	Scrapping or dumping Sorting for nontoxic incineration Biodegrading packaging Recycling Reuse Low-density packaging

Makower (1994) in Wee et al (2005) has derived two main goals out of the concept of environmental management; reducing waste and maximizing resource efficiency. To reach these goals six key concepts must be paid attention to, categorized in two parts; rationale and process, see Figure 6. The first two key concepts concern the first part, Rationale, and are Economics and Enforcement. Economics communicate that environmental management is a necessity to improve a firm's financial performance. Enforcement refers to increased amount of regulations and a stronger pressure from stakeholders which force a firm to improved environmental performance. The second category, Process, includes the key concepts Empowerment, Education, Efficiency and Excellence. Empowerment describes how vital leadership and corporate vision is to reach environmental goals and also points out the importance to involve employees in the task setting environmental goals and create green teams to run environmental projects. Otherwise the corporate vision would not be fulfilled. Education is a rather clear key concept and requires open communication and disclosure by the companies with stakeholder such as suppliers, customers and employees concerning environmental performance and practices. Efficiency stands for the need for improvement of efficiency measures and has three branches which are pollution prevention, waste reduction and energy efficiency. The last key concept, Excellence, is a concept where environmental management has been merged with the concept of total quality management and the common denominator is that both are trying to reduce waste. Further, Excellence nurses the importance of audits and benchmarking. (Wee & Quazi, 2005)

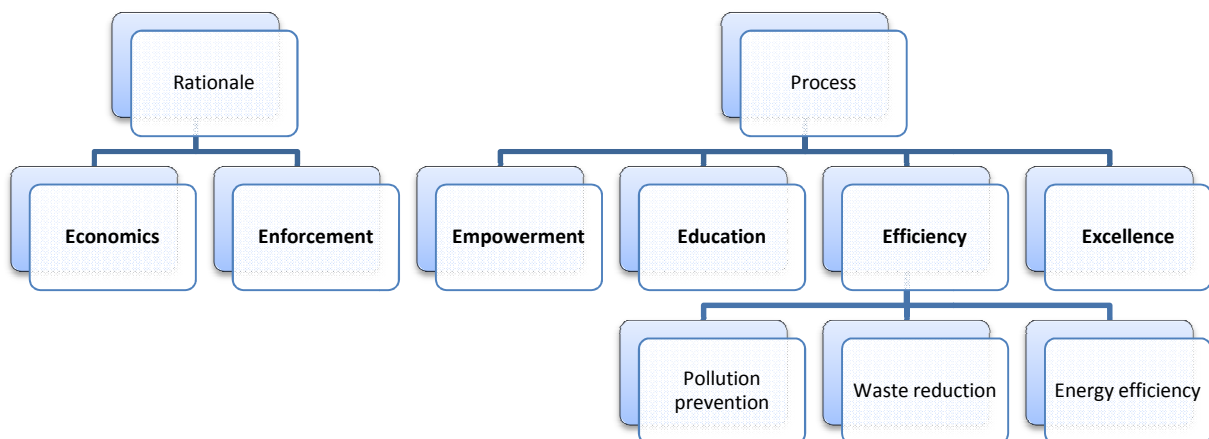


Figure 6 Six key concepts for environmental management, Makower (1994) in Wee et al (2005)

Wee et al (2005) have performed a literature review to derive critical factors for effective environmental management and found that supplier management is one of in total seven critical factors, see Figure 7. They emphasize supplier management activities such as including environmental performance as one of the criteria when choosing supplier, clear communication of environmental expectations of the company to suppliers, supplier education concerning environmental issues and supplier involvement during the product development phase and performance of environmental audits or certification programs by the company on their suppliers. The authors suggest that the validated instrument to measure the seven critical factors of environmental management can be applicable on a firm's suppliers to measure their environmental

performance and not only applicable on the own firm. These seven critical factors can thereby be interpreted as environmental performing attributes for suppliers. (Wee & Quazi, 2005)

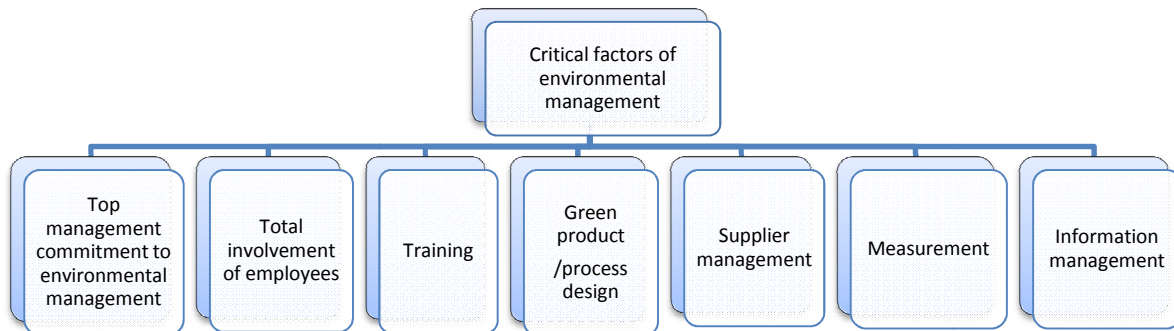


Figure 7 Seven critical factors of environmental management (Wee & Quazi, 2005)

Jabbour et al (2009) present a framework for supplier selection based on environmental criteria and have split the criteria into seven different categories. Two categories, environmental costs (effects of pollution) and environmental costs (environmental improvement), are quantitative criteria which can be expressed in monetary value. Remaining five categories consist of qualitative criteria and cannot be expressed in monetary value. These are management competencies, environmental image, design for the environment, environmental management systems and environmental competencies. The categories are chosen in respect to the most recent proposals in the area, the authors explain. (Jabbour & Jabbour, 2009)

There are three common corporate purchasing approaches for handling environmental issues; resource reduction, product reuse and recycling (Carter & Carter, 1998)(Carter, Kale, & Grimm, 2000) (Murphy, Poist, & Braunschweig, 1995). The first approach, resource reduction, describes activities to minimize the waste to achieve forward and reverse distribution processes that are more efficient than previous. Reuse is defined as “the use of a product or component part in the same form and for identical use without remanufacturing”, while recycling is a well-known expression that refers to “a process by which materials otherwise destined for disposal are collected, processed and remanufactured into new products” (Zsididin & Siferd, 2001). Zsididin et al (2001) imply that material packaging is a good example of an activity that can use all three approaches for improve the environmental performance.

Noci (1997) suggests different approaches of evaluating environmental performance dependent on which environmental strategy the company prefers. For companies that apply a reactive strategy the measures of current environmental performance of a supplier’s production process and the life cycle cost associated with the component supplied are considered as relevant. This assessment will result in evidence of how well the supplier fulfils regulations and legislations and the life cycle analysis will reveal the supplier’s economical stress caused by the component. These measures are strictly quantitative. Four indicators of impact on the environment are introduced as suitable as measures of environmental performance of a supplier’s production process; waste water, air emissions, solid

wastes and energy consumption. For companies that prefer a proactive environmental strategy there are other measures to take under consideration due to Noci (1997). Characteristic for these measures is that they take on a long-term perspective. Main objective is to investigate whether a supplier in the future will be able to follow corporate environmental programs and develop continuous innovations. Hence focus is not on assessing the supplier's current status but to assess their future abilities and capacity to carry out new environmental programs. The author believes that an evaluation criterion such as achievement of eco-auditing or certification is not relevant to include in a supplier environmental efficiency assessment. It is also highlighted that meeting such a criterion does not reveal the impact on the nature by the supplier's processes. Emphasis is also on including both qualitative and quantitative criteria in the evaluation and especially on the four factors green competencies, current environmental efficiency, supplier's green image and net life cycle cost. The first two factors aim at defining what is the engine behind the supplier's environmental innovation, the third factor assures that there are no boundaries regarding the green image introducing a new green product and the last factor brings the financial aspect. From these four factors environmental criteria for evaluation a supplier's environmental performance are developed. (Noci, 1997)

Six performance attributes for supplier environmental performance is presented by Handfield et al (2002). They highlight product attributes, waste management, labeling/certification, packaging/reverse logistics, compliance to governmental regulations and environmental programs at the supplier's facilities as important factors to take under consideration when assessing a supplier's environmental performance. Product attributes refer to internal recycling activities within the supplier's organization but also to what extent hazardous materials are being used and emitted. Information collection of these types of data must be performed by an on-site evaluation of the supplier's processes. Waste management information can be derived from the primary outputs from supplier processes and is the gross annual solid waste tonnage that goes to landfill and disposition of hazardous materials. Labeling/certification investigate if the supplier is certified by third parties and to what extent. An attribute easy to track is packaging/reverse logistics, which aims at activities such as remanufacturing and reuse, returnable or reduced packaging and reverse logistics systems available. Compliance to governmental regulations assures that the supplier performs processes in such a way that the governmental regulations are fulfilled, hence a relatively easy attribute to check. Investigations if the supplier has an environmental system or not is the objective of the last performance attribute, environmental programs at the supplier's facilities. In accordance to the first attribute this must also be validated through an on-site assessment. (Handfield, Walton, Sroufe, & Melnyk, 2002)

The classification of green purchasing strategies of Min et al (1997) into source reduction and waste elimination can be discussed in further detail. Purchasing has the opportunity to reduce waste in a number of ways. Min et al (1997) suggest this can mainly be done through recycling, reuse and low-density packaging. In their study they conclude that the most common action to reduce waste is by recycling, primarily paper, cardboard, pallets, plastics and ferrous metal. Next common strategy used for source reduction is found to be reuse, primary of durable commodities such as pallets, cardboards and paper. When waste elimination strategies are discussed they are identified as scrapping or dumping, sorting for nontoxic incineration and biodegradable packaging, where scrapping or dumping is the most common strategy. The authors conclude that waste elimination strategies are not as frequently used as waste source reduction strategies. (Min & Galle, 1997)

3.4.3 Aspects to consider when selecting environmental criteria

Walton et al (1998) present five major supply chain-oriented categories of main task areas where purchasing could influence environmental-friendly practices. One of these is supplier evaluation. The importance of a healthy and deep relationship is emphasized for successful integration of suppliers in environmental friendly practices. Guidelines articulated contain recommendations that methods and criteria used for supplier evaluation must be consistent with the company's environmental strategic direction, which can be achieved by first selecting criteria and then focus on meeting government regulations followed by proactive criteria focused on process improvements. (Walton, Handfield, & Melnyk, 1998)

Evaluation of supplier environmental performance is not similar to a regular supplier evaluation considering criteria such as cost, quality, delivery etc. The primary reason is that a supplier plant's impact on the environment and natural resources must be tracked and measured according to new perspectives (Noci, 1997), especially when definitions of air emissions, solid wastes, energy consumption and waste water require indices that are measurable and integrated to form a base for an overall assessment of a supplier's environmental performance. To transform these measures into economical results, except from quantitative criteria also qualitative criteria must be considered such as a supplier's environmental effectiveness.

Assessment of suppliers' environmental performance is not a procedure that should be performed on the complete supplier base. Especially for suppliers that have occasional relationships with the company or supply components with a secondary importance of the final product with respect to functionality and environmental impact such an assessment is not significant and does not contribute to value creation. A supplier environmental performance evaluation should rather be applied on strategic suppliers with substantial relationships with the company, large volume and/or significant environmental impact on the end product.

When inserting environmental criteria in the supplier selection process some additional aspects need to be directed except from which environmental criteria to select (Jabbour & Jabbour, 2009):

- The analysis of the supplier environmental performance should be systematically performed.
- Supplier selection should consider whether supplier have enough capacity to deal with growing demand for improvements of the suppliers environmental performance.
- The insertion of environmental criteria needs to be suitable for suppliers regardless of size or branches.
- Suppliers that have modern management practices have a larger potential to improve its environmental performance.
- Environmental criteria need to be proportional to the environment demand of final consumers.
- An increasing trend towards closed loop supply chain models is identified as well as a domino effect of the buying company's greater environmental awareness.
- A lack of information regarding suppliers' environmental performance.

3.4.4 Environmental criteria

Due to the difficulty to categorize environmental criteria suggested by the literature in distinct categories following chapter is structured after author. To present a general discussion about each of the criteria would not be possible due to the fuzzy boundaries between different authors' criteria definitions.

Quantitative criteria that are applicable for a firm that want to measure their suppliers' current environmental impact are waste water, air emissions, solid wastes and energy consumption (Noci, 1997). Waste water criteria can be measured with respect to total water consumption or some critical water wastes such as total nitrogen or dissolved salts, air emissions are measurable when tracking emissions of critical substances, for example SO₂, NH₃ or CO₂ and solid wastes can be defined as total volume of solid wastes annually achieved by the supplier. By investigating the supplier's annual total amount of energy consumption the criterion energy consumption can relatively easily be measured and quantified. As mentioned in chapter 3.4.2 Environmental performing factors, the author insists on four factors that should be included in a supplier environmental performance evaluation when the company's general environmental strategy is proactive. Green competencies, current environmental efficiency, supplier's green image and net life cycle cost are all relevant to get a clear and sound picture of the supplier's environmental attitude, activities and qualifications. Operating indices of both qualitative and quantitative nature for the four factors are derived to ease the implementation and use of the model. The supplier's green competencies can be evaluated based on availability of clean technologies, type of materials used in the supplied component and capacity to respond in time to process or product modifications.

When discussing current environmental efficiency Noci (1997) states that it is not of importance to purchasing managers to quantify precise levels of pollution but rather to make a qualitative assessment of the supplier's current environmental efficiency in relation to technologies available. Therefore the indices air emissions, solid wastes, waste water and energy consumption will be used, but not assessed similar to the assessment of these indices for a company with a reactive environmental strategy which used quantitative measures. Goal is to make qualitative judgments of how suppliers' general performance accordingly to these indices and use the judgment to identify potential areas for improvement concerning environmental performance. When assessing supplier's green image both qualitative and quantitative indices will be applied. Share of green customers who buy products from the supplier is an example of a quantitative measure while type of relationship with stakeholders is a qualitative measure and so is also customers' purchase retention. Net life cycle cost is suggested to be assessed with cost of supplied component, cost for component disposal and depreciation for investments aimed at improving the supplier's environmental performance, hence it is a quantitative measure as well. (Noci, 1997)

When measuring the supplier's environmental efficiency Makower (1994) in Wee et al (2005) agrees with Noci (1997) that pollution prevention, waste reduction and energy efficiency need to be identified, though they do not differ between waste water and solid wastes like Noci (1997) does. (Wee & Quazi, 2005) (Noci, 1997)

Handfield et al (2002) have performed a literature review to identify environmental performance indicators. The 55 indicators found were by companies not systematically integrated in the supplier evaluation and selection process but used as complement to existing criteria in an unsystematic manner. The long list of indices was presented to a group of managers which assessed them according to relevance, easily assessed and importance to corporate environmental strategy. All indices were considered to be relevant, so a derived list of ten criteria for supplier environmental performance were created based on most easily assessed and importance. This list is presented in

Table 17. (Handfield, Walton, Sroufe, & Melnyk, 2002)

Table 17 Criteria for supplier environmental performance (Handfield, Walton, Sroufe, & Melnyk, 2002)

Top 10 – most important	Top 10 – most easily assessed
1. Public disclosure of environmental record	1. ISO 14000 certified
2. Second tier supplier environmental evaluation	2. Ozone depleting substances
3. Hazardous waste management	3. Recyclable content
4. Toxic waste pollution management	4. VOC content
5. On EPA 17 hazardous material list	5. On EPA 17 hazardous material list
6. ISO 14000 certified	6. Remanufacturing/reuse activity
7. Reverse logistics program	7. Returnable or reduced packaging
8. Environmentally friendly product packaging	8. Take back or reverse logistics
9. Ozone depleting substances	9. Participation in voluntary EPA programs
10. Hazardous air emissions management	10. Public disclosure of environmental record

Some of the criteria from the long list were eliminated because of their difficulty to be measured. The managers that created the derived list also tended to rely on perceived measures of environmental performance such as ISO 14001, due to the authors. A problem identified was further the fact that few managers could determine effectively the internal process characteristics of their suppliers. The authors propose a framework for environmental performance attributes based on this derived list of criteria, which can be seen in Figure 8 on the next page.

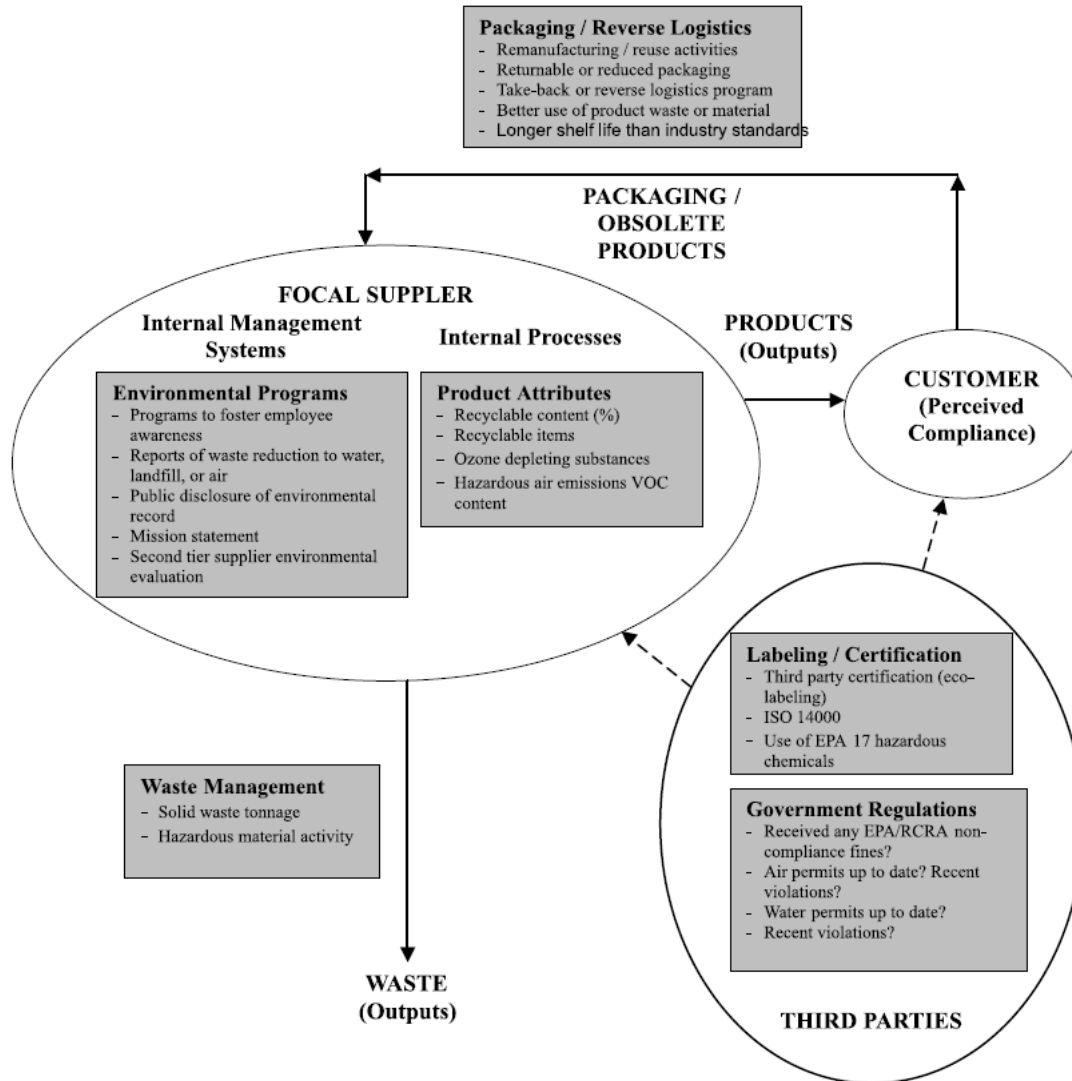


Figure 8 Framework for environmental performance attributes (Handfield, Walton, Sroufe, & Melnyk, 2002)

Attributes highlighted are focused on waste management, labeling and certification, environmental programs and product attributes, packaging and reverse logistics. This categorization is discussed previously in chapter 3.4.2.

Both qualitative and quantitative criteria are taken under consideration in the framework of Jabbour et al (2009) adopted from Humphreys, Wong and Chan (2003). Like previous authors they also emphasize solid waste, chemical waste, pollutant gas emissions, water recovery and energy as quantitative criteria to take in use when evaluation a supplier's environmental performance. Acquisition of environmental raw materials and environmental technologies, projects for environmental products and recycling are criteria that should be included and can be measured as costs. More difficult is assessing the qualitative environmental criteria suggested as top management, involvement of partners, exchanges of information and environmental training which all are categorized as management competencies. To get a clear picture of suppliers' environmental image retention of green consumers, environmental market share and relation to stakeholder are suggested. The attribute design for the environment includes criteria such as recycling, reuse and remanufacturing, reduction, disassembly and storage. Environmental management systems is an

attribute that is commonly articulated in the literature and suggested to be assessed by environmental policy, environmental planning, implementation and operation, continuous environmental improvement and ISO 14001 certification. Finally environmental competencies should not be bypassed and relevant criteria for that attribute are competence for environmental technologies, use of environmental materials, capacity to reduce pollution and manage reverse flows. This framework presented consists of both reactive criteria such as ISO 14001 certification as well as merely proactive criteria assessing capacity for environmental improvements, green image, environmental policy and top management engagement. In comparison with the criteria mentioned by Walton et al (1998) these can be considered covering a broader environmental view more suitable together with current environmental trends. (Jabbour & Jabbour, 2009) (Walton, Handfield, & Melnyk, 1998)

Min et al (2001) have made a research about green purchasing practices of US firms and highlight a number of environmental variables that affect supplier selection, which can be interpreted as environmental criteria for supplier selection, except from the variable buying firm's environmental mission which is an internal variable, see Table 18. The authors conclude that these variables also to a large extent reflect a reactive manner among buying firms. (Min & Galle, 2001)

Table 18 Environmental variables affecting supplier selection (Min & Galle, 2001)

Environmental variables
Potential liability for disposal of hazardous materials
Cost for disposal of hazardous materials
State environmental regulations
Federal environmental regulations
Cost of environmental friendly goods
Cost of environmental friendly packages
Supplier's advances in providing environmentally friendly packages
Supplier's advances in developing environmentally friendly goods
Environmental partnership with suppliers

As a conclusion of the environmental criteria suggested above by different authors, some are more suitable for companies with a reactive environmental strategy and others have a deeper proactive approach or cover both perspectives. A common reflection made by the authors is that the need for both qualitative and quantitative criteria is a necessity for performing a supplier environmental performance evaluation that takes all important aspects into consideration. Frameworks or models that only consist of quantitative criteria or are considered to have a field of application strictly for companies with reactive strategies are in many cases suggested by the authors to be extended with proactive criteria.

3.4.5 Challenges and obstacles to environmental purchasing

Supplier evaluation and selection are routine processes within many companies today, but only a minor part of them have a methodology for how to integrate environmental aspects into their existing supplier selection processes. Environmental goals are more commonly pronounced and stated but next step incorporating them in a systematical manner are still not taken (Handfield, Walton, Sroufe, & Melnyk, 2002). Describing supplier environmental performance using quantitative data is an identified problem by purchasing managers, primary due to unclear definitions of

environmental performance indicators and lack of data stored concerning supplier environmental performance. Another issue is that some criteria for supplier environmental performance are time-consuming and difficult to measure, which directly excludes them from being suitable criteria even though they might be of high relevance. Handfield et al (2002) have further found an absence of information needed for assessing environmental criteria, which constitute a large barrier in evaluating suppliers' environmental performance correctly. A challenge can be convincing the supplier to discuss environmental issues and their environmental performance, when it is considered to be a "social desirability". (Handfield, Walton, Sroufe, & Melnyk, 2002)

Min et al (1997) analyze obstacles to green purchasing and describe them as numerous even though green purchasing has become important to purchasing managers and an everyday concern. Costs and revenues are identified as main sources for the three most common obstacles which are high cost of environmental programs, uneconomical recycling and uneconomical reuse. They mean that this result shows that purchasing managers do not fully understand the economical potential in green purchasing. Another unseen barrier, similar to the challenges that Handfield et al (2002) mentioned, is lack of systematic methods assisting purchasing managers in how to accurately measure benefits and costs related to environmental purchasing. (Min & Galle, 1997) (Handfield, Walton, Sroufe, & Melnyk, 2002)

Upstream members of the supply chain are by Carter et al (1998) mentioned to be a threat against the effectiveness of environmental purchasing. This statement is explained by uncertainty of the availability of resources, poor quality of environmental-friendly inputs and insufficient coordination with suppliers of these inputs. (Carter & Carter, 1998)

Identified as the most important obstacles to establishing environmental policies are lack of resources and high costs of environmental compliance (Murphy, Poist, & Braunschweig, 1995). Walton et al (1998) also support the fact that lack of internal resources is a main challenge for environmental purchasing. The difficulty to measure benefits of establishing environmental policies is one reason for profit opportunities to only be a minor driver but instead a substantial obstacle. The common appreciation is that benefits are hard to achieve and that costs for establishing environmental policies often not are worth it. Inconsistency and variance of green guidelines already being used are mentioned as main barriers for environmental purchasing due to Mulder (1998). The author claims that different approaches exist not only between countries but also within them and even within the same organization, which increase the degree of complexity. Another aspect is language and interpretation differences between purchasers and their suppliers. Mulder (1998) means that if only purchasers would be more successful indicating what their concerns and expectations from their suppliers are, then suppliers would be able to contribute with more relevant and comparable information. (Walton, Handfield, & Melnyk, 1998) (Mulder, 1998)

3.5 Quality management and environmental purchasing

Carter et al (1998) lift the topic of quality and environmental purchasing to the surface and conclude that a quality level of environmental-caring input was not high enough it could hinder environmental purchasing activities. The quality discussion is cared about by Zsididin et al (2001) claiming that quality management and environmental activities are strongly connected. One primary principle of quality management is that waste should be eliminated or minimized, which can best be realized by eliminating waste in the initial design phase of products and processes. Environmental performance

is improved by the eliminating waste early, hence product and process design is considered the key for quality improvement and improvement of environmental performance. Environmental focus can be interpreted as an extension or branch of quality focus with immediate impact on natural resources and environment. Without top management involvement and engagement this level of environmental excellence cannot be reached. (Carter & Carter, 1998) (Zsididin & Siferd, 2001)

3.6 Weighting methods for supplier evaluation criteria

A critical step in the supplier selection framework is the decision making process. When supplier evaluations tend to consider more and more aspects of a supplier, the understanding of the supplier performance becomes particularly complex. To evaluate a supplier on criteria of different importance, it has become common to use specific tools or methods to perform the weighting of the criteria systematically (de Boer, Labro, & Morlacchi, 2001). An uncomplicated method to apply is assigning equal weights to each of the supplier selection criteria. Since this does not consider the fact that the measured criteria are of different importance to the company, it can be considered as insufficient. If each supplier selection criterion is assigned a unique weight depending on its importance to the purchasing company, the quality of the supplier evaluation could be significantly improved (Wee & Quazi, 2005).

Various decision making approaches have been discussed to solve the supplier evaluation problem. Some commonly discussed multi-criteria decision making approaches are:

- Analytical Hierarchy Process (AHP)
- Analytic Network Analysis (ANP)
- Case-Base Reasoning (CBR)
- Data Envelopment Analysis (DEA)
- Fuzzy Set Theory
- Genetic Algorithm (GA)
- Mathematical programming
- Simple Multi-Attribute Rating Technique (SMART)

Further there are approaches combining several of these individual approaches. A general aspect that differs among the approaches is that of application on quantitative/qualitative criteria. Some methods are more suitable for qualitative criteria while others work best with quantitative criteria and a few can handle a combination of qualitative and quantitative criteria. The issue of decision making was addressed in 78 articles published between 2000 and 2008 (Ho, Xu, & Dey, 2010). The authors state that the most popular individual approach is DEA, Data Envelopment Analysis, followed by mathematical programming and AHP, Analytical Hierarchy Process. AHP is a benefit measurement model that relies on subjective managerial inputs on multiple criteria. An individual approach uses one model alone while an integrated approach uses two or more models combined. The individual approach was found to be more popular than an integrated approach. Among the integrated approaches, the ones which included the AHP model were found to be most popular (Ho, Xu, & Dey, 2010).

Ho (2008) analyzes different combinations of approaches and concludes that the AHP-GP approach, where GP stands for Goal Programming, is the most common approach. The main contribution of the AHP approach is defining weights for supplier evaluation criteria. Though, for some multi-criteria

decisions merely addressing the relative importance weightings of criteria are not sufficient. Limitations in resources might also affect the adoptability of the AHP model. The GP model can compensate for the AHP model by providing a method of how to perform multi-criteria decisions in regard to limitations. Therefore it is argued that the integrated approach consisting of the AHP model and GP model could be fruitful. (Ho, 2008)

Table 19 Multi - criteria decision making approaches discussed by (Ho, Xu, & Dey, 2010), (facts not discussed in the report are marked N/A)

Approach	Qualitative /quantitative criteria	Popularity ranking	Special feature
AHP	(x/x)	3	Easy to use, high flexibility
ANP	N/A	5	N/A
CBR	N/A	4	N/A
DEA	(-/x)	1	High robustness
Fuzzy Set Theory	N/A	6	N/A
GA	N/A	8	Can use information from earlier experience
Mathematical programming	(-/x)	2	Force the decision-maker to state a goal function
SMART	N/A	7	N/A

Although approaches such as those presented in Table 19 can handle complex decision making problems and consider multiple criteria, none of them consider business strategy. The weightings are in practice also subject to business priorities and strategy. (Ho, Xu, & Dey, 2010)

In some cases, multi-criteria decisions are made based on models consisting of criteria in categorized in hierarchies. Since the decision design does not reflect the relative importance between criteria in each hierarchical level, the AHP model should be used to evaluate the relative importance in all hierarchical levels. (Ho, 2008)

Noci (1997) discusses how different weighting models can be incorporated in environmental vendor rating systems. Weighting models are evaluated with respect to type of information handled, completeness and objectivity, see Table 20. The AHP-based approach is the only one that can handle both qualitative and quantitative information in the supplier selection and the objectivity of the model is one of the highest among those compared such as the categorical method, weighted-point method and the matrix approach. The weighting methods compared, including the AHP-based approach, indicate problems with low degree of completeness. Additionally, none of the methods can help decision makers in the criteria definition phase. (Noci, 1997)

Table 20 Performance of state of the art models for environmental vendor rating systems (Noci, 1997)

Approach	Qualitative /Quantitative criteria	Completeness of the assessment procedure	Objectivity of the assessment procedure
Categorical method	(-/x)	Low	Very low
Weighted-point method	(-/x)	Low	Low
Matrix approach	(-/x)	Low	Very low
Vendor Profile Analysis	(-/x)	Low	Low
AHP method	(x/x)	Low	High

Focus on applying environmental criteria to supplier assessment is discussed by Handfield et al (2002). The authors argue that few companies use structured analysis to evaluate suppliers along environmental dimensions. The AHP model is introduced as suitable to handle the problem situation of weighting environmental criteria in combination with traditional criteria, especially since it is capable to consider both qualitative and quantitative criteria. The advantages of the AHP model to the user include its reliance on data that are easily obtained. The user does however still need to consider the fact that AHP is only a model, and that clear thinking is needed as a reference. The AHP model is on the other hand capable of handling the decision making situation as a system, which a human being would never be able to. (Handfield, Walton, Sroufe, & Melnyk, 2002)

A limitation important to consider when using the AHP method is that it does not allow the elements of hierarchical model to have dependence and feedback between each involved element (Kuo, Wang, & Tien, 2010).

The usefulness of weighted supplier evaluation systems in measuring a supplier's environmental performance is however discussed in the area of supplier development. Binary criteria such as the ISO 14000 certificate would become static, as a yes, whenever the supplier implements the standard. To handle the continued measurement of this kind of criteria in weighted supplier evaluation systems is therefore not useful. (Handfield, Walton, Sroufe, & Melnyk, 2002)

The basic purpose of the AHP model is to decide what alternative is the best depending on multiple criteria. It is used to compare alternatives to each other and not to create an index. The AHP model is a theory of measurement through pairwise comparisons and relies on judgments from experts in the area to derive priority scales. The model is used to make a decision in an organized way by decomposing the influencing factors through the following steps.(Saaty, 2008)

1. Define the problem and determine the kind of knowledge sought.
2. Structure the decision hierarchy from the top with the goal of the decision, then the objectives from a broad perspective, through the intermediate levels (criteria on which subsequent elements depend) to the lowest level (which usually is a set of the alternatives).
3. Construct a set of pairwise comparison matrices. Each element in an upper level is used to compare the elements in the level immediately below with respect to it.

4. Use the priorities obtained from the comparisons to weigh the priorities in the level immediately below. Do this for every element. Then for each element in the level below add its weighed values and obtain its overall or global priority. Continue this process of weighing and adding until the final priorities of the alternatives in the bottom most level are obtained.

3.6.1 Likert scale

A Likert scale is commonly used in research and surveys to investigate the attitudes of respondents to different types of statements. By using the Likert scale, the respondents can express their strength of feeling on a scale consisting of response categories. The scale is categorical and can consist of between three and up to 25 different response categories. For a five-point Likert scale the labeling of the categories can be between one and five. Characteristic for the Likert scale is the fact that the endpoints are defined such as “not at all serious” and “very serious”, “very unimportant” and “very important” or “strongly dislike” and “strongly like”. The Likert scale is used by the authors to provide an ordering of the relative importance of a set of items, and how this relative importance may vary according to other characteristics of the individual. (Dittrich, Francis, Hatzinger, & Katzenbeisser, 2007)

Jacoby et al (1971) have in their research studied the optimum number of response categories for a rating instrument. This issue concerning the number of response categories is highly important regarding the Likert-type scale due to the authors. They mean that too few response categories would result in too coarse a scale and consequence in that the rater’s discriminative powers significantly will be reduced. Contradictory, by having too many categories would make it difficult for the rater and go beyond his limited powers of discrimination. The study results in conclusions that reliability and validity of the responses using a rating scale with many response categories contrary using a rating scale with only three response categories are equal for both cases, hence the reliability and validity are independent of the number of response categories used for Likert-type scales. They suggest that validity should not be considered when determining the number of steps in a Likert scale rating format since they cannot demonstrate a consistent relationship between validity and the number of scale steps utilized. (Jacoby & Mattel, 1971)

3.7 Supplier information collection

When setting up a model for supplier evaluation the issue of collecting data and information needed should also be addressed. Due to organizations’ resource restrictions the collection methods have to be efficient. Gordon (2005) points out that the main problem is the coverage, meaning how information for a large part of the supplier base should be collected with existing resources. The author describes a number of methods for information collection and also reflects over their respective challenges and disadvantages. The methods highlighted are described below in Table 21.(Gordon, 2005)

Table 21 Supplier information collection (Gordon, 2005)

Method	Challenges
Paper questionnaires	Hard to construct sound information gathering instruments. Require knowledge of what to measure. Difficult to deploy. Suppliers procrastinate filling out.
Web based questionnaires	Require resources to develop. Compliance issues (internal and external).
Extracts from current systems	Data integrity. Require cleansing, massaging and formatting. Data integrity disputes with suppliers.
Site visits	Resource intensive for both customer and supplier. Requires trained personnel. Can be inconsistent.
Third-party certification	Conformance to procedures does not guarantee best practice deployment. Can move the focus away from performance to documentation of procedures. Not specific to performance, processes and practices required by the customer.

Constructing a good questionnaire is not an easy task the author explains. A sound questionnaire does not contain buzzwords, does not ask for diverse information in one question and are clearly to be understood and does not contain vague questions. To remember when constructing a questionnaire is further that the information acquired should be actionable. Exclusively using a questionnaire for data information gathering may also lead to low validity since too few data points are collected from a strictly limited number of supplier employees. To get a sound picture of the supplier's performance other people than just quality managers, owners and site managers need to be interviewed. The methods proposed in Table 21 should be used in combination to gather a holistic view of supplier performance. (Gordon, 2005)

3.8 Supplier rating

Lasch et al (2005) have made a research on supplier rating procedures commonly used by investigating 193 industrial companies. Their findings imply that point rating systems and scoring models as well as portfolio analysis are three methods for supplier rating suitable for the demand of supplier classification and are all qualitative methods. No quantitative methods were found to be fulfilling the demand of supplier classification. The central position of supplier rating in the supplier management process is articulated, which the authors back up with the argument that supplier rating has connections with both the supplier selection and the supplier controlling. With supplier controlling they describe the same things that previously have been discussed as supplier development in this study. Classification can be interpreted as a variant of ranking, since the classification is based on the results from the supplier evaluation. Portfolio analysis is the method most frequently applied followed by point rating system and finally scoring model in the authors' research. (Lasch & Janker, 2005)

Bayer AG is a global company that works intense with supplier relationship management. Bayer clearly shows the relationship between supplier selection, supplier evaluation and supplier optimization and applies a program called SUPREME, that is characterized by a cross-functional and collaborative approach within the Bayer organization for supplier management. The SUPREME supplier evaluation is performed at least once a year and the scoring of the suppliers is executed using a quantitative range of results between 0 and 100. The ranking of the suppliers due to their acquired score is highly important to conduct according to the company, hence not exclusively focusing on the scoring activity. Bayer has identified four groups of suppliers correlated to what score the supplier has reached; the supreme class, the standard class, the poor class and the desourced class, see Table 22. (Bayer AG, 2010)

Table 22 Supplier classification due to scoring results (Bayer AG, 2010)

Classification	Score (0-100)
Supreme	> 90
Standard	70 < 90
Poor	50 < 70
Desourced	< 50

Suppliers categorized as supreme suppliers are those which are high-performers and are seen by Bayer as preferred partners for strategic relationships. Standard suppliers have a lower categorization characterized by fulfilling the standard requirements of Bayer. Being a poor supplier means need for special attention concerning supplier optimization, with other words there are many potential areas for improvements. Finally, a desourced supplier has such a low score that the supplier cannot be considered for long-term relationships and/or large volume purchasing with Bayer due to too poor performance.

3.8.1 Scales

A basic fact in ranking theory is the differences between relative measurement and absolute measurement. Relative measurement implies that two or more alternatives are being compared, while absolute measurement means that the alternatives are compared to an ideal alternative of which is known of or that can be imagined, a process that is called rating alternatives. The first is descriptive and conditioned by observational ability while the second is normative and conditioned by what it is know best. To rate alternatives with respect to ideal alternative intensity levels, degrees or variation in that criterion needs to be created. When rating a measurement with an absolute number, normalization is required by dividing the measurement with the highest number achievable. For example if a criterion is evaluating amounts of claims, the criterion needs to be compared in regard of the amount of products ordered, ending up as a percentage. This percentage can then be divided into different intervals corresponding to a specific score. When evaluating qualitative criteria using an intensity scale, for example 1-100, an intuitive idea of what score a supplier's performance should correspond to need to be available. An alternative to that is to clearly define what specific fulfillments a supplier should achieve qualitatively to get a specific score. (Saaty, 2004)

To handle that quantitative criteria usually are measured in different units it is suggested that the data is normalized (Saaty, 2004). Since normalized data can be compared on the same scale they can then be included in the supplier evaluation model when weighing the criteria together.

Experienced based qualitative criteria are judged over the evaluators' experience of the supplier's performance. Saaty (2004) suggests that this kind of qualitative criteria are evaluated over a subjective intensity scale where each score is not specified in detail. Since this is a subjective measurement and that the same group of employees evaluates the same category of suppliers year after year, the judgment will be based on the same experience why a further mapping could even be seen as irrelevant. (Saaty, 2004)

Qualitative fact based criteria are evaluated based on a supplier's provided information in the shape of written reports, emails or other tangible data. Since the data is clear this kind of criteria can be evaluated by anyone who has an understanding for what type of information is needed to assign the supplier a specific score. Saaty (2004) therefore suggests that these criteria are complimented by specific descriptions of what the supplier needs to accomplish to get a specific score. (Saaty, 2004)

There are basically four types of scales; nominal scales, ordinal scales, interval scales and ratio scales. Nominal scales use labels, such that waste can be classified as paper, glass, plastic, burnable etc. Variables assessed on nominal scales are called categorical variables and measure categorical data. Ordinal scales can be used to rank data by their relative size or intensity. Three examples are (1st, 2nd, 3rd, ...), ("bad", "medium" and "good") and ("very satisfied", "neutral", "unsatisfied", "very unsatisfied"). Ordinal scales are used widely in psychology, but it also has applications in mathematical order theory, when it is used to define total preorder of objects. Interval scales can be used for quantitative attributes when any difference between the levels of an attribute can be multiplied by any real number to exceed of equal another difference. The Celsius scale is a good example, where the unit of measurement is 1/100 of the difference between the boiling point and the melting point. Ratio scale is the scale most commonly applied in the physical sciences. Engineering, mass, length, time are examples of physical measures that are ratio scales. (Stevens, 1946)

Kumar (2008) discusses the number of alternatives on a rating scale briefly. In attitude scales, an even number of alternatives forces the respondent to choose side while a scale with an uneven number of options on the other hand gives the respondent the choice of being neutral. Dawes (2008) performed a study to compare 5-point, 7-point and 10-point Likert scales to determine how the size of a scale influences the outcome. The author realized that the overall mean score was 0.3 points lower for the 10-point scale than either the 5-point or 7-point scale. Finding of the study was that the 5-point and the 7-point scales produced the same mean scores as the 10-point Likert scale. (Kumar R. , 2008) (Dawes, 2008)

4 Specification of the task

The intention of this chapter is to break down the purpose of the study into fragments, which together with the theoretical review will conclude in general questions of the investigation. Aim is at determining a plan for how to conduct the investigation so that it will be performed accurately (Lekvall & Wahlbin, 2001). Following specification of the task can be seen as a necessity for planning and executing the investigation properly. Lundahl et al (1999) support this statement by pointing out the importance of in an early stage defining what results that are expected. (Lekvall & Wahlbin, 2001) (Lundahl & Skärvad, 1999)

4.1 Problem identification

The supplier's role in the contribution to a company's success is continuously increasing and consequently purchasing's role within the company has increased as well into constituting a link between internal departments (Zsididin & Siferd, 2001). This implies the importance of an exhaustive and systematic supplier evaluation process with can be applied for both the selecting of new suppliers and the development of existing suppliers.

Sharpened environmental regulations and growing environmental awareness among customers are two main sources for companies to allocate their resources on environmental-caring activities and actions. Cederroth is a company with an already large environmental focus but to remain competitive in the fast-moving consumer goods branch continuous improvements are essential. The purchasing department is a key player in the company when it comes to improve environmental performance. Choosing suppliers that care about the climate and actively work for reducing environmental impact is considered by Cederroth as an important next step in becoming a greener company but also to reduce costs and increase value.

At present, the strategic supplier process at Cederroth, consisting of supplier identification, qualification, evaluation, selection and development, does not consider any environmental criteria and few requirements concerning environmental aspects are communicated to their suppliers. A need for an improved and extended strategic supplier evaluation process, which also considers environmental criteria and makes it possible to evaluate both new and existing suppliers on these criteria, is identified within the company. Today's evaluation process is to a large extent subjective when almost no criteria are possible to measure in figures. The strategic purchasers assess suppliers based on their own and the operative purchasers experience with the supplier, notes from supplier visits and with support from R&D, logistics and quality department. An issue is furthermore lack of guidelines for how to assess the suppliers following current evaluation sheet. Therefore there is risk for significant differences in how the purchasers interpret the criteria and how the suppliers are evaluated. The level of subjectivity should be reduced by a standardized subjective evaluation process characterized by measurable criteria where possible and clearly defined guidelines for how to interpret and assess non-measurable criteria.

4.2 Problem discussion

The purpose of the study is often very briefly described in the introductory part of the report and this section aims at giving the reader a deeper understanding about what the investigation will look into and what results that are expected. Thereafter follows a detailed description of the system that will be studied and its delimitations. Presented shortly, the evaluation model will be constructed based

on theory and thereafter iteratively revised after being evaluated by representatives from Cederroth and finally tested on three of Cederroth's strategic suppliers to assure its applicability.

The investigation should result in a model for strategic supplier evaluation. Except consisting of traditional strategic supplier evaluation criteria, environmental criteria should also be considered. The model should be general and applicable for all Cederroth's existing and potential strategic suppliers. Result of the evaluation should be a visualization of supplier performance in a number of different categories. The result should be used for highlighting strengths and weaknesses in supplier performance and give indications of improvement areas as well as for supplier selection decisions. Environmental issues will hereby be taken into light and recognized as an important area for supplier improvements and supplier development. The evaluation process can furthermore support a proactive way of supplier management due to early identification of problems when executed on a regular basis.

4.3 System description

After defining the task in closer detail it is appropriate to describe the system that will be studied. In Figure 9 the system is visualized. The supplier process can be split into two branches; one for strategic suppliers and one for non-strategic suppliers. Further the supplier process for new strategic suppliers consists of supplier identification, qualification, evaluation, selection and finally development. For existing strategic suppliers the purchasing process is limited to consisting of the supplier evaluation and development, when they already have qualified into the strategic supplier base of Cederroth and have been selected as approved supplier. The supplier process for non-strategic suppliers consists of identification, qualification and selection. This category consists of suppliers considered as suppliers with small volumes and/or suppliers with little importance for Cederroth. Hence supplier development and supplier evaluation are not applied on this category. Due to this fact the supplier management process for non-strategic suppliers is not included in the system studied. The task of the study is to create a supplier evaluation process that is applicable on both new and existing strategic suppliers. That brings forth a system restriction that excludes the identification and qualification process in the beginning of the strategic supplier process and excludes the supplier selection and supplier development in the end of the process. The identification, qualification and selection concern only new suppliers, which is a reason for not taking those incremental processes into consideration in this investigation. Cederroth work closely with their existing strategic suppliers to a large extent and try to develop the cooperation as far as possible instead switching to new suppliers. On account of this, studying the supplier process for new suppliers only would not be of beneficial use for Cederroth when that process is applied occasionally. Instead focus is to develop a model for strategic supplier evaluation, which is a major incremental process in the supplier process and includes both new and existing suppliers. Studying supplier development would also be an area of interest. Currently Cederroth are running a few supplier development projects with their strategic suppliers, which is the main reason for not including supplier development in the system studied because of its already ongoing.

As can be seen in Figure 9, the evaluation process is an iterative process which should be performed on a regular basis. Hence input to the system can either come from the previous supplier qualification or from supplier development, dependent on if it is a new or existing supplier that is to be evaluated. Output from the system will be used as a foundation for strategic supplier development or as decision basis for supplier selection.

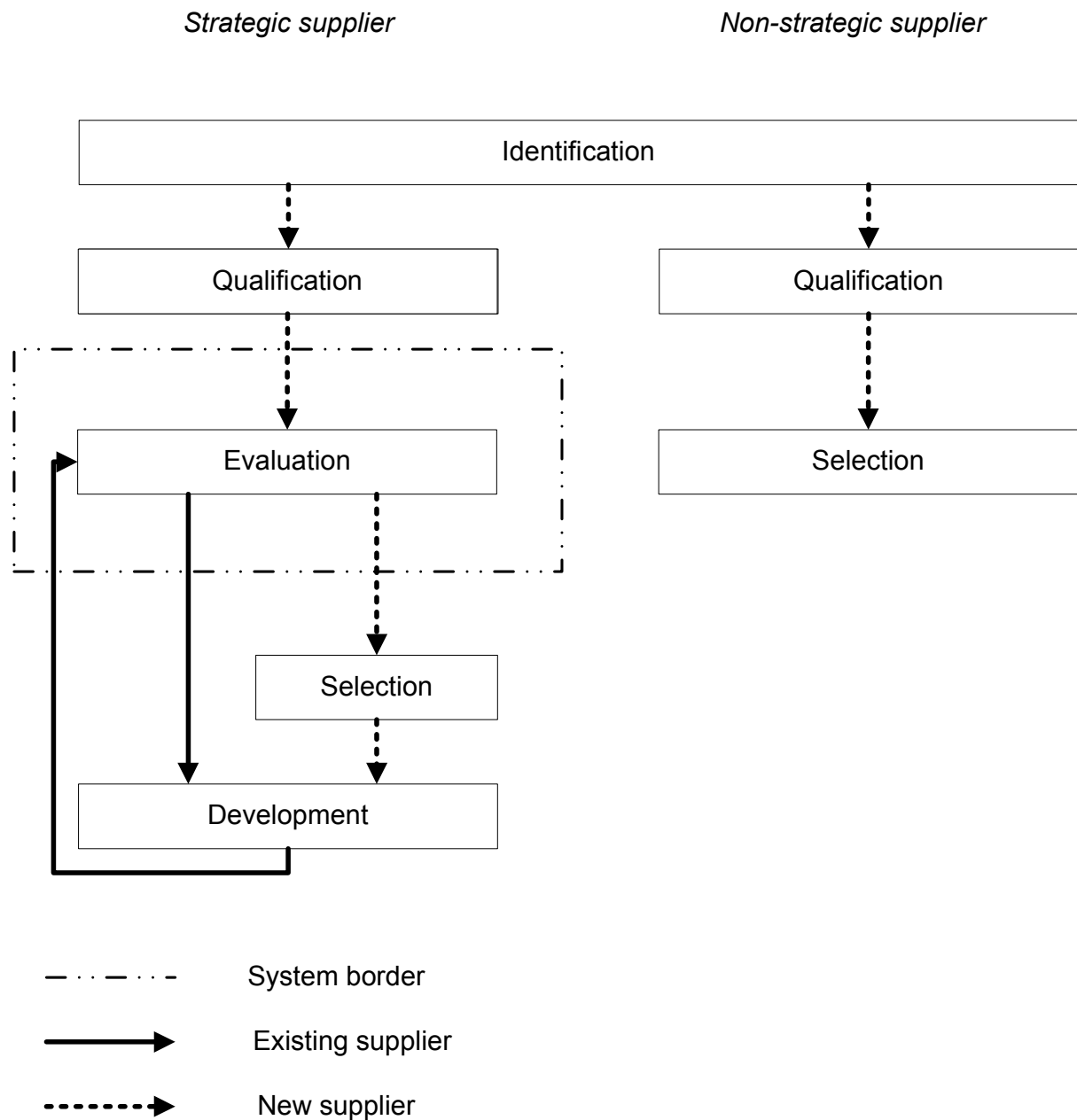


Figure 9 System description

4.4 Definition of environmental purchasing

Before entering the purpose break down the definition of environmental purchasing needs to be clarified, since it is a central concept in the study. Including environmental criteria in supplier evaluations and assessments are recently becoming a hot topic for purchasing managers, even though the concept of environmental purchasing is established since long. At present, environmental purchasing is a concept which is not clearly or uniformly defined in the literature despite of its relatively long existence (Björklund M. , 2010). This fact complicates the definition of the concept of environmental criteria as well. To be able to select environmental criteria suitable for Cederroth to evaluate their strategic suppliers on, there is of substance to communicate a definition of the

concept environmental purchasing which will be adopted in this study. Chapter 3.3 presents definitions stated in the literature by different authors. The definitions are of different depths and further they have more or less holistic and exhaustive approaches. When aim in this study is at identifying and selecting criteria that are applicable on all categories of Cederroth's suppliers and that should be able to integrate with the traditional supplier evaluation criteria, a holistic definition of environmental purchasing is appropriate. The supplier evaluation will be used as a foundation for further supplier development within different areas such as product development, logistics and quality which support the suitability of a holistic approach. Therefore the definition of environmental purchasing is adopted from Zsididin et al (2001) described as:(Zsididin & Siferd, 2001)

"The set of purchasing policies held, actions taken, and relationships formed in response to concerns associated with the natural environment. These concerns relate to the acquisition of raw materials, including supplier selection, evaluation and development;; suppliers' operations; in-bound distribution; packaging; recycling; reuse; resource reduction; and final disposal of the firm's products".

Their definition clearly includes supplier selection, evaluation as well as development, latter which will be a long-term application area for integrating environmental aspects in the supplier selection process. The definition is an extension of the definition by Carter et al (1998) which is commonly referred to and the most tangible and descriptive definition of those presented in chapter 3.3. (Carter & Carter, 1998)

4.5 Purpose breakdown

The study will aim at creating a supplier evaluation process which can be used to evaluate existing and new strategic suppliers that has passed Cederroth's initial supplier qualification in accordance with the general requirements in the assessment process, see Appendix C. In Cederroth's supplier base there are three main strategic supplier categories; packaging, chemicals, contract manufacturing. The evaluation process should be able to assess strategic suppliers despite of category. Cederroth have approximately 40 suppliers that are classified as strategic suppliers and even though they could be grouped Cederroth believe that general supplier selection criteria are more useful (Andersson, 2010). It would not be time or money efficient to develop different strategic supplier evaluations with diverse sets of criteria for each supplier category, even though the supplier categories have significantly various characteristics; packaging suppliers being mainly small family-run companies while chemicals suppliers generally are multinational companies. Instead it is of interest to develop one strategic supplier evaluation model containing one set of criteria, which through adjustable criteria weighting can be applied for different supplier categories.

The measurability of existing supplier evaluation criteria needs to be improved, and the qualitative criteria call for becoming less subjective. Cederroth also wish to include environmental criteria in the supplier evaluation. The new supplier evaluation process should consequently contain traditional criteria along with environmental criteria, latter which indicate the environmental performance of the suppliers. The evaluation process will consist of both quantitative and qualitative criteria.

To assure a structural proceeding an analysis model is applied, which describes the questions that need to be answered in order to fulfill the purpose of the investigation. This model describes the structure for the purpose and what aspects to address. The process of developing strategic supplier evaluation criteria for Cederroth can be parted in three phases, illustrated in Figure 10, where each

phase is explained further in detail below. The investigation will foremost focus on the first two phases of criteria selection, definition and description, however also intends to derive weights.

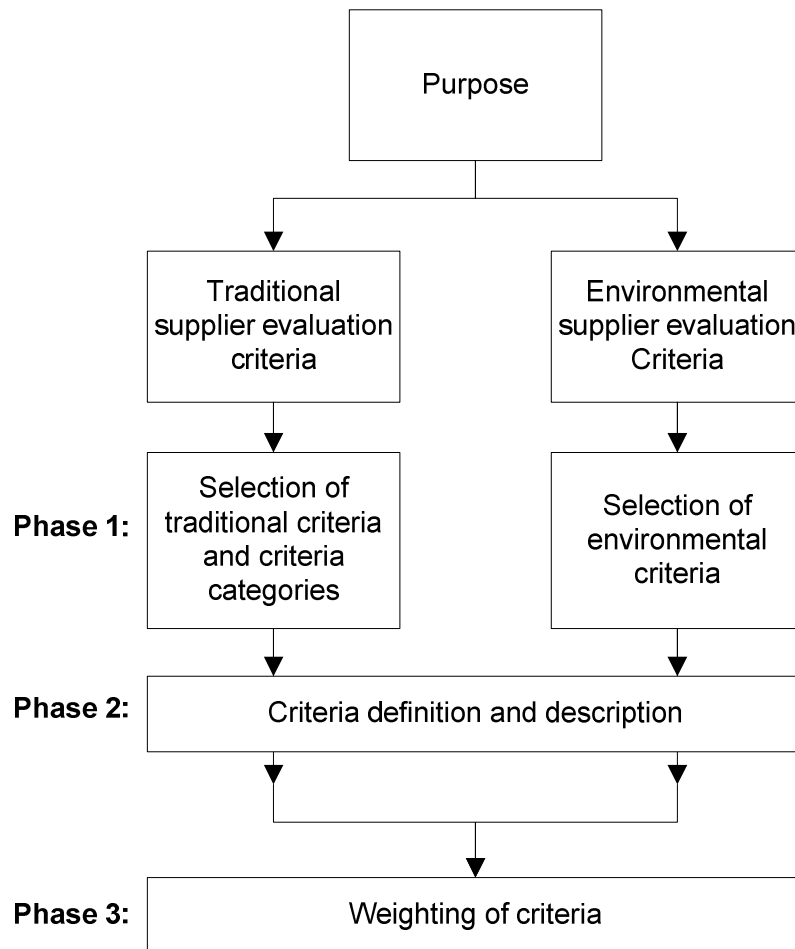


Figure 10 Purpose breakdown

The proposed strategic supplier evaluation model should assist Cederroth when selecting new strategic supplier as well as identifying potential areas for supplier development for existing strategic suppliers. The model should be easy to apply and give clear indications about which criteria performance are not met and should be improved. When Cederroth have expressed a wish for increasing their environmental focus and put more effort into environmental-caring actions, the strategic supplier evaluation model proposed in this study will be a starting point for deeper cooperation with their strategic suppliers regarding environment issues and jointly reduce environmental impact. Hence the model will evaluate the suppliers on their environmental performance.

The literature review indicates that environmental supplier evaluation criteria initially can be separated from traditional supplier evaluation criteria in order to how these criteria should be selected. Hence, firstly the purpose is divided into two separate tracks. Aim is however at integrating these two types of criteria when all criteria have been selected and award each criterion with an individual weight which will be summarized into an overall score on supplier performance.

4.5.1 Phase 1

First, focus is on determining what aspects of a supplier are important for Cederroth to assess in the supplier evaluation. The literature review indicates that there is a wide spectrum of criteria and aspects of supplier performance that can be considered during a supplier evaluation, see chapter 3.1. Supported by the argument that supplier evaluation needs to be performed according to a company's economical restrictions, all possible aspects cannot be considered at once. Therefore obligation to determine what aspects that is of importance for Cederroth to address is obvious. de Boer et al (2001) specify that the first step in the supplier evaluation process is the problem formulation. The review of methods for supplier selection conducted by de Boer et al (2001) highlights the fact that research in this area is still vague. There exist only two articles specifically addressing the topic criteria formulation. None of these articles however suggests how to determine which aspects that should be considered in the evaluation. The approach utilized by other research articles is simply to review criteria and areas of criteria suggested by other authors and then subjectively evaluate what aspects are considered to be relevant for the company in question. This investigation will apply a similar method, introduced further in chapter 5. Supplier evaluation models all begin by defining what areas are of importance for the evaluation. This phase will be conducted in two parallel tracks, one analyzing traditional aspects to consider in supplier evaluation and the other track will analyze how to assess suppliers' environmental performance. (de Boer, Labro, & Morlacchi, 2001)

4.5.1.1 *Traditional supplier evaluation criteria*

The traditional criteria accepted in the research community are just like (Bharadwaj, 2004) clarifies quality, delivery, service and price. However, the literature review indicates that authors tend to complement these aspects with a wide range of aspects such as management and organization, technology, financial stability etcetera, see chapter 3.2.1. What aspects those are interesting for Cederroth depends on product category, relationship level strived for with suppliers, availability of information etcetera. Questions that need to be addressed to handle these issues are:

- Which traditional evaluation criteria categories and what criteria within are relevant for Cederroth to evaluate their suppliers on?
- What other criteria categories and criteria can be of relevance for Cederroth to evaluate their suppliers on?

4.5.1.2 *Environmental supplier evaluation criteria*

The importance of environmental management strategy identification is clearly expressed in the literature. Many authors touching the subject of environmental purchasing and involving environmental performance factors in supplier selection process also mention the topic environmental management strategy as a prerequisite to consideration of environmental aspects in purchasing. Primary two distinct strategies can be derived from the literature review, the reactive strategy and the proactive strategy, though some authors name them differently. Regarding of the company's environmental management strategy the requirements on their suppliers are clearly diverse and requires diverse evaluation criteria. Hence following question should be answered before selecting environmental criteria:

- Which environmental management strategy is applied by Cederroth?

Regarding of environmental strategy chosen by the company, the relevance of environmental performance factors differ. For example, a reactive environmental management strategy requires performance factors focused on current environmental performance of a supplier's production process and life cycle costs while a proactive strategy should be supported by performance factors focusing on green competencies, current environmental efficiency and supplier's green image (Noci, 1997). The amount of performance factors to be found in the literature is extensive and therefore factors relevant for Cederroth's purpose must be sorted out and from which environmental criteria in the next step of the study will be derived. Example of performance factors referred to are education, efficiency and empowerment or top management commitment, green product/process design and measurement. When selecting environmental criteria it is important to consider that environmental criteria require attention paid to a number of certain aspects that do not concern traditional supplier evaluation criteria (Jabbour & Jabbour, 2009). Environmental criteria call for choice made on partly different grounds than for traditional criteria and challenges and obstacles for evaluating suppliers based on environmental criteria should be noticed and considered in this analysis. Handfield et al (2002) point out the problem of lack of information needed from the supplier to evaluate their environmental performance. This discussion suggests that this question needs to be examined: (Handfield, Walton, Sroufe, & Melnyk, 2002)

- Which criteria can assess environmental performance in accordance with the environmental management strategy applied by Cederroth?

4.5.2 Phase 2

The second phase of the purpose breakdown in Figure 10 addresses the problem of how to define criteria and how to describe them. In this phase a number of criteria demand simultaneous consideration. A method for formulating sound criteria is suggested in chapter 3.1.2. Other aspects that need to be addressed are interconnectivity between defined criteria which is discussed in chapter 3.1.3, availability of data and finally usefulness of the selected the criteria should be considered. One of the most important aspects is to make sure that the criteria assess what they are supposed to assess. Another aspect to consider is the exhaustiveness and the number of criteria selected as well as data required to assess each criterion. Assessing environmental criteria is an issue frequently discussed in the literature and constitutes one of the main obstacles to evaluation of suppliers' environmental performance (Handfield, Walton, Sroufe, & Melnyk, 2002). Many criteria that are found to be relevant can on the other hand be time-consuming to assess and require much resource. To strengthen the objectivity of the evaluation it should be clearly defined how the criteria will be assessed and the criterion should be exhaustively described. If the assessment itself requires extensive resources to perform, the evaluation model will probably not be applied. Therefore the assessment needs to be discussed. Criteria will be discussed from the perspective of qualitative versus quantitative definition, which rating scale to apply when rating the suppliers according to their performance and what data should constitute the basis for the assessment. This discussion results in following questions:

- How should the criteria selected be defined and described so that the criteria assess what they are intended to and are easy to use?
- What type of rating scale should be applied for rating the supplier performance?

The purpose of these questions is to formulate criteria so that they are relevant, reliable and assess what they are intended to do. Choice of rating scale also needs to be discussed to determine how the application of the model should proceed in practice.

4.5.3 Phase 3

Chapter 3.6 implies that there are many weighting models available, each with different suitability for different weighting situations. Generally, multi-criteria decision approaches are applicable for either qualitative criteria, quantitative criteria or both characteristics of criteria. The model that best can handle the combination of both qualitative and quantitative criteria and that addresses supplier aspects of both traditional and environmental character should be selected. The model selected further needs to be economically defensible and be practically implementable at Cederroth. Aspects to consider when selecting weighting model are the robustness of the model and the completeness and objectivity of the assessment procedure. Further, special features of the model should be noticed so that the weighting model does not require anything that will be difficult to fulfill.

- Which weighting model should be selected for criteria weighting?

For some of the weighting models the weighting of the criteria is a subjective procedure and needs to be executed by one or several persons, which implies the following question:

- Who will perform the weighting of criteria and criteria categories?

4.6 Summary of the study's questions

To simplify for the reader, the questions derived previously in this chapter are summarized and presented separately below.

4.6.1 Phase 1

- 1) *Which traditional evaluation criteria categories and what criteria within are relevant for Cederroth to evaluate their suppliers on?*
- 2) *What other criteria categories and criteria can be of relevance for Cederroth to evaluate their suppliers on?*
- 3) *Which environmental management strategy is applied by Cederroth?*
- 4) *Which criteria can assess environmental performance in accordance with the environmental management strategy applied by Cederroth?*

4.6.2 Phase 2

- 5) *How should the criteria selected be defined and described so that the criteria assess what they are intended to and are easy to use?*
- 6) *What type of rating scale should be applied for rating the supplier performance?*

4.6.3 Phase 3

- 7) *Which weighting model should be selected for criteria weighting?*
- 8) *Who will perform the weighting of criteria and criteria categories?*

4.7 Delimitations of the study

When this study is a master thesis the study has a time restriction of 20 weeks. The literature review is one of the parts of the study that has been limited due to the time constraint. The review could have been even more exhaustive taking additional aspects into consideration if only the time limit

was not restricted. The fractional theoretical review concerning how to select supplier evaluation criteria and especially environmental criteria for supplier evaluation is one of the areas in this study that has been limited due to this restriction. Environmental purchasing is further a concept that has been around for a while but environmental criteria integrated in the supplier evaluation is a fairly new topic; hence it has been challenging to find an extensive pool of written books and articles concerning this subject. Further, much literature cover implementation and measurement of traditional evaluation criteria but little literature brings up the topic of how to perform the selection of suitable evaluation criteria.

Cederroth have given directions for the thesis to investigate the supplier evaluation on a general level, not customized to the different supplier categories. Since Cederroth have a diverse product portfolio consisting of a span of products from nutrition bars and diet soup to first aid products and dishwasher detergents the diverseness of suppliers is extremely broad as well. Cederroth mean that there is no need for customized supplier evaluation models for each kind of supplier but more useful with a general evaluation model that is applicable for all kinds of suppliers when the number of suppliers within each category would be too limited to justify a customized evaluation model. Further, Cederroth have given a directive that the supplier evaluation model should concern strategic suppliers only, since non-strategic suppliers are considered to be too unimportant or supply Cederroth with such a small volume that an extensive evaluation of these suppliers would not be beneficial.

Due to the significant differences of supplier characteristics indicated above, it could have been interesting to design different versions of the evaluation model to improve the quality of the result. Cederroth have roughly categorized the strategic suppliers into three major supplier categories, chemical suppliers, packaging suppliers and contract manufacturers. A general supplier evaluation model was however requested from Cederroth in order to improve the application handiness and time-efficiency. Additionally, having one general model for all supplier categories makes the comparability between suppliers within different categories possible, which may be of more interest for Cederroth than evaluating each supplier category differently.

Since this study concerns supplier evaluation it could have been of interest to investigate the suppliers' aspect of the supplier evaluation to a larger extent than performed in this study. This was primarily executed by involving strategic suppliers in the case study by testing the evaluation model on strategic suppliers from the three main supplier categories chemicals, packaging and contract manufacturing. Reason for not integrating strategic suppliers earlier in the study is exclusively due to the time restriction. By considering the strategic suppliers' opinions and improvement ideas in an early stage of the investigation the applicability of the supplier evaluation model could have been further improved.

5 Methodology

In this chapter the methodology of the study is described, discussed and criticized. The chapter begins with a discussion about the three aspects objectivity, validity and reliability through a scientific approach. The three aspects should be considered in the development of the methodology for this study. Secondly, the methodology of the study is introduced in detail to the reader to provide an understanding for how the study has been executed and to evaluate the study's objectivity, validity and reliability. Finally, choices made that have influenced the methodology in the investigation will be discussed and criticism to the methodology is addressed in the end of this chapter.

5.1 Scientific approach

Scientists use different structures for their research based on the type of research and what questions the research are supposed to enlighten (Jacobsen, 2002). Other aspects that need to be considered in the methodology are delimitations of available resources, for example time and money. The selection of methodology needs to consider all these aspects (Björklund & Paulsson, 2003).

5.1.1 Objectivity

The measurement of objectivity concerns to what extent a scientist can or should be objective throughout the research, or if the research becomes colored by the scientist's personal values. By presenting all choices made throughout the investigation and the reasons for them, the objectivity can be held high. It is also important to describe all facts honestly and carefully throughout the process of an investigation (Lundahl & Skärvad, 1999). If the study is conducted objectively, the planning report should be written so that someone outside the investigation will be able to use it to replicate the investigation and achieve an identical result (Björklund & Paulsson, 2003).

5.1.2 Validity

According to Björklund et al (2003) the measurement of validity can be illustrated below in Figure 11. A high validity will be reached when the darts are centered around the bull's eye on the dart board, visualized in the leftmost picture. Validity is defined as to what extent the method of measurement actually measures the feature it is designed to measure. To measure validity the true results of the measurement would be required as comparison (Lekvall & Wahlbin, 2001). (Björklund & Paulsson, 2003)

Litwin (1995) in Wee et al (2005) explains validity as to what extent a measure measures what it is intended to measure and describes three different types of validity; content validity, criterion related validity and construct validity. Content validity assures that the measure has items that exhaustively cover all aspects of the variable being measured, hence it is not a numerical evaluation criterion but judged by the researchers and therefore subjectivity influences it. An investigation has reached criterion validity when a measuring instrument is related to an independent measure of the relevant criterion. Measurements that are collectively positively and strongly correlated with the criterion they measure are considered to have high criterion validity. Construction validity can be described as a measure that measures the theoretical construct that it is intended to measure and can be evaluated through multi-trait/multi-method analysis, factor analysis or correlation and partial correlation analysis. (Wee & Quazi, 2005)

The following six methods of ensuring the validity of an investigation are suggested: (Merriam, 1994)

1. *Triangulation*, by using several different sources of information and methods the result can be confirmed.
2. *Control by participants*, the way that the researcher collects information is controlled by the interviewees and other human sources as to see if the interpretations are trustworthy.
3. Observation during a *long period of time* or *repeated observations* of the same phenomenon.
4. *“Horizontal”* evaluation and criticism e.g. let colleagues comment on the achieved result.
5. *Participation* in the investigation throughout every phase of the research *by the same persons*.
6. *Previous knowledge* from the researcher such as assumptions, theoretical perspective etc. is *carefully explained* to protect interference in the conducted study.

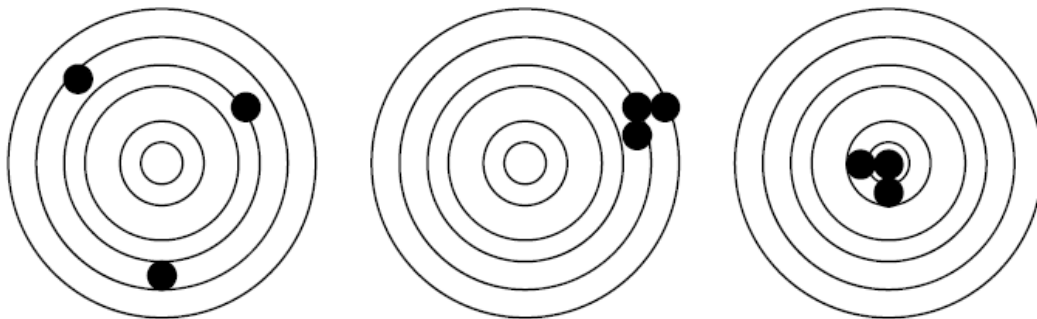


Figure 11 Illustration of reliability and validity measurements based on (Björklund & Paulsson, 2003)

5.1.3 Reliability

Reliability expresses how well an experiment, test or any measuring procedure achieves identical results on repeated trials ((Carmines & Zeller, 1979) in (Wee & Quazi, 2005)). Björklund et al (2003) further illustrates reliability in the same example as previous. In the middle illustration in Figure 11 above, the darts are centered on the same spot, but the spot is not in the bull's eye. Reliability is the measurement of how well the outcome of the method will be the same every time it is used, meaning that the outcome of several independent measurements will result in the same outcome.(Björklund & Paulsson, 2003)

When both measurements of validity and reliability are high, the result from the method selected will both be accurate and focused on measuring what is requested. This can be illustrated in the rightmost illustration of Figure 11, where all the darts are focused and centered on bull's eye.

The following three techniques are suggested to ensure reliability: (Goetz & LeCompte, 1984)

1. *The researcher's position*. Underlying assumptions and theories for the research as well as the researcher's perspective of the group is being studied. Choice of sources and social context from which data is collected is also specified.
2. *Triangulation* can be used to ensure reliability in the same way as for validity.

3. *“To follow the same path”*. The researcher has to describe the method used throughout the study with the purpose that other researchers can replicate the study by using it as a guide.

5.2 Methodology of this investigation

This investigation is split into four steps describing the proceeding, see Figure 12 below. Initially a preliminary study has been conducted followed by definition of the task. The creation of the strategic supplier evaluation model, which constitutes the major part of the investigation, is described in detail in chapter 5.2.3. In this stage criteria have been taken into the model, which thereafter have been weighted against each other. A sensitivity analysis has been performed to prove how the model responds to different inputs. Finally, results and conclusions are summarized and recommended and a report is written and presented at Linköping University and at Cederroth.

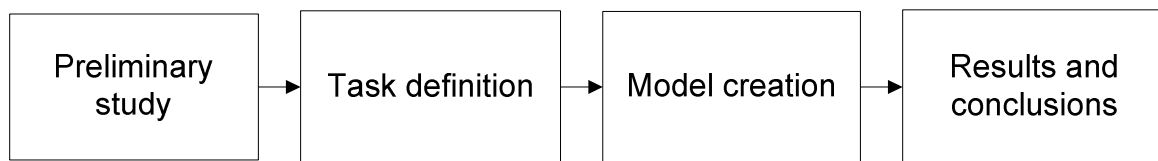


Figure 12 Methodology proceeding

5.2.1 Preliminary study

The study origins in the request from Cederroth to investigate how to integrate environmental aspects in the existing supplier evaluation. In order to address that request, the preliminary study was introduced which aims at mapping Cederroth's current purchasing process and supplier evaluation process with the goal of determining where and how the study could make impact in the area of green purchasing. Cederroth's purchasing manager, Magnus Andersson, has expressed a request that the result of the thesis should be of a general character so that it can be applied for the entire organization independent of business unit. Early findings revealed a need for a completely re-designed strategic supplier evaluation, hence the study was decided to focus on the entire strategic supplier evaluation model and not primarily on the environmental issue, but on the environmental issues as an integrated part in the general focus. The purpose defined for this thesis was based on findings during the preliminary study. To secure that the purpose was appropriately defined, it has been discussed in detail with Purchasing Manager Magnus Andersson as well as with the supervisor at Linköping University, Håkan Aronsson. The preliminary study was accomplished in four phases, illustrated below in Figure 13.

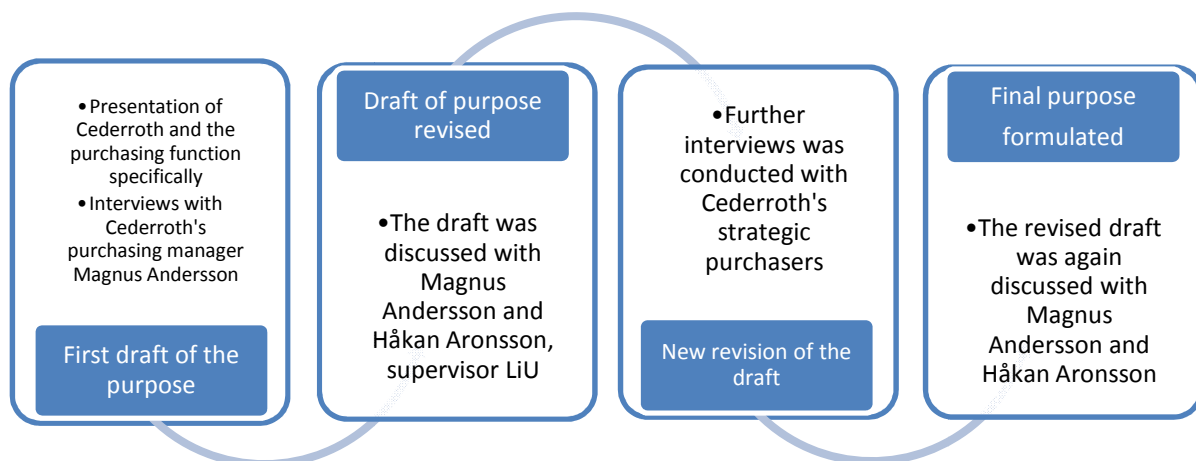


Figure 13 Accomplishment of the preliminary study

The preliminary study took approximately three weeks to accomplish and was carried out through qualitative interviews with Cederroth representatives, observations and through internal company presentations. Primarily the interviewees were representatives from the purchasing department, however to extend the understanding of how purchasing collaborates with other departments of the organization interviews with employees from R&D Packaging, R&D Formulation, R&D Healthcare, R&D Wound care, quality, logistics and environment department were additionally performed. Since the purpose of the interviews was to increase the understanding of Cederroth's business, processes and purchasing function in particular, a semi-structured approach has been chosen. Interviews executed according to a semi-structured approach conclude that predefined interview questions are used as support during the interview (Björklund & Paulsson, 2003). The interviewee is allowed to talk spontaneously and free about topics, though the predefined questions are setting the frame of the interview. By these means a wider understanding of Cederroth has been acquired as well as insights in some issues relevant to the purpose defined for this thesis. The information gathered during the preliminary study are summarized and presented to the reader in chapter 2.

To validate the information gathered during the initial interviews notes have been taken by both interviewers during the interview, which thereafter have been compiled and sent to the interviewee for control and assurance that no misinterpretations during the session have occurred. The interviewee has critically reviewed the notes and returned them with corrections if necessary. Through this proceeding it has been assured that the information acquired is correct.

5.2.2 Task definition

The information and experiences from the preliminary study and directives from Cederroth implied the next step, task definition. This phase is characterized by focusing on identifying the actual problem formulation. A theoretical perspective has been applied to break down the purpose into detailed fractions. The fractions are subsequently used as foundation from which tangible questions have been derived, which the thesis aims at answering to fulfill the purpose defined. Hence, the questions stated are output of the task definition phase and serve as a foundation for the model creation.

The process of defining the task origins in a literature review focusing on research publications that touches topics of supplier selection, supplier evaluation, supplier evaluation criteria, criteria weighting, environmental purchasing and environmental evaluation criteria. The process is described in Figure 14. Research publications were complimented by book reviews, previously published master thesis within the area of logistics and informative Internet sites regarding EU-directives and environmental regulations. Theoretical findings in books principally concern the topics supplier selection, supplier evaluation, criteria formulation and measurement, while environmental purchasing and environmental issues are found to be a relatively new-born area of research and therefore not yet such widely described in books but rather in research publications. Additionally, theoretical information regarding how to integrate environmental supplier evaluation criteria with traditional supplier evaluation criteria was searched for but not found.

The sources of research publications used when conducting the literature review have mainly been online databases such as Business Source Premier, Academic Source Premier and Emerald, which are sources that provide recent research publications as well as having an extensive database with research stretching long back in time. The database searching has been restricted with the constraints of “peer review” and “full text” to filter out publications of high quality. Research was complimented by literature recommendations from Håkan Aronsson, Mats Abrahamsson and Maria Björklund, Department of Management and Engineering at Linköping University and Seth Jonsson, Logma Institute.

Additionally, discussions were held with Cederroth representatives and above all with Purchasing Manager Magnus Andersson to define the task of this study to assure fit into Cederroth’s perspective as well.

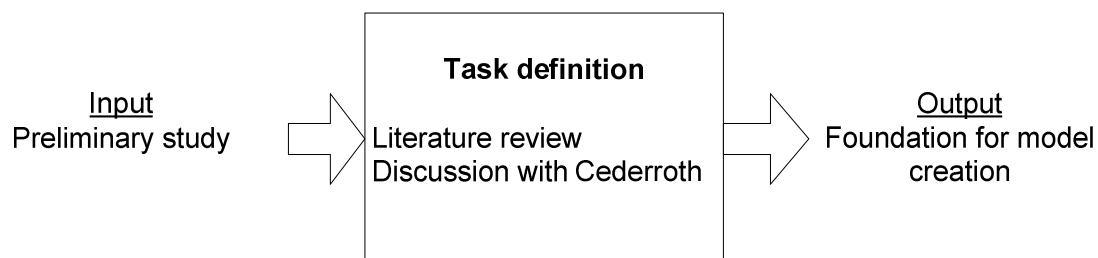


Figure 14 Outline of the task definition

5.2.3 Model creation

The proceeding of the creation of the strategic supplier evaluation model can be split into interim targets; Model 1-4 and the final model. The proceeding is presented below, see Figure 15. Five different research steps can be identified associated to the interim targets.

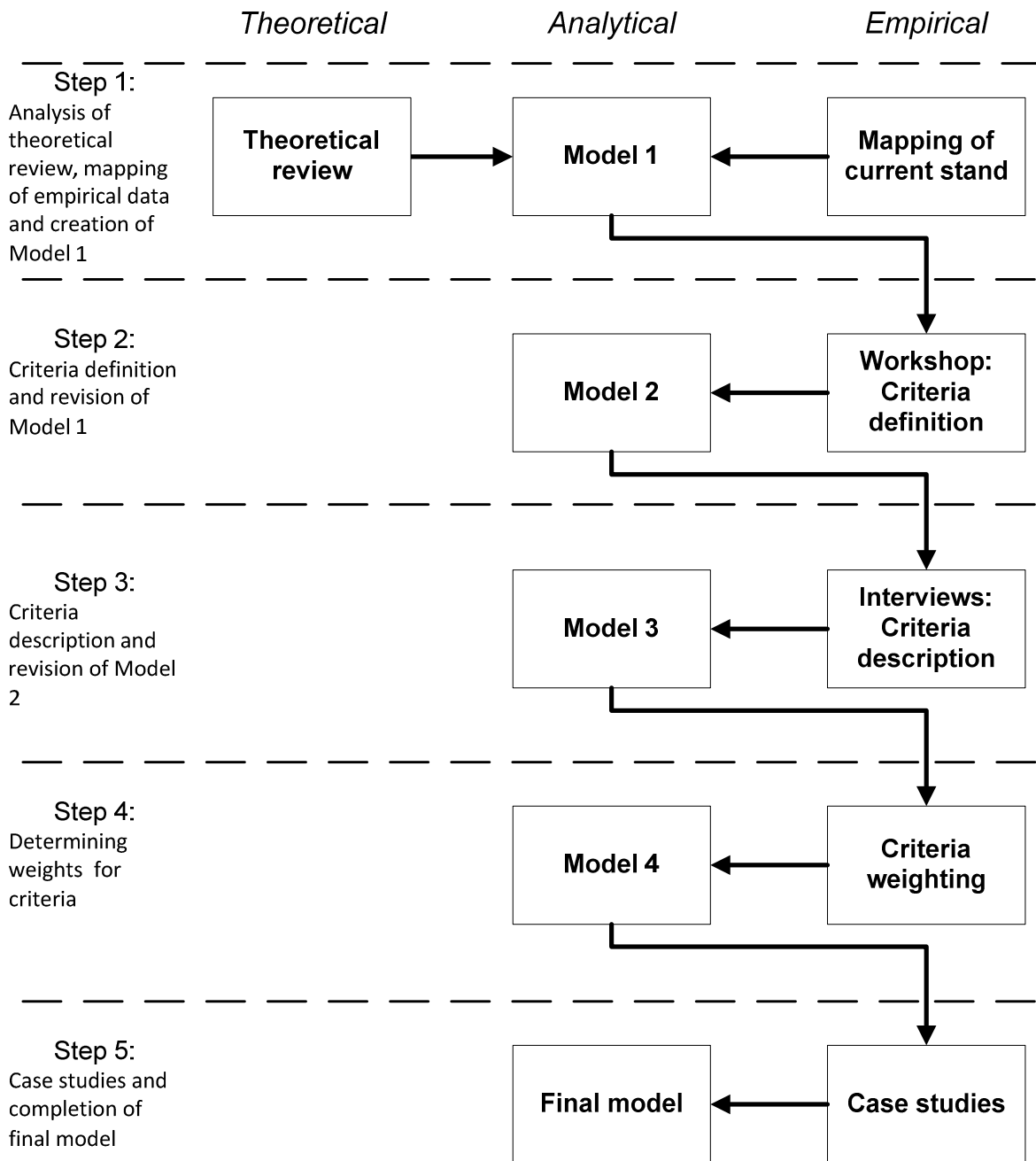


Figure 15 Proceeding of the model creation

5.2.3.1 Step 1

Model 1 was created based on information from four main sources of data; the theoretical review, general interviews with Cederroth representatives, special interviews with Cederroth representatives regarding central criteria and lastly the existing supplier evaluation model. Mapping of current stand concludes the interviews and the existing evaluation model. The mapping was conducted in the preliminary study. The purpose of model 1 was to establish a solid foundation for further model development with a strong theoretical support. Model 1 became extensive in order to number of criteria and included 39 criteria sorted into seven criteria categories. Each criterion included in the

model was clearly described and advantages and disadvantages were analyzed as well as how the criterion should be evaluated.

Central criteria derived from special interviews are criteria that the interviewees found to be the top three most important criteria to evaluate strategic suppliers on. The representatives from Cederroth that were interviewed initially during the general interviews were also those attending the special interviews. The purpose of the special interviews was to briefly determine what criteria are central to include in the supplier evaluation and can be distinguished as more important than other criteria. The interviews were conducted by phone or during personal meetings asking which three criteria are most important for strategic supplier evaluation, if only allowed to select three criteria.

The criteria included in this initial draft of the supplier evaluation model were consequently a mix between criteria found in the literature and criteria highlighted in the empirical study. The idea was to start from a broad perspective and successively reduce the number of criteria due to harder requirements on theoretical support and practical usefulness in the following steps of the model creation. The criteria proposed during the interviews and not initially derived from the theoretical review were searched for in the literature to gain support for their relevance. Model 1 is presented in Appendix K.

5.2.3.2 Step 2

In the second step of the proceeding of the model creation the analysis of model 1 in combination with input from workshops held with Cederroth representatives were forming model 2. Each criterion in model 1 was analyzed in regard of if support for the criterion could be found in the literature and whether the criterion was mentioned as important during interviews or existing in the original supplier evaluation model. During the workshops some criteria not included in model 1 were suggested and after analysis of these some of them were included in model 2. As a result, model 2 was created and constituted a modification of model 1 based on new input from workshops.

Two separate workshops were held, the first one in Upplands Väsby and the second in Falun, when purchasers of chemicals and packaging are located in Falun as well as R&D Packaging and Formulation. This decision was made to be able to gather opinions from all departments involved in the supplier evaluation process. Focus of the workshops was exclusively on which criteria to include in the strategic supplier evaluation model, hence questions regarding how to evaluate the criteria suggested and how they should be weighted were not discussed during the workshops but intended to be focused on in later stages of the model creation procedure. Participants in the workshop in Upplands Väsby were Purchasing Manager Magnus Andersson, Senior Buyer Mira Ludkiewicz, Project Manager Sourcing Joachim Wersén and Head of Logistics Mats Björkqvist. Firstly, the participants were asked to brainstorm criteria for strategic supplier evaluation for about ten minutes. To give the participants a starting point and to stimulate the creativity, model 1 had been handed out per email a couple of days in advance. Further, the participants were asked to write down the proposed criteria for strategic supplier evaluation on post-it notes and gather them on a large board. The criteria on the post-it notes were thereafter categorized into functional categories such as logistics, product development, general and quality. After all the notes were grouped, the meaning of each criterion proposed was discussed together in the workshop to catch other potential ideas related, develop the criterion suggested and increase the understanding of the criterion. In the end of the workshop, the

participants were also asked to comment on the criteria in model 1, which led to suggestions of criteria name changes and elimination of criteria that the participants did not find applicable.

The workshop held in Falun was performed with two participants; Senior Buyer Conny Åslund and Jonas Ingmarsson, R&D Packaging. The proceeding of the workshop was similar to the one held in Upplands Väsby except that a greater focus was put on criteria relevant for product development and purchasing of chemicals, when Conny Åslund and Jonas Ingmarsson represented those departments particularly.

The workshops contributed with valuable input for further analysis of the model and resulted in that some criteria suggested in model 1 were eliminated and some new criteria were taken into model 2, see Appendix L.

5.2.3.3 Step 3

After revising model 1 based on suggestions and improvement ideas discussed during the workshops in step 2, model 2 was created. Next step in the proceeding of the model creation was subsequently to decide how each criterion should be described and evaluated. The overweighting number of criteria was qualitative; consequently the evaluation cannot be performed over a quantitative scale but needs to be assessed based on judgments. To increase the reliability of the model the description of how to evaluate the criteria need to be as detailed as possible describing what to look for at the supplier and which aspects to weight together into a common assessment.

To strengthen the validity of this step, description of how to evaluate the criteria was conducted through interviews with Cederroth representatives for each specific criteria category. For example, Head of Logistics, Mats Björkqvist, was found to be the single one who should decide how the logistics criteria should be evaluated and described, when he will be main responsible for evaluating the logistics criteria in the strategic supplier evaluation. The same proceeding was applied for all criteria categories. Representatives from R&D Packaging, R&D Health Care and R&D Wound Care were involved in the procedure of describing the product development criteria and decided how those criteria should be evaluated and which aspects of each criterion that needed to be considered in the evaluation. Head Quality Assurance, Jan Karlström, described the quality criteria and environmental criteria and Purchasing Manager, Magnus Andersson, described the purchasing criteria as well as the general criteria and the production criteria, since those two latter criteria categories are evaluating general impressions of the supplier, hence conducted by the purchaser in charge. Those criteria categories are further generally evaluated based on audits performed at the supplier site, where the purchasers responsible for the supplier as well as representatives from quality assurance department and/or R&D department are attending. The description and decision of how to evaluate the criteria described were conducted through personal interviews with Cederroth representatives mentioned. Each criterion in respective category was discussed, which resulted in model 3. Model 3 is moreover a more detailed version of model 2 in regard of the extent of the criteria description and the definition of how the criteria should be evaluated, see Appendix M.

5.2.3.4 Step 4

Before the model is applicable the weighting of the criteria and the criteria categories need to be conducted. First, a weighting model suitable for this study was selected based on theory regarding weighting models for supplier evaluation criteria. Thereafter the weighting procedure was discussed with Purchasing Manager Magnus Andersson. To increase the validity of the weighting, the weighting

of the criteria within each criteria category was conducted by Cederroth representatives identified. These representatives were selected based in their knowledge about the category and their involvement in the supplier management process. The weighting procedure was conducted by sending out matrix questionnaires where the representatives selected for performing the weighting performed the weighting individually and returned the questionnaire. For some criteria categories the weighting could be conducted jointly in group, which was the case for the criteria categories *General*, *Production* and *Purchasing*. The weighting of the criteria categories against each other was conducted by Purchasing Manager Magnus Andersson, since the weighting of the categories is considered to be a strategic issue related to which extent Cederroth want to focus on certain aspects such as quality, environment or product development.

When evaluating the strategic supplier according to the model proposed, the scoring of the strategic suppliers will be conducted by awarding the supplier with a score depending on their performance. The scoring scale was selected based on support from the literature. The score awarded to each criterion was multiplied with the weight of the criterion and finally the weighted scores were summarized resulting in a total score of the supplier performance.

Model 3 complemented with criteria weights and weights for criteria categories constitutes model 4, see Appendix N.

5.2.3.5 Step 5

Step 5 includes running the strategic supplier evaluation model on Cederroth's strategic suppliers. Three strategic suppliers have been selected for the testing of the model proposed. The selection was performed with respect to the main three categories of strategic suppliers identified at Cederroth. One supplier from each supplier category, packaging, chemicals and contract manufacturer, have been selected. The supplier categories are showing diverse characteristics, why suppliers representing all three categories are selected for the testing to gain a comprehensive view of the model performance. Additionally, a ranking scale for ranking the suppliers according to their total performance score was introduced to the model in this step. The ranking scale was defined based on best practice comparison with other large companies with well-developed supplier management processes.

The results from the case studies were subsequently evaluated and analyzed to assure that the model fulfilled the requirements initiated by Cederroth at the beginning of the study. Conclusions were drawn from the results of the case studies regarding criteria applicability and supplier scores in order to create the final model. The case studies also constituted the basis of the sensitivity analysis of the model which aims at clarifying and documenting how the model responds to different inputs and how the supplier scores are affected when different parameters are changed.

5.2.4 Results and conclusions

Control has been performed to assure that the initial questions of the investigation stated in chapter 4.6 were satisfactory answered, if relevant conclusions of supplier performance could be drawn using the evaluation model and to investigate if the final model further could be improved by future investigations. A discussion about how delimitations made in the study may affect the final result was held and conclusions and recommendations were drawn based on the discussion. A final task of the investigation was to present the procedure and result of the investigation in a written report handed over to the supervisor at the university and the supervisor at Cederroth. A public oral

presentation of the report was conducted at the university and a specific presentation of the study was additionally presented at Cederroth.

5.3 Criticism of the methodology

The proceeding of the methodology can and should be challenged. First, the approach does not include any reverse steps but only improvements forward. It is difficult to predict what results that would have been obtained if the approach would have contained iterative steps as well. Generally iterative steps enable going back and improve and correct things that initially were not optimally performed due to information collected at later stages, hence using an iterative methodology may have improved the results further. However, the steps presented in the model creation do allow new information and aspects that are brought up to be included in the model and as proof of this statement new criteria were taken into the model in step 2 as well as in step 1, hence reducing the need for iterative steps.

A further critic against the proceeding of the study is that the proceeding of the model creation consists of steps in one special sequence, starting with a theoretical review as basis for the initial strategic supplier evaluation model. Other results may have been obtained when a different sequence would have been applied. For example, the initial model could have been built on information collected during workshops and thereafter supported by findings in the literature. This is however handled to a limited extent by the fact that the initial model was based on four sources of data, taking both theory and empirical data into account; theoretical review, general interviews, special interviews and Cederroth's existing supplier evaluation model.

As a third critical aspect, no interviews with Cederroth's suppliers have been conducted. By in an early stage of the process asking the strategic suppliers about their aspects of relevant and sound supplier evaluation criteria and how those criteria should be evaluated, the supplier evaluation model may have reached another level of applicability, reliability and validity. Since the supplier evaluation model aims at assessing supplier performance, which in turn is partly to be derived from the relationship between Cederroth and the supplier, the supplier's aspect should be given almost as much attention as considering the strategic supplier evaluation from a customer's perspective. Hence, the supplier evaluation should be a product of a two-perspective investigation. This topic can be seen as an area for further investigation if Cederroth want to develop this strategic supplier evaluation model further.

Main criticism of Step 1 is that the theoretical review was limited in time and resources. Even though it aims at covering all relevant aspects and theory, it could have been further extended. For example, literature research in libraries was only conducted to a strictly limited extent due to the fairly new and modern topic. Furthermore, the general interviews were as the name reveals wide-ranging covering many areas of Cederroth's purchasing activities and not aimed at specifically determining which criteria should be included in the strategic supplier evaluation model. The specific interviews were on the other hand directly asking the interviewees which three criteria that were the most important ones for including in a strategic supplier evaluation model. This combination of three empirical sources of data is however believed to ensure reliability, since all interviewees were given the opportunity to state their opinion in different forums. Validity was further assured through triangulation by including stakeholders from purchasing, logistics, quality and R&D working with different supplier categories.

The two workshops performed in Step 2 may not have been as accurately performed as anticipated. There are many risks that a group gets unfocused on the initial questions and ends up discussing other topics than initially introduced as the main topics of the workshop. Furthermore, the workshops were parted into two occasions due to geographical inconveniences when the initial plan was to conduct one workshop with representatives from both Falun and Upplands Väsby. High validity of the workshops results can be achieved by having workshop participants from different functions within the organization. Even though the split into two separate workshops was not intended, opportunities for more focused discussions during the separate workshops were opened up. Representatives from purchasing department responsible for contract manufacturing suppliers, project sourcing and wound care suppliers as well as logistics department were attending the workshop in Upplands Väsby, while representatives from purchasing department responsible for chemical suppliers and R&D department responsible for packaging suppliers were attending the workshop in Falun. Conducting workshops with smaller groups can make it easier for the workshop participants to express their opinions and ideas to a larger extent than if being part of a large group. On the other hand, having more participants in one workshop may stimulate the creativity more than having a brainstorming with few participants, where the inspiration for new ideas very soon can be limited. Input from two separate workshops on the same topic, discussing slightly different aspects, may result in that more opinions and ideas in total can be preserved. In a workshop with several participants it is almost impossible to catch all ideas that arouse, but by using post-it notes it is believed that everybody's opinion came through.

Step 3 is included in the model creation with the purpose to strengthen the validity and reliability of the model. By describing each criterion in detail and clearly specify what to look for when evaluating the supplier on every criterion the reliability can be increased. By not having a clear description of what to look for when evaluating the criteria, the results may be very diverse from time to time and depending on how the person performing the evaluation interprets the criteria. Validity is secured by letting the Head of Logistics set up guidelines for logistics criteria, Head Quality Assurance construct guidelines for quality criteria and environmental criteria since he also is responsible for environmental issues within the organization, Purchasing Manager defined guidelines for purchasing, production and general criteria and R&D managers from packaging, healthcare and wound care did set up guidelines for product development criteria. These persons were found to have the knowledge and competence required and most suitable for this task based on the fact that their respective criteria category was the category related to their area of expertise.

The main criticism of Step 4 is that the weighting of criteria in the product development criteria category was not performed jointly in group. Instead, a simulation of weighting performed in group was executed, which may not correspond to the outcome if performed in a real group. In a real group, the weighting would be based on a discussion that assures that all participants interpret the criteria similarly and assess them on the same basis. When performing the weighting separately and afterwards construct a simulation of a group weighting, it is likely that the participants frame of reference differs, which may influence the outcome. It can further be discussed whether or not the participants selected for performing the weighting are the right ones for executing the weighting, but since they were selected on the basis of Purchasing Manager Magnus Andersson's recommendation and that they represent diverse departments involved in the supplier evaluation process, it is assumed that the selected participants are sound representatives to perform the weighting. These persons have further been involved in this study from an early stage, which indicates that they have

sufficient background information for performing the criteria weighting. The reliability is also considered to be high since the persons responsible for the weighting for each criteria category was selected according to their position and department belonging. The validity can further be assured in the weighting of the criteria by having several participants weighting the same criteria within one criteria category. However, for some criteria categories only one person performed the weighting of the included criteria, but this person in question was found to be the only one with the knowledge required for performing the weighting correctly.

The main critics in step 5 address that the model was exclusively tested on three of Cederroth's strategic suppliers. Testing the model on a larger number of strategic suppliers could have improved the quality of the analysis of the model's performance, and consequently lead to improved model performance. Conversely, due to time limitations it was not possible to perform the testing on more than three strategic suppliers. When selecting strategic suppliers for the case studies, a good relationship status was preferred when that would increase the chance for commitment to participate in the test evaluation and also provide information requested within the given deadline. The level of cooperation was considered as important in the selection of participating strategic suppliers since a detailed level of cooperation would increase the depth of the answers on the questions.

Further, when the model for strategic supplier evaluation proposed aims at evaluating both new and existing strategic suppliers it would have been relevant to test the model on potential strategic suppliers as well, and not exclusively on existing strategic suppliers. Unfortunately, Cederroth did not have any new suppliers ready for this step in the supplier selection process and therefore testing the model on new suppliers could not be performed. The performance of the model regarding evaluation of new strategic suppliers can be questioned due to this limitation. On the other hand, criteria included in the model that are only applicable for new suppliers are applicable for existing suppliers, while the opposite relationship does not apply. Criteria applicable for existing suppliers are not exclusively applicable for new suppliers. This implies that the limitation is not as severe as a reverse limitation would be.

6 Mapping and analysis of current stand

The empirical data collections, performed in Step 1 of the model creation procedure, are following thoroughly presented to the reader. The three sources of data discussed are general interviews, existing supplier evaluation model and central criteria acquired through special interviews. Focus of the chapter is on describing status quo of the existing strategic supplier evaluation and identifies opportunities and potentials for improvements. The mapping of current stand will consequently constitute the basis for creation of the strategic supplier evaluation model proposed in this study together with the theoretical review.

6.1 Criteria categories identified through general interviews

General interviews were performed with representatives from the purchasing, logistics, quality and R&D department. To map the information, some important criteria categories for supplier evaluation has been derived, which are summarized in Table 23. These criteria categories from the general interviews are not to be confused with the criteria that are mentioned during special interviews as central criteria.

Table 23 Criteria categories mentioned as important for supplier evaluation

<i>Criteria categories for supplier evaluation</i>	Mira Ludkiewicz, Senior Buyer	Conny Åslund, Senior Buyer	Moncia Engström, Senior Buyer	Jonas Ingmarsson, R&D Packaging	Stefan Snell, Product & Process Development	Mats Björkqvist, Head of Logistics
<i>Price</i>	X	X	X		X	
<i>Quality</i>		X	X	X	X	
<i>Delivery</i>	X				X	X
<i>Documentation</i>					X	
<i>Environment</i>	X	X	X	X		
<i>Product development</i>		X	X			
<i>Location</i>	X		X			
<i>Supplier relationship</i>			X			
<i>Cooperation</i>				X		
<i>Storage possibilities</i>				X		
<i>Transportation options</i>				X		

Senior buyers Conny Åslund and Monica Engström both highlight quality, potential for mutual product development and environmental aspects as categories that should be noticed. Aspects exclusively mentioned for packaging suppliers are supplier location and supplier relationship.

Quality is expressed in terms of quality of the product and quality of delivery. Quality of the product can be interpreted as a pre-requirement in the supplier qualification and is therefore not intended to be included in the supplier evaluation. When a supplier has been qualified it is assumed that it delivers products that fulfill the technical specification and required quality of the product. Quality of delivery is contradictory relevant for the supplier evaluation when it can vary between qualified suppliers and influences Cederroth's business to a large extent. However, it is referred to as a

logistics aspect and evaluated under the category logistics introduced later in chapter 7.5. Since Cederroth is a medium-sized company, potential and opportunities for mutual product development is a significant aspect to include in purchasing decisions. Environmental aspects are according to the general interviews thought of in terms of product material, wrapping and certifications such as ISO 14001. Regarding wrapping reusable material is preferred, though some products are still delivered with non-reusable wrapping material. Purchasers take certifications of ISO 14001 into account when assessing suppliers, though pointing out that even though a supplier is certified it is no guarantee for being more environmental-friendly than any other supplier. Therefore environmental certification is noticed but not applied as an outstanding criterion in the supplier evaluation. Environmental aspects concerning the actual product delivered can be seen as an issue belonging to the specification of the product and therefore be relocated to the supplier qualification.

Transportation is further a topic mentioned together with environmental aspects. Though, it is generally not immediately connected to the supplier performance but should be interpreted as an independent category that needs to be evaluated separately. Transportation suppliers are not taken into the strategic supplier list by Cederroth; hence transportation suppliers will not be evaluated on the evaluation model of this study. Internal transportation is on the other hand a kind of activity that a supplier could be evaluated upon but this was not mentioned during the interviews.

Supplier location and supplier relationship are expressed as two important areas for packaging suppliers to be evaluated on. These suppliers deliver bulky products which imply high transportation costs; therefore aim is at locating packaging suppliers close to Cederroth. Packaging affects the entire supply chain, from product development to marketing and sales as well as recycling issues in the end of the product life cycle. Hence, the importance of close relationships with Cederroth's packaging suppliers is obvious and vital. Packaging needs to be developed in co-operation with supplier and requires an intense innovation and development process to constantly improve performance and fit to external requirements, market, consumers, internal customers etc.

Location is an area highlighted by Senior Buyer Mira Ludkiewicz as well together with price, environmental certification such as ISO 14001 and delivery accuracy and precision (Ludkiewicz, 2010). As purchaser responsible for contract manufacturer, location plays a vital role in her decisions just like in purchasing of packaging. When purchasing chemicals, the amount of suppliers available is very limited and additionally they are global suppliers located abroad, which implies little concern about location when evaluating chemicals suppliers.

Jonas Ingmarsson, R&D Packaging, has a R&D-perspective on which areas that should be taken into account in a supplier evaluation. He suggests that supplier co-operation, storage possibilities and transportation options should be prioritized areas but that material and quality are the exclusively the most important areas to evaluate. Environmental aspects should not be neglected, however it cannot be considered as a prioritized area from a R&D point of view to the same extent as other areas. (Ingmarsson, 2010)

Mats Björkqvist supports the supplier selection with a logistics perspective and put weight on the logistics area. Criteria measuring delivery time and accuracy should be obvious criteria. (Björkqvist, Head of Logistics, 2010)

Quality, documentation, price and delivery time are areas mentioned by Stefan Snell, Product & Process Development (Snell, 2010). Documentation has not been articulated in any other interview while quality, price and delivery time have been considered as important areas by others.

6.2 Supplier evaluation criteria in existing model

Cederroth currently evaluate suppliers on eight areas over a total number of 31 criteria, see Table 24. Cederroth usually evaluate each strategic supplier annually, however for economical reasons the category Facilities, machinery and equipment is evaluated on the basis of colleagues' visits to the suppliers when annual inspection is not performed by the purchaser. The time needed to perform the evaluation is approximated to 30-45 minutes and an evaluation is normally performed by a team consisting of representatives from the Purchasing, R&D and Logistics department (Engström, 2010).

Table 24 Summarization of criteria in existing supplier evaluation model, for details see Appendix D

Criteria category	Criteria
Facilities, machinery and equipment	Appearance/condition Production facilities Important equipment Equipment for measurement and testing Calibration system Investment plans Orderliness
Quality	Quality on product/service Quality control Reach SDS Traceability Reclamation handling Monitoring
Logistics	Delivery security Lead time Communication Flexibility
Competence	Production technical competence
Product development	Product development process Experience in product construction Documentation R&D competence
Productivity	Cost reduction and goals Price development
Purchasing	Purchasing process Knowledge about sub suppliers
Environmental effort	Environmental management system Environmental policy Environmental key indicators Transportation efficiency Influence on suppliers environmental impact

As can be seen the existing supplier evaluation covers a rather broad spectrum of areas. One criterion is quantitatively measurable, the rest are to be evaluated based on subjective assessments of the supplier performance. Among existing criteria, there is potential for converting some of the qualitative criteria into quantitative criteria without changing the criteria itself, only the basis of assessment. The criterion Quality control for example is currently subjectively assessed based upon the impression if it is good or not. However, it could be defined as how often quality controls are performed and then the subjectivity is reduced and replaced by something measurable by counting

how many times per year quality controls are performed by the supplier. The areas Facilities, machinery and equipment, Quality and Environmental work are consisting of relatively many criteria in comparison with other areas. Logistics, Productivity and Purchasing for example contain two or four criteria each. It can be questioned if these areas with fewer criteria are considered as less important areas than the areas consisting of more criteria, especially since all criteria are given equal weights and have equal impact on the single percentage measurement.

The environmental criteria have been found to be difficult to assess, mainly due to lack of information from suppliers or too much unstructured information from the suppliers regarding their environmental performance, making it impossible to handle the information received. Even though the environmental aspect very recently has been included in the supplier evaluation the area has five criteria, mainly a result of that Cederroth are rolling out the ISO 14000 standard (Åslund, 2010).

Since price is considered to be a negotiable variable it is not included in the supplier evaluation. Price will instead be a focus point in the final negotiation and in connection with agreement signing. Price development however is included as a criterion and can be seen as a signal about price level in comparison to other suppliers. Before supplier qualification is performed a price indication from potential suppliers are requested by the purchasing department to assure that the suppliers will be able to offer a reasonable quotation later on in the process.

Existing supplier evaluation does not regard what kind of product the supplier offers. It can be argued that a supplier evaluation adjusted to type of supplier could be more suitable and measure the overall supplier performance in a truer manner than a general supplier evaluation. Characteristics for chemicals suppliers differ significantly from characteristics for packaging suppliers; hence these differences should be reflected in the supplier evaluation to achieve a true reflection of supplier performance. The relative importance between criteria does further differ for different types of suppliers. *Investment plans* for example is likely to be an important criterion for packaging suppliers while it does not play a considerable role when evaluating suppliers of chemicals due to their large size and global presence. Cederroth is a fairly small customer to the suppliers of chemicals and *Investment plans* should not influence the purchasing decision. The same thing also concerns the criterion *Experience in product construction* and *Appearance/condition in facilities*.

The number of criteria measured under each area is differing from one criterion up to seven criteria. Each criterion is measured in a five-point Likert-scale with the sixth option of "Not applicable" and a seventh column for comments. One of the criteria "Delivery security" is a measurable quantitative criterion transferred to the Likert-scale. All other criteria are qualitative criteria. The number of points given on each criterion is described on the scale presented below in Table 25:

Table 25 Existing scale for evaluating supplier performance

Points	Performance description
1	Failed
2	Not acceptable
3	Passed
4	Good, potential for improvements
5	Excellent

The points awarded to each criterion are subjectively assessed by the evaluator and generally based on previous experience of what each level on the scale represents. The supplier evaluation is filled in manually on paper and a percentage performance rate is calculated on the basis of equal weights to each criterion. The performance rate calculated is then stored in a spreadsheet. The performance rate for a supplier tends to vary both up and down, but the single percentage indicator does not independently support an analysis of the cause to the variation. It can be speculated that there is either a performance change in some underlying variable that is causing the variation or that the subjective judgment is the main reason behind.

6.3 Central criteria identified through special interviews

To acquire a general picture of which criteria that are considered as most important by Cederroth representatives when evaluating suppliers, special interviews were conducted. Aim was at deriving the most important criteria suggested by internal stakeholders in the Logistics, Quality, R&D and Purchasing department representing all groups of trademarks; health care, wound care, personal care and household. The interviewees are Senior Buyer Mira Ludkiewicz, Senior Buyer Conny Åslund, Senior Buyer Moncia Engström, R&D Packaging Jonas Ingmarsson, Product & Process Development Stefan Snell, Head of Logistics Mats Björkqvist, Project Manager Sourcing Joachim Wersén and Purchasing Manager Magnus Andersson.

In addition it is interesting to see that some of the articulated criteria are outside of the existing supplier evaluation model and that quite many of the criteria in the existing supplier evaluation model was not mentioned at all. The criteria mentioned as one of the three most important one will hereafter be referred to as “central criteria”. When a criteria category was mentioned that covered several criteria consequently several marks were added in Table 26. The cells including several marks represent that several of the interviewees has articulated this criterion.

Table 26 Central criteria identified through special interviews

Criteria category	Criteria	Criteria mentioned in X number of interviews
Price		X,X, X, X, X
Well-known for delivering to the industry		X
Quality		
	Quality on product/service	X, X
Logistics		
	Delivery security	X, X
	Lead time	X, X
	Flexibility	X
Product development		
	Experience, resources and time for product development	X, X
	Product development process	X, X, X
	R&D competence	X, X, X
Purchasing		X
	Knowledge about sub suppliers	X
Environmental effort		X

Price was suggested by five representatives as a central criterion, hence the criterion that was mentioned by most of the representatives. Thereafter *Quality on products/services*, *Delivery security* and *Lead time* were claimed to be important by two representatives each. Finally, *Flexibility*, *Environmental aspects* and R&D-related criteria were suggested by one single person each as well as *Well-known for delivering to the industry*.

Conclusively, not all criteria mentioned as central criteria were included in the existing supplier evaluation model. This implies the fact that there is potential for improvements of the model. *Price* for example is not represented in the existing model with the argument that it is considered to be a negotiable variable which will be attended during the final negotiations with a supplier. The criterion that illustrate if the supplier is well-known as a supplier within the industry is further not to be found in the existing supplier evaluation model, which may be explained by its strong relevance for evaluation of chemicals suppliers but with less relevance for packaging suppliers or contract manufacturers.

7 Analysis of criteria

Following chapter intends to analyze the criteria and criteria categories that are included in the final strategic supplier evaluation model. The analysis is structured so that the creation of the model is firstly analyzed generally. The discussion includes reflection over the transformation from the existing model to the final model proposed in this study. Main changes made through Model 1 to Model 5 are firstly described below in chapter 7.1. Thereafter, the analysis leading to the final model is structured according to the shape of the final model. Where every criteria category is discussed separately and each criterion included respectively, see chapter 7.2 to 7.8. Finally, interconnectivity between the criteria is briefly analyzed. An analysis of the criteria weighting is presented in chapter 8 and chapter 9 presents an analysis of the supplier evaluation to the reader.

7.1 Creation of the model

The final strategic supplier evaluation model was created in five steps. The major transformations and modifications made in each step are described below. The details of these modifications can be studied in respective versions of the model in Appendix K-O including model 1 to model 5. This chapter analyzes the criteria included in the final model, hence not analyzing each draft of the model separately but a discussion about the evolution of criteria and developments are held based on the criteria included in the final model. However, all five drafts are concerned in the discussion.

In step 1, the first draft of the strategic supplier evaluation model was created, model 1 see Appendix K. Model 1 was developed based on the theoretical review, see chapter 3, and the three sources of empirical data presented in chapter 2. Some criteria were removed from the existing supplier evaluation model and several new criteria were added. Criteria categories were partly restructured and besides, new categories were designed to increase the understanding and interpretation of the evaluation model. Exclusion of criteria was performed either when there was no support for the criterion to be found in the literature, when the criterion was assumed not to be suitable or relevant for Cederroth's strategic suppliers or when the criterion was too abstract to constitute a good criterion due to some of the definitions of a good criterion/measurement (Caplice & Sheffi, 1994).

In step 2, refinements were based on evaluation from workshops with Cederroth representatives, resulting in model 2, see Appendix L, where re-categorization of criteria, elimination and addition of criteria, revised definition of criteria and added draft description of criteria. Major change affecting the structure of the model was the re-categorization. First, the category *Miscellaneous* was eliminated. Moreover, *Service* was renamed *Logistics*, which describes the focus area more directly and increase the understandability. *Price/Cost* was eliminated and the two criteria included previously were transferred to the new criteria category *Purchasing*, which is found to be a more extensive category than *Price/Cost*, including criteria previously found in the criteria categories *Miscellaneous* and *Production*. These changes made regarding the categorization of the criteria are characterized by a return transformation to categories that were to be found in the existing supplier evaluation model of Cederroth. Conclusively, the categorization of the criteria in the existing supplier evaluation model was considered to be satisfactory and no major change was requested by the users. However, the criteria included in each of the category were discussed and replaced to a larger extent, which will be more extensively presented later on in this chapter.

In step 3, interviews were contribution to modification of model 2; resulting in model 3, see Appendix M. Changes consist mainly of refinement of criteria description. Restructuring was also performed, the category *General* was added, which aims at hosting criteria that are concerning several of the other categories in the model and covers general aspects. Criteria also changed categories/were deleted after refinement of criteria descriptions.

In step 4, focus was on performing the weighting of each criterion, which is analyzed in chapter 8. Model 4, see Appendix N, is the extended version of model 3 with weights for criteria and criteria categories.

In step 5, model 4 was tested in case studies where aim was at evaluating the applicability of the descriptions and availability of information from suppliers as well as the classification of the suppliers according to the total score achieved. Additionally, other smaller adjustments of criteria description were made. Depending on the case suppliers' characteristics and the information provided by them, some criteria were found "Not applicable". Moreover, calculations for computing the total score as well as ranking was added to model 4, concluding in the final model to be found in Appendix O. The case suppliers were one chemical supplier, hereafter named CCS (chemical case supplier), one packaging supplier, hereafter named PCS (packaging case supplier) and one contract manufacturer, hereafter named CMCS (contract manufacturer case supplier).

7.2 General criteria

This criteria category was introduced since a call for a general category was articulated by Cederroth that contained criteria which were not possible to award to a specific criteria category but evaluate the supplier on a general level.

7.2.1 Uniqueness

Criteria description: Evaluates unique attributes important to Cederroth e.g. unique competences, good fit with Cederroth's strategy, unique product or supplier of strategic importance.

This criterion did not exist in model 1 but was proposed during the workshops. It aims at evaluating the supplier on its unique attributes, products and competences, its strategic fit into Cederroth's supplier base or general strategic importance. *Uniqueness* can be applied for both new and existing suppliers. In the literature there is little to be found regarding supplier evaluation criteria directly described as uniqueness. Whether the criterion should be included in the supplier evaluation or in the supplier qualification has been discussed but found to be of high importance and therefore included in the supplier evaluation. It is a qualitative criterion that is based on the user's subjective judgment. The description of the criterion is tangible and gives good support to the user when evaluating uniqueness of the supplier.

The case studies supported that uniqueness was a criterion fairly easy to evaluate. CCS is a large chemicals supplier without any uniqueness, hence awarded with score 1, while CMCS is exceptional in regard of combining low price and high quality for the product wet wipes why the criterion uniqueness was awarded with score 4. PCS was awarded with score 3 for this criterion with the motivation that there are other capsule suppliers available on the market, however PCS is still supplying unique products to a certain extent compared to its competitors. Generally, the criterion was successfully evaluated without misunderstandings of how it should be interpreted.

7.2.2 General attention from supplier

Criteria description: Supplier's prioritization of Cederroth as customer, attention paid to Cederroth's general needs, requests and level of contacts.

General attention from supplier is another criterion that was invented during the workshops and suggested to be a development of the criterion *Cederroth's share of supplier's turnover*, existing in the previous supplier evaluation model. The purpose of the old criterion was to assess the importance of Cederroth to the supplier and to which extent Cederroth was a prioritized customer whose requirements and needs was paid attention to. General attention from supplier is considered to give the criterion higher validity when it more distinct describes what it is intended to measure. Level of contact between supplier and Cederroth is further meant to be included in the criterion e.g. if general contact is held on CEO-level or on lower hierarchic level. This must not be the only indication of large attention from supplier, when there can be clearly articulated by the top management that Cederroth is an important customer and therefore well-known within the supplier organization that Cederroth should get the amount of attention needed.

In the case studies, CCS was assessed to have short response time and to care about Cederroth as a customer why score 4 was awarded. Cederroth constitutes CMCS's most important customer and historically they have had successful collaboration with Cederroth, hence was awarded top score 5. PCS was awarded with score 3 due to average attention paid to Cederroth. The criterion was successfully evaluated for all three case suppliers.

7.3 Production criteria

The criteria group *Facilities, machinery and equipment* in the existing supplier evaluation model is suggested to be renamed into *Production* as to correspond to the change of the criteria it compounds. The category contained eight criteria in the existing supplier evaluation model, which is quite many in comparison with other categories that might be of more importance to Cederroth in the supplier evaluation. The criteria *Production facilities* and *Important equipment* were found to measure whether or not the supplier is capable of producing the requested goods, why they are suggested to be moved into the supplier qualification. The criterion *Appearance/condition* is suggested to be renamed to *Condition facilities/equipment* with the purpose of clarifying the difference from the criterion *Orderliness*. Since the criterion *Equipment for measurement and testing* is a requirement for the supplier to be able to go through with quality tests it is suggested to be moved to the supplier qualification as well. The criterion *Calibration system* measures the supplier's ability to calibrate their own machinery, though does not assure that the supplier's machinery is well calibrated. For example, a supplier that possesses high tech calibration equipment might not have the competence to use it, while a supplier who only has access to basic calibration tools might be more competent and therefore have better calibrated machinery. The criterion is also difficult for Cederroth to measure and is therefore suggested to be removed.

The case studies concluded that this criteria category is "Not applicable" to evaluate the chemicals supplier CCS on and after further discussion with Senior Buyer Conny Åslund it was concluded that it is "Not applicable" for any chemical suppliers since they are distributors not having own production.

7.3.1 Condition facilities/equipment

Criteria description: Evaluates the condition and functionality of supplier facilities and equipment.

The criterion was suggested in Cederroth's existing supplier evaluation model and is also supported in the literature (Carlsson & Dahlgren, 1997). *Condition facilities/equipment* has however not been mentioned in neither the general interviews nor as a central criterion. Measuring the condition of facilities and equipment is a way of assessing how well the supplier's production works, which can influence the production flow and in a long-term perspective also delivery security. The criterion is suggested to measure how well the supplier takes care of their machinery and equipment and to assess in what condition the machinery and equipment are.

In the case study of the contract manufacturer CMCS, this criterion was evaluated on the basis of the purchaser's experience. CMCS's machinery with a mix of old and new equipment was awarded score 3. The packaging supplier PCS was awarded with score 5, with the motivation of very modern production facilities. A discussion with the persons involved in the evaluation confirmed that this criterion is costly to evaluate if historical information about the status of the facilities and equipment is not available, since it requires new supplier site visits.

7.3.2 Tidiness in production facilities

Criteria description: Evaluates tidiness in production facilities and general orderliness.

This criterion exists in Cederroth's original supplier evaluation model under the criterion name *Orderliness*. It is however not mentioned in the general interviews nor is it considered to be a central criterion. The criterion is however suggested by Carlsson & Dahlgren (1997) to be included in supplier evaluation and being consistent of two measurements; order in documents and order in manufacturing. *Impression* is mentioned by Dickson (1966) and Sen et al (2008) and can be suggested to assess similar factors as *Orderliness*. *Tidiness in production facilities* describes the same aspects as *Orderliness* did in model 1 and is the final name of the criterion. The name was changed due to several misinterpretations of the previous criterion name *Orderliness*. *Tidiness in production facilities* is a qualitative criterion that needs to be well described to ease the assessment of the criterion. During the assessment the user should look for tidiness in documents and in manufacturing such as cleanliness, tools in order and instructions in place (Carlsson & Dahlgren, 1997). In the case study of CMCS, score 3 was awarded with the motivation that about 50 % of the supplier's machinery are new and held clean while 50 % are old and not looking properly. PCS was awarded with score 5 based on the fact that their machinery is new and the production facilities are well cared about and held clean. AstraZeneca is PCS's most important customer, from which Cederroth can gain positive effects from. Since AstraZeneca is a medical company, its suppliers' level of cleanliness is highly important.

7.3.3 Production-technical competence

Criteria description: General assessment of production-technical competence. Assessment should be based upon the general feeling acquired during audit or other experiences.

Production-technical competence is described as a central criterion and therefore included in the supplier evaluation model. It was however not mentioned during the general interviews nor is it discussed in any of the literature studied. The criterion measures the supplier's competence to run the production processes and tackle obstacles in the production. If the competence is high it can be assumed that the supplier's production-related problem-solving capability is sufficient and that the products are manufactured in a competent manner. Finding information to evaluate this criterion on is a difficult task, further it cannot be described in detail how the assessment should be performed. A general feeling and impression of the company and the production should be a foundation for the

assessment. How the supplier answers production-technical questions and the employees' education and experience level are additionally examples of how to acquire a solid foundation for the assessment.

In the case studies CMCS was awarded score 3 since they have good knowledge about their machinery as well as extensive production experience. PCS was awarded top score 5 with the motivation that they have their own construction department as well as are considered to be the top third packaging supplier in Sweden and moreover act professionally.

7.4 Quality criteria

Dickson (1966) suggests quality to be measured as the ability of each vendor to meet quality specifications consistently. Mummalanenia et al (1996) introduce a qualitative approach parting suppliers based on percentage of defects in the categories poor, good and excellent. Neeraj (2004) measures the supplier's product quality, while Sen et al (2008) and Kuo et al (2010) introduce a number of different criteria to measure quality, six and five criteria respectively. Cederroth's original supplier evaluation contains six criteria in the quality category. The quality category was further mentioned both in the general interviews and as a central criterion and is therefore considered as an important category in the strategic supplier evaluation.

The criterion *REACH/SDS* from the original supplier selection is measuring whether or not the supplier is following a safety data sheet standard. Since it is found to be closely connected to product documentation it has been included in the criterion *Product Documentation* as well, otherwise risk for being assessed twice.

Quality on product/service is suggested to be eliminated from the supplier evaluation model and replaced by the three criteria *In process control/inspection*, *Total value of complaints* and *Total value of rejections*. Since the purpose of *Quality control* is to assess whether the supplier performs regular quality controls it is suggested to be shifted to the initial qualification phase. Quality controls should be a requirement for supply. The other aspect of the criterion *Quality control*, to what extent the supplier performs quality controls and the quality on the quality controls itself, will be assessed in the criteria *Frequency of rejections* and *Frequency of complaints*. *Quality control* will therefore be eliminated from the evaluation model.

7.4.1 Total value of complaints

Criteria description: Evaluation of the total value of complaints divided by the purchasing value.

Both Sen et al (2008) and Kuo et al (2010) suggest the criteria *Defects* and *Reject rate* respectively to be included in supplier evaluations. Cederroth's existing supplier evaluation model addresses this aspect in the criterion *Quality on product/service*. *Quality on product/service* was pointed out twice as a central criterion during special interviews. Initially in this study the criterion *Frequency of complaints* was suggested and during workshops it was developed into *Total value of complaints* with the purpose of also taking the value of complaints into account. *Total value of complaints* should address how often and to what extent Cederroth are unsatisfied with received goods. Hence, the value of the product that lacks in quality is assessed. When assessing total value of complaints, first of all it is of importance that the supplier is informed about every single complaint and not just complaints that exceed a certain value. All level of complaints should be accounted for in this criterion, even goods that have only limited defects and still being functional. Examples of such

complaints are bottles packaged in the wrong way or goods incorrectly marked that result in extra time and money spent handling the goods.

Total value of complaints should be measured in relation to total purchasing value by the supplier. The criterion can be defined on product level, order row level, order level or pallet level. A definition on detailed level is suitable for more expensive products, while a higher level like pallet level is more appropriate for cheaper products such as bottles. If a pallet of bottles contains one unusable bottle, it might not be visible which may result in soap getting spilled when put into the bottle creating a cost higher than the bottle itself. Since suppliers might use different ways of packaging goods and since the purchased goods most likely vary in characteristics it is suggested to calculate the total value of complaints divided by total purchasing value as to enable comparison between suppliers.

In the case studies both CMCS and CCS was awarded top score 5, since there have not been any complaints during the last year. PCS was given score 3 as there have been problems with the packaging for plasters during the last year. Persons evaluating the suppliers found it complex to evaluate this criterion quantitatively, mostly because data required needed to be extracted from Cederroth's ERP-system Movex. Recommended is however that the criterion should be evaluated quantitatively when possible since the subjectivity of the assessment is reduced when scoring the supplier performance based on hard numbers instead of judgments. Extracting the data from Movex may be found to be time-consuming initially, however it is assumed to be seen as a minor issue when it has been performed a couple of times and routines for how to extract the data needed is clearly set up.

7.4.2 Total value of rejections

Criteria description: Evaluation of the total value of rejections divided by the purchasing value.

Total value of rejections assesses similar aspect as the criterion *Total value of complaints* but aims at describing the value of goods that is rejected by Cederroth due to defects or lack of quality and sent back to the supplier or disposed. The criterion is supported in the literature by the same authors as the criterion *Total value of complaints*, specifically by Kuo et al (2010) mentioning *Reject rate*. *Total value of rejections* can be found to be a version of assessing complaints but on a more detailed level than simply assessing complaints and focus on goods that are not useable in Cederroth's production. This criterion should also be assess by dividing the total value of rejections with the total purchasing value by the supplier to get a relative understanding of the rejection value. When assessing value of rejected goods in relation to purchasing value the rejection value can be tracked over time and used for evaluating the development of the supplier in regard of rejections.

In the case studies all three suppliers were given the similar score as they were awarded individually in the previous criterion *Total value of complaints*, why it can be discussed whether or not the persons evaluating the suppliers have actually noticed and understood the difference of these two criteria. However, the case may also be that the number of rejections and complaints are directly correlated and the share of rejections out of complaints is equal independent of supplier category. The two criteria assess different aspects of quality shortness; hence they should both be included in the strategic supplier evaluation model proposed in this study. Recommended is to thoroughly read the description of the criteria before assessing the suppliers.

7.4.3 Responsiveness

Criteria description: Evaluates availability and accessibility of the supplier and communication language regarding quality issues.

During the workshops with Cederroth representatives the criterion *Responsiveness* was suggested to be included in the model. The criterion is supposed to evaluate the availability and accessibility of the supplier and communication language regarding quality issues. Dickson (1966) describes attitude as one component in the service category which can be interpreted to include responsiveness in the definition. Availability and accessibility regarding communication with the supplier can be derived to the supplier's attitude to a certain extent. Neeraj (2004) further articulates the supplier's support as important to take into consideration regarding service aspects, which also can be interpreted as correlated with communication responsiveness. Good support requires clear communication and good responsiveness. Hence, responsiveness should be interpreted as a more tangible and detailed level of evaluating supplier's support or attitude.

This criterion is qualitative and needs to be assessed based on judgment; however what to look for when evaluating this criterion is found to be clear and should include how often supplier representatives searched for are reached and what methods of communication that are accessible, e.g. phone, email or other modes. If there is a language problem and how quickly and accurate the supplier respond to questions and attend meetings requested by Cederroth are additionally aspects to include in the criterion description.

In the case studies CMCS's responsiveness regarding quality issues was awarded with top score 5 since they are quick and attentive to Cederroth's needs. CCS was also given top score 5 based on short response time, while PCS was awarded with score 3 since they care about Cederroth as a customer but do not respond as quick and attentive as the other two case suppliers. PCS's low score is noticeable in comparison with the score of CCS and CMCS, since the motivation behind all three scores is considered as fairly similar. Assessment of this criterion indicates that subjectivity of the persons evaluating the suppliers may impact the scoring of the suppliers to a significant extent. The motivation implies the question whether PCS had been given score 4 when another Senior Buyer had evaluated the supplier based on the same information of its performance.

7.4.4 Traceability

Criteria description: Evaluates traceability of the products.

Cederroth's existing supplier evaluation model includes this criterion; however it is not suggested as a central criterion nor mentioned during the general interviews. Further, *Traceability* is not supported as a quality criterion in the studied literature. The interpretation of the criterion is how well it is possible to trace goods back to when it was produced and to what batch. For goods to be completely traceable, it should be possible to trace it through all activities in the supply chain the entire way back to the source of raw materials. The purpose of this criterion is to assure that components to a product are traceable in case the product malfunctions and appears to be harmful. Traceability is also important if mass media suddenly blacklists a component from a certain source and Cederroth want to investigate and declare the source of the raw material used.

The importance of the criterion can be of different levels for products such as chemicals or packaging products such as bottles or labels. Since Cederroth offer products within the consumer goods

industry, legal and reputational reasons are the main driving forces for evaluating suppliers on traceability. If defect end-products are discovered by consumers, Cederroth will then be able to act rapidly when doing business with suppliers that offer complete traceability of their products. Cederroth can in that case trace the goods and stop the flow of inbound material in an early stage and moreover trace products coming from the same batch as the product that was discovered to be defect. When evaluating a supplier on this criterion, initially it is of relevance to determine whether it is possible to trace the purchased goods and secondly evaluate the supplier's attitude to this issue.

In the case studies performed CMCS was awarded top score 5, when their products are traceable on batch number. PCS's products are also completely traceable on batch number and was given score 4. CCS's traceability is described as excellent, hence awarded top score 5. This outcome indicates that there are differences in how the persons evaluating this criterion apply the scoring scale differently. PCS has been found to deliver completely traceable products just like the other two case suppliers, however only awarded score 4 while the other achieved score 5 based on similar motivations. As long as the same person evaluates the criterion in the future, the development of the supplier performance according to the criterion in question can be followed up, but when another person evaluates the criterion next time, another score may be given even though the supplier performance is unchanged. Therefore the persons involved in the strategic supplier evaluation is recommended to meet and jointly go through the criteria and agree upon some general directives for how to award the scores so that they all have a similar view of what is required for achieving the top score.

7.4.5 Complaints management system

Criteria description: Assessment of supplier's complaints management system, plans for how to handle claims and corresponding corrective actions aiming at preventing similar complaints in the future.

The criterion *Complaints handling* is existing in Cederroth's current supplier evaluation model. It is not mentioned during the general interviews or as a central criterion though. *Quality of support services* highlighted by Sen et al (2008) could be assumed to include the aspect of complaints management. The criterion *Warranties and complaint policy* is supported by Kuo et al (2010) in the quality criteria category. Suppliers that have high-quality complaints management systems taking well care of reported complaints and do not only offer solutions to the customer but more importantly use the reported complaints as a way of identifying problems inside their own production, hence increase quality. A good system for complaints management should result in fewer complaints over time. *Complaints management systems* is a development of the criterion *Complaints management* to be found in model 1. Complaints management was considered to be difficult to assess and complaints management systems suggested as a criterion more clearly defined and interpreted more similar by the users than exclusively complaints management.

The criterion is supposed to assess the quality and exhaustiveness of the supplier's complaints management system, plans and processes for how to handle complaints and corresponding corrective actions aiming at preventing similar complaints in the future. By assessing the system for handling complaints rather than complaints management in general, the criterion is defined to be narrower and the span of diverse interpretations will be limited, hence reducing subjectivity.

In the case studies CMCS's performance was described as lacking of a specific system for handling complaints, though has some implicit routines for handling complaints why score 3 was awarded.

CCS has extensive processes and was described as handling complaints in a too detailed manner taking too much time, why they were awarded score 3. PCS on the other hand has well functioning routines and well-defined complaints management processes, hence they were given score 4. These scores point out that the persons evaluating the suppliers interpret the criterion differently since a very good complaints management system was given the same score as a complaints management system that actually shows shortages. Conclusion may be that the evaluators' insight in what the criterion is designed to measure was different when assessing the supplier performance. To avoid this issue in future assessments, complaints management systems should be discussed jointly so that the persons evaluating this criterion have agreed upon what characteristics are significant for a good respectively bad system.

7.4.6 Quality management system

Criteria description: Evaluates the quality management system.

The criterion *Quality management system* is a criterion suggested by Sen et al (2008) and Kuo et al (2010). Cederroth's existing supplier evaluation model contains the criterion as well. Quality management system is not specifically addressed in the general interviews or in interviews regarding central criteria. To evaluate how well the supplier manages quality issues and attain high quality on their products is not completely uncomplicated. Suppliers that use well-functioning quality management systems can assure Cederroth not only that the products supplied are of high quality, but that they use a systematic approach when dealing with quality issues. When defects occur it is thereby guaranteed that the supplier takes actions to solve the issue. During workshops the reliability in measuring the existence of a quality management system was discussed. Ideally the effectiveness of the system would be measured. The lack of a practical approach and the limitation in resources bounds the criterion to assess a supplier's quality management system in a subjective manner. It is therefore suggested that the supplier should be asked to describe their quality management system. This description in combination with Cederroth's experienced quality of the supplier's quality management system will then be the base for the assessment of this criterion.

During case studies CMCS was found not to have any defined quality management system but that they have internal routines, why they were awarded with score 3. CCS's large organization has an extensive quality management system and was therefore given score 5. PCS has ISO-certification which AstraZeneca put pressure on that they use. PCS was awarded with score 5. As previously discussed, to evaluate how suppliers practically use their quality management systems may be difficult, but since this strategic supplier evaluation model proposed aims at improving the strategic supplier evaluation it consequently will require some extra effort, above all in the introductory stage.

7.4.7 General product safety risk

Criteria description: Evaluates the risk for product mix-up in production. Products such as capsules and tablets are targeted.

Jan Karlström suggests a criterion to assess risk for product safety in the supplier's production (Karlström, 2010). He explains that this risk needs to be assessed specifically for contract manufacturer where product specifications often tend to be complicated. Karlström further points out the diverseness among Cederroth's suppliers which affects the risk level. Chemical suppliers for example mainly produce bulk products while packaging suppliers and contract manufacturer can produce much more complex products such as capsules or tablets, hence associated with much

larger risk. This criterion describing general product safety risk has not been suggested in the general interviews or as central criterion, which can be explained by the fact that Karlström was not attending those interviews. Therefore the relevance of this criterion should not be underestimated simply for not being highlighted during general interviews. The criterion is not directly supported by the literature but *Process quality* (Inemak & Tuna, 2009), *Operational Control* (Sen, Basligil, Sen, & Baracli, 2008) and *Quality control* (Min, 1994) are examples of criteria that indirectly assess product safety risk. It is believed that this criterion is important for evaluation of certain contract manufacturers that supply complex products. For other of the strategic suppliers such as chemical distributors this criterion may however not be applicable.

General product safety risk is suggested to be defined as the risk for product safety in a supplier's production and to be evaluated based on audits performed at the supplier. General product safety risks can be:

- Risk that product is mixed up with other similar products during production
- Risk that undesirable ingredients are mixed with the product

The case studies revealed that for CMCS the only risk is that the liquid in their product wet wipes would get mixed up, but this risk is considered to be limited and if occurring only to cause a limited damage. Achieved score was consequently 4. This criterion was rated as "Not applicable" for CCS as they are a large chemical supplier with detailed control systems that Cederroth have no insight into. Regarding PCS, product mix-up occurs seldom and the damage would be minor, why the score 4 was assigned. Concluding, the criterion is not suitable for all categories of suppliers.

7.4.8 In process control/inspection

Criteria description: Evaluation of in process controls, if statistic process control (SPC) is applied and how inspections are executed.

In process control/inspection is found to be indirectly supported by several criteria mentioned in the literature, namely *Product quality* (Inemak & Tuna, 2009; Neeraj, 2004), *Quality control* (Min, 1994), *Quality assurance* (Kuo, Wang, & Tien, 2010) and *Operational control* (Sen, Basligil, Sen, & Baracli, 2008). The criterion was however not mentioned during general interviews or as central criterion. It is still a criterion included in Cederroth's existing supplier evaluation model and during workshops the criterion was brought up. By having quality controls at an early stage in the production process it is possible to distinguish and correct defects and errors before it is too late and consequence major damage. When dealing with suppliers that conduct detailed quality controls Cederroth can save money and time on not having to control the goods themselves to such an extent, however on the other hand they may need to pay a higher price for the goods. Another benefit with high quality control of the suppliers' production processes is that Cederroth can use the product faster in their own production process when reducing the quality inspection upon arrival. It is suggested that this criterion evaluates suppliers on their internal work with process quality control in the meaning of for example random sample control. To assess the supplier performance of this criterion it is suggested to determine how often sample control is performed, if Statistic Process Control (SPC) is applied and how consistent controls are performed.

When evaluating this criterion in the case studies performed, CMCS was described as using in-process control but that potential for higher standardization is present, hence score 4 was assigned.

When CCS is a distributor and do not have own production and additionally insight into the supplier is limited, the criterion was “Not applicable” for CCS. At PCS there is staff present at all machinery assuring that the right version of printing plate is used and quality inspection is regularly performed, therefore score 4 was assigned.

7.5 Logistics criteria

The category *Logistics* corresponds to the category *Delivery*, which is considered as one of the four traditional categories relevant for supplier assessment (Weber, Current, & Benton, 1991). The category *Logistics* is supported widely in the studied literature (Mummalanenia, Dubas, & Chaoc, 1996; Neeraj, 2004; Dickson, 1966; Kuo, Wang, & Tien, 2010; Sen, Basligil, Sen, & Baraclli, 2008), all of them suggest several criteria relevant for this category. Cederroth’s existing supplier evaluation model names this group *Logistics*, which was firstly renamed *Delivery* according to the traditional categories. During workshops it became obvious that the change of name was confusing and it was decided to rename the category *Logistics*. The category originally includes the four criteria *Delivery security*, *Lead time*, *Communication* and *Flexibility*. The logistics category is defined to contain the delivery service elements lead time, delivery reliability, delivery security, information, flexibility/customer adaptability and stock availability (Oskarsson, Aronsson, & Ekdahl, 2006).

An essential fact to consider when discussing criteria in the logistics category is the difference in usage and need of evaluation depending on if the supplier delivers according to incoterm Ex Works (EXW) or Delivery Duty Paid (DDP). Suppliers delivering EXW cannot be evaluated on the criteria Hitrate - Time or Lead time directly. The transportation is handled by another company resulting in that the accuracy in time and lead time are also influenced by the transportation company and not exclusively addressed to the supplier. However, additionally assessing the transportation company in regard of their performance and then weighting the performance together with the performance of the supplier would be too resource demanding for Cederroth in relation to the value created by such a proceeding. Therefore it is suggested to assume that the transportation supplier fulfills its obligations satisfactory and evaluate the supplier on accuracy in delivery time in form of Hitrate - Time and lead time of the supplier solely looking at the supplier and exclude the transportation company from this specific assessment. On the other hand, performance of hired transportation companies is assumed to be evaluated by other evaluations than these for strategic suppliers.

Cederroth’s original criterion *Communication* included in the existing supplier evaluation model was first suggested to be shifted to the criteria category *General*, since communication is a tool used for several categories. Discussions in workshops pointed out that communication can be different among functions and that it is beneficial to measure in several categories simultaneously. The criterion is suggested to change name into *Responsiveness*.

7.5.1 Responsiveness

Criteria description: Evaluates availability and accessibility of the supplier and communication language regarding logistics issues.

As previously described, *Responsiveness* is a criterion to be found under several criteria categories and described in detail under the criteria category *Quality*. Regarding logistics, responsiveness should assess the communication within the logistics functions of the supplier and Cederroth as well as the availability, accessibility and easiness to reach logistics managers and their willingness to answer

Cederroth's questions. Clear communication is a requirement for excellent logistic performance and Cederroth need to be informed immediately regarding obstacles concerning logistics.

In the case studies performed for testing the strategic supplier evaluation model proposed, CCS was awarded with score 4 since they make an effort to quick response and communication when facing problems. CMCS was awarded score 5 as they are fast and always send reports concerning root causes to problems that have occurred to Cederroth.

7.5.2 Accuracy in logistics data

Criteria description: Evaluates accuracy in basic logistics data e.g. tagging and logistic related figures.

During workshops accuracy in logistics data was suggested and discussed as a criterion. The criterion has not been mentioned in previous empirical studies neither is it suggested by the theoretical review. A dilemma within the logistics at Cederroth is that suppliers not always provide Cederroth with correct figures regarding their logistics and that goods shipped do not correspond with the data regarding goods ordered. By evaluating the strategic suppliers on how well their logistics data correspond with reality this issue will be highlighted and can be improved in a long term perspective by following up continuously when evaluating the suppliers (Björkqvist, 2010).

The case study of CCS resulted in score 5 since chemicals delivered always are well tagged. Additionally data mistakes concerning orders or invoices have never occurred. CMCS was also awarded score 5 as their packaging slips and other data always are correct. PCS uses a register to count the amount of packages delivered in each order and there is seldom any faults in logistics data, hence they were given score 4.

7.5.3 Hitrate – Quantity

Criteria description: Evaluates delivery security by measuring the delivery quantity accuracy.

Hitrate – Quantity is one of the key figures in the tool of Hitrate. The criterion exists as *Delivery security* in Cederroth's existing supplier evaluation model and is further supported by Kuo et al (2010) who define it as order fulfill rate. Oskarsson (2006) define the criterion as "the correct article in the correct amount". The criterion is also mentioned during the general interviews and suggested twice as central criterion. *Delivery security* measures how well a supplier delivers what is ordered and can be considered as the quality in logistics. The name for this criterion is suggested to be *Hitrate – Quantity* to make the connection to Cederroth's manner of storing this data. For cases of EXW deliveries it is assumed that the third party logistics company treats the goods correctly so that the metric *Hitrate – Quantity* still is applicable for all suppliers regardless of incoterm agreed.

The criterion can be defined and measured on different levels, SERV1 and SERV2 (Oskarsson, Aronsson, & Ekdahl, 2006). SERV1 means that if a delivery includes 97 out of 100 ordered articles it is regarded as 97% fulfillment. SERV2 would consider this as 0% fulfillment. Which calculation that describes reality the best depends on how the manufacturing in Cederroth is set up. Many of Cederroth's processes are manual and a delivery of 90/100 articles can be used directly (Björkqvist, Head of Logistics, 2010). It is however still likely that this results in that not all goods on each pallet are finished during the same production period, consequently half-filled pallets are stored in the warehouse. Cederroth's current use of Hitrate corresponds to the theory of SERV2 and treats any unfulfilled order as an unfulfilled order. This treatment saves time and resources but does not map the reality truthfully.

In the case studies CMCS was awarded score 5 based on that they have had 100% accuracy in this metric in the last year. For two periods they had one fault resulting in 94% at that time. CCS was also awarded score 5, while PCS was given score 4. Although this criterion was intended to be evaluated quantitatively, lack of data for both CCS and PCS still resulted in qualitative evaluation.

7.5.4 Hitrate – Time

Criteria description: Evaluates delivery reliability by measuring the delivery time accuracy.

Neeraj (2004) defines delivery reliability as the supplier's on-time delivery performance which is similar to the definition of Oskarsson et al (2006) as the reliability in lead time. The idea is to measure how well the supplier delivers within in the specified time frame. This criterion has not previously been included in Cederroth's supplier evaluation model. It has not been mentioned during the general interview nor suggested as central criteria. After being suggested initially in this study discussions in workshops support the choice of this criterion. To match available data it is suggested that the criterion is named *Hitrate – Time*. How well a supplier can deliver within a specified time frame influence to what extent Cederroth can reduce their safety stock level. A supplier that follows schedule is beneficial in terms of logistics planning and staffing and creates opportunities for Cederroth to improve in the process of becoming leaner.

As discussed under the criterion *Hitrate – Quantity*, for suppliers with agreements on the incoterm EXW there will be assumed that the transportation company fulfils its commitments satisfactory so that the supplier can be evaluated on accuracy in delivery time.

When defining this criterion it should be considered how the time frame of delivery influences Cederroth. Early deliveries to crowded warehouses can be very expensive, but to an empty warehouse the cost is almost zero. Late deliveries are on the other hand almost always expensive. The practical assessment of the criterion can be based on data that Cederroth register in Hitrate. Time for registration of incoming goods however influences the criterion's validity (Ludkiewicz, 2010). If the delivery is performed when there are no personnel in the warehouse or when the personnel have insufficient time to immediately handle the delivery, the criterion does not correspond to when the goods are actually delivered since Hitrate information is based on when the goods are registered into the system by the warehouse personnel. Hitrate has further been adjusted to each supplier by tuning the acceptable time interval depending on the arrangement with that supplier in particular. Thereby a 100% hitrate can still be achieved without being extremely costly. This makes it difficult to discuss a general aim for this metric why the judgment of a company's performance over this metric will need to be assessed qualitatively.

When evaluating the case suppliers on this criterion, CMCS's performance was found to be 100% with two exceptions in the last year, hence awarded score 5. CCS and PCS were given score 5 and score 4 respectively based on the evaluators' experience. Even though Cederroth have a system for storing these figures the data have not been available for this study. When evaluating strategic suppliers according to the model proposed, the evaluators need to prepare the hitrate data before performing the supplier evaluation to be able to assess the supplier performance correctly according to the criteria definition.

7.5.5 Lead time reduction

Criteria description: Assessment of lead time and lead time-reducing actions.

Lead time is a suggested criterion by (Neeraj, 2004; Dickson, 1966; Kuo, Wang, & Tien, 2010) and is also one of the original criteria in Cederroth's supplier evaluation. The criterion was also discussed during the general interviews as well as being suggested as general criteria. Oskarsson (2006) point out that lead time is related to cost of bound capital, which can be calculated based on current interest rate. During workshops the suitability of lead time as a criterion for supplier development was discussed. It was then suggested that assessing a supplier's actions for reducing the lead time probably leads to better improvement of lead time than simply assessing the actual lead time.

Lead time is a quantitative criterion that is generally defined as the period of time between ordering and time of delivery (Oskarsson, Aronsson, & Ekdahl, 2006). To specify this definition further the ordering system used in each case needs to be taken into consideration. Different suppliers probably provide different methods to handle ordering. As suggested above this should be a qualitative criterion that evaluates the supplier's actions for reducing lead time and not the actual lead time itself since it varies significantly between type of goods. Further, the supplier should be evaluated on their attitude and efforts towards continuously reducing lead time since even though the lead time already is considered as short in comparison to other suppliers in most cases it is possible to reduce it further by taking the right actions (Oskarsson, Aronsson, & Ekdahl, 2006).

When performing the case studies, Purchasing Manager Magnus Andersson pointed out that suppliers generally show no interest in reducing lead times, especially since Cederroth generally apply a short-term approach when negotiating prices. CCS was awarded score 2 since Cederroth has no or very small influence on such a large supplier's lead time. CMCS was awarded score 4 as they are a minor supplier over which Cederroth have influence. Senior Buyer Mira Ludkiewicz did however point out that shorter lead time from CMCS would result in higher costs.

7.5.6 Short term flexibility in order volume

Criteria description: Evaluates supplier performance in flexibility e.g. season varieties, emergency orders and trends.

Flexibility is a criterion present in Cederroth's existing supplier evaluation model. It was not mentioned during the general interviews but suggested once as central criteria. The criterion is also proposed for supplier evaluation by (Neeraj, 2004). *Ability to fill emergency orders* (Sen, Basligil, Sen, & Baracli, 2008), *responsiveness to customer needs* (Mummalanenia, Dubas, & Chaoc, 1996), and *Flexibility/Customer adaptability* (Oskarsson, Aronsson, & Ekdahl, 2006) are other suggested definitions that address what is evaluated in *Flexibility* in this model proposed. When discussing the criterion in detail during workshops it became clear that Cederroth re-schedules production often and that supplier flexibility such as coping with emergency orders is highly important (Björkqvist, 2010). Even though Cederroth use rolling demand forecasts for the next three months, which are sent out to the supplier, Cederroth more or less re-schedule on a daily basis and create weekly demand plans. This results in that safety stock levels need to be kept high and that emergency orders are common (Björkqvist, 2010). This criterion is therefore relevant to consider when setting production strategies.

The definition of flexibility suggested by (Oskarsson, Aronsson, & Ekdahl, 2006) is the supplier's ability to handle a request to change an order, number of order lines or to add an order within a short period of time, specialized delivery, shorter lead time, express transportation, specialized

packaging, other forms of tagging the goods. Practically, the criterion should assess how well a supplier can handle seasonal varieties, emergency orders and trends.

During the case studies CCS was considered to be aiming at flexibility but that they in reality often fail, therefore score 3 was appointed. CMCS was awarded score 4 since they have the possibility to increase the production capacity if needed. Cederroth is further a prioritized customer and CMCS have storing facilities available for consolidated transports. PCS was given score 3 due to the fact that it is fairly difficult to acquire raw material for cardboard within a short time period.

7.5.7 IT-maturity

Criteria description: Existence of IT-systems such as APS, EDI and prerequisites for VMI.

IT-maturity was not discussed during the preliminary empirical collection. It is supported by (Min, 1994; Inemak & Tuna, 2009) and was taken into the strategic supplier evaluation model after being suggested during workshops. Cederroth currently apply EDI-systems with a selection of large customers which demand this but also with the strategic supplier SCA Packaging, with whom Cederroth have a high level of cooperation. Even though Cederroth are not currently using EDI-systems extensively, if suppliers have the capability Cederroth appreciate and value the potential to develop it in a later stage, hence it is still relevant to evaluate the suppliers' IT-maturity. Introducing IT-systems is expensive for small companies, but when in place it can decrease costs and increase efficiency substantially (Björkqvist, 2010).

Since this criterion aims at assessing suppliers attitude and steps toward more automatic logistic systems it is of a qualitative nature. The criterion can be defined as the supplier's actions in introducing IT-systems as well as the likelihood that they will introduce IT-systems in the near future. Suggestion is made that suppliers should be evaluated on APS, EDI and prerequisites for VMI (Björkqvist, 2010).

CCS was awarded score 4 in regard of their performance concerning IT-maturity. Since they use SAP the potential for further IT-development is considered to be high. CMCS was given score 2 as their IT-maturity currently is limited to production planning and billing systems. PCS was awarded score 4 with the motivation that they use the ERP-system Movex, just as Cederroth, so potential for integration is expected to be high.

7.6 Product development criteria

The category product development previously consisted of four criteria. Future technology development, design/process improvements and research are suggested to be relevant criteria regarding product development issues for supplier selection (Kumar & Kopitzke, 2008; Kuo, Wang, & Tien, 2010). *Design experience* was included in the existing supplier evaluation model but found to partly assess the same features as *R&D competence*. In order to avoid overlapping criteria *Design experience* has been eliminated and replaced by the criterion *Product portfolio/Innovation*, that assesses a supplier's experience and attitude in product development more comprehensively than easily *Design experience* by also take result of design experience under consideration.

When performing the case studies and evaluating the selected strategic suppliers according to the model proposed, Senior Buyer Monica Engström performed the evaluation of the packaging supplier, PCS. The optimal procedure would have been evaluation performed by representative from R&D

Packaging due to better insight into R&D issues, hence motivations for the scores concerning the packaging supplier PCS are not available.

7.6.1 Product documentation

Criteria description: Assessment of existence and level of detail of drawings and specifications, risk assessment, existence of SDS for included raw materials, REACH-compliance for chemicals and compliance to EU-directives for packaging.

Documentation exists as a criterion in the existing supplier evaluation model and is suggested to be included in the new strategic supplier evaluation model as well. Especially representatives from R&D department at Cederroth have articulated the essence of documentation and expressed a wish to evaluate strategic suppliers on documentation in R&D (Snell, 2010). It is not highlighted as one of the central criteria for supplier evaluation, though it is assumed to constitute a good complement to other selected criteria concerning product development. During workshops this criterion was discussed and analyzed resulting in action taken to rename the criterion to *Product documentation* to increase the distinctiveness. Documentation as a criterion for supplier evaluation has not been discussed in the literature, on the other hand found to be a relevant criterion for Cederroth to evaluate their strategic suppliers on.

This criterion is supposed to measure the supplier's ability to provide clear and detailed product documentation. This implies *Product documentation* to constitute a qualitative criterion in the evaluation model. Assessment of the criterion should be considering following areas:

- Drawings and specifications
- Product risk assessment
- SDS (Safety Data Sheet)
- REACH-compliance
- Compliance to EU-directives

For contract manufacturer the concerned R&D department also has the responsibility for regulatory questions which should be taken under consideration in this criterion. Further, a supplier's product documentation should not exclusively be evaluated by the R&D department but also representatives for quality assurance should attend the evaluation of supplier performance regarding product documentation.

When performing the case studies with the three selected strategic suppliers, CMCS was evaluated as top-performing when it concerns product documentation based on that they send the specifications requested by Cederroth hence awarded score 5. However, reason for a high score may be the fact that the products that CMCS supply are fairly uncomplicated products, hence with less complex and extensive product documentation. The product documentation of CCS corresponds to Cederroth's request, though sometimes CCS has failed in performing tests required by Cederroth which is the reason for assigning CCS score 4. PCS is awarded with score 4 since they tend to fulfill the requirements good but not exemplarily.

7.6.2 Responsiveness

Criteria description: Evaluates availability and accessibility of the supplier and communication language regarding R&D issues.

Just like discussed previously in the categories *Quality* and *Logistics*, *Responsiveness* is a criterion to be found under several criteria categories. Regarding product development, responsiveness should assess the communication within the R&D functions of the supplier and Cederroth as well as the availability, accessibility and easiness to reach R&D managers and their eager to answer Cederroth's questions. Clear communication is a requirement for excellent logistic performance and Cederroth need to be informed immediately regarding obstacles concerning logistics. Significantly important is further on which level the communication takes place. By having direct contact with the supplier's R&D department the cooperation and communication is heavily facilitated and issues can more easily be tackled and solved (Knutsson, 2010; Törnevik, 2010).

From a product development perspective, CMCS was assessed to be easy to deal with motivated by that they answer quickly, hence score 5 was assigned. In CCS's case, the responsiveness is good but can be further improved resulting in score 4, and the same thing applies to PCS also achieving score 4.

7.6.3 R&D competence

Criteria description: Evaluates supplier's R&D competence based on experience with the supplier and general feeling acquired.

R&D competence is included in the existing supplier evaluation model and considered to be one of the central criteria as well as a criterion discussed during general interviews, which implies its importance. Competence is suggested to be a key factor for a company's success and therefore strategic suppliers should be evaluated on competence. R&D competence is not mentioned in the literature review, but can be assumed to secretly be included in other criteria in the literature such as *Supplier's expertise* (Sen, Basligil, Sen, & Baracli, 2008) or *Design capability* (Kuo, Wang, & Tien, 2010). Competence is interpreted by some authors as one single criterion covering all kinds of competence areas such as R&D, environment, quality and production. The supplier evaluation model proposed in this study suggests competence to be assessed separately in regard of criteria category in order to provide a more nuanced picture of the supplier's performance and ability. Competence is considered as such an important criterion that a too shallow level of assessment concerning supplier competence may have significant negative impact on the general supplier evaluation result.

R&D competence was proposed to be assessed on average level of education or years of experience among employees in R&D department. During workshops the reliability of such a definition was discussed and found to be rather unreliable and would not consider the relevance of the competence or the competence available for Cederroth's interests and activities. R&D competence was instead suggested to be evaluated on experience from earlier collaboration with the supplier's R&D department and a general feeling acquired of the supplier's R&D competence. By investigating the educational background and the previous experience of the employees at the R&D department of the supplier a more extensive apprehension of the competence can be gathered, which is supported by representatives from R&D Healthcare and Wound care (Knutsson, 2010; Törnevik, 2010).

Evaluating the criterion *R&D competence*, the performance of CMCS was awarded with score 3. Generally Cederroth develop the products bought from CMCS together with other partners, however it is assumed that CMCS can assist in R&D questions. On the other hand, CCS's R&D competence is assessed to be excellent and Cederroth has good technical contact with the supplier in question, therefore score 5 was assigned. R&D competence for PCS was awarded with score 4 but without any

descriptive motivation since the main responsible for R&D issues at Cederroth was not able to attend the assessment, but which had to be performed by the Senior Buyer responsible for the supplier.

7.6.4 Technical support

Criteria description: Assesses technical support available from supplier regarding product defaults and supplier assistance with product specific knowledge.

Technical support is a new criterion that was not applied as an evaluation criterion by Cederroth in the past. The criterion did not occur in any of the initial empirical information collections, but was requested during the workshops. Technical support is described in two of the articles studied as *Supplier's post sales assistance and support* (Neeraj, 2004) and *Quality of support* (Sen, Basligil, Sen, & Baracli, 2008). The issue has indirectly been touched during interviews with Cederroth representatives and is described as a major concern. If for example a shampoo turns out to be harmful the technical support from the supplier to find a cure, assistance to find out what went wrong with the product design and mapping the sources of ingredients is invaluable to Cederroth. Under the pressure from today's mass media this is of even higher importance. Technical support from the supplier to suggest new components, chemicals and product designs to minimize the share of materials or chemicals in products that are in the risk zone for causing negative publicity concerning ethical and environmental aspects, is strongly requested by Cederroth. Hence it should be an aspect that suppliers will be evaluated on.

Technical support has been discussed to assess a supplier's technical support regarding product defaults, product modifications and supplier assistance with product specific knowledge. Among other things the criterion aims at measuring the supplier's ability to assist in case the mass media suddenly blacklists a component that is a part of a Cederroth product. The supplier's proactive attitude in suggesting environmental-friendly, ethical and non-hazardous products is also evaluated.

When evaluating CMCS on this criterion, scoring was based on the experience last time Cederroth needed technical support from the supplier. That time, the technical support was assessed as high and therefore CMCS scores 5. This situation took place a few years ago when the paste in a wet wipe was leaking. CCS's technical support is described as good and assigned score 4, just like PCS.

7.6.5 Product portfolio/Innovation

Criteria description: Evaluation of breadth, complexity and technical level of product portfolio and development of existing products and share of new products in the portfolio. Level of innovation within the company should also be assessed.

Product portfolio/Innovation is a new criterion that assesses similar supplier attributes as the discarded criterion *Design experience*. The aspect *Experience, resources and time for product development* was suggested as a central criterion and *Product portfolio/Innovation* is suggested to address that aspect with distinctiveness. The criterion is further suggested by the literature described as *Supplier's ability and willingness to assist with the design process* (Neeraj, 2004). The criterion *R&D cooperation* that is present in the existing supplier evaluation model constituted the foundation for a discussion during the workshops resulting in modifying the criterion to *Product portfolio/Innovation*. Assessing the product portfolio is more practical when evaluating suppliers' ability to assist in the design process and the suggestion to include the innovative aspect of a supplier was expressed by Purchasing Manager Magnus Andersson. Example of an asset valuable to Cederroth can be a

supplier's ability to develop a specific product like a blueberry bar customized for Cederroth. Kumar et al (2008) suggest the criterion *Partnering in product development* which can be seen as a contribution to further support the selection of this criterion. Partnering can be described as a high level of supplier relationship and by choosing a supplier with high score on *Product portfolio/Innovation* the supplier's ability to assist in product development and refining Cederroth's product portfolio can be assured.

Product portfolio/Innovation can assess both the supplier's historical and current stand by evaluating the product portfolio, but also the supplier's ability to refine their product portfolio and possibilities for innovation. It is therefore suggested that the criterion is evaluated on following aspects:

- Breadth, complexity and technical level of product portfolio.
- Development of existing products and share of new products in the portfolio.
- Level of innovation within the supplier.
- Ability to develop products customized for Cederroth.

In the case studies CMCS's performance in regard of the criterion *Product portfolio* was estimated to be good, however the evaluator's knowledge about the product portfolio was limited, and score 5 was assigned. CCS has a large product portfolio with high complexity, breadth and innovation, conclusively they were assigned score 5.

7.6.6 Product development process

Criteria description: Evaluation of the product development process by controlling that activities are performed in the right order and that key requirements are clearly stated before entering next steps.

None of the authors reviewed from the literature suggests product development process as a criterion for supplier evaluation, which is a reason for questioning the existence of the criterion in the supplier evaluation model. During the general interviews the criterion is mentioned once as important, however not specifying the definition of the criterion further in detail. An opinion regarding the criterion is that it is difficult to assess by not being clearly defined when included in the existing supplier evaluation model (Ingmarsson, 2010). On the contrary, it is articulated as important to investigate before selecting a supplier together with which products will be developed in the future (Knutsson, 2010; Törnevik, 2010). On these grounds the criterion *Product development process* is taken into the new supplier evaluation model proposed in this study, since its practical usefulness tends to be high.

The criterion should assess the supplier's product development process in terms of how requirements for new product development are set up and in which order activities are performed. It is vital that key requirements are clearly specified before entering further steps in the process. Other aspects to consider are whether the supplier on own initiative run product development processes or exclusively on assignments from customers and if the supplier is depend on support and resources from Cederroth to run the product development process or not.

In the case study this criterion was "Not applicable" to CMCS since they never cooperate in product development. CCS has a clear documentation of the whole product development process and was assigned a 4 since it is considered as structured and sound. PCS is additionally awarded score 4 based on a general impression.

7.7 Purchasing criteria

The purchasing category has not been changed since the existing supplier evaluation model, but the criterion *Supplier purchasing process* included in the existing supplier evaluation model is eliminated from the model whilst *Knowledge about second tier suppliers* still is included in the new evaluation model. No author in the literature review mention the supplier purchasing process or knowledge about second tier suppliers explicitly in their articles. However, it can be discussed whether the criterion *Knowledge about second tier suppliers* is hidden under criteria categories concerning quality issues in the literature. Kuo et al (2010) mean that quality assurance is a criterion to evaluate the strategic suppliers on and included may the quality assurance of second tier suppliers be as well even though it is not explicitly articulated by the authors. One reason for not mentioning this criterion may be the difficulty controlling the second tier suppliers. In the chemicals industry for example, second tier suppliers are confidential and not transmitted to customers (Åslund, 2010). Controlling the second tier suppliers would require a large amount of resources, which are not available at Cederroth. To what extent the supplier have knowledge about the second tier supplier can only briefly be checked and therefore it may not be considered as a criterion good enough for taking into account by the literature. Since *Supplier purchasing process* and *Knowledge about second tier suppliers* tend to describe approximately the same thing, the criterion first mentioned is eliminated when it is found to be less essential than trying to assess the supplier's knowledge about the origin and quality of its products. Further, society's focus on how well second tier suppliers fulfils general requirements and take social and environmental responsibility is growing and it is becoming increasingly important to secure second tier suppliers to avoid scandals and negative publication which can cause severe damage to the company (Wersén, 2010).

Existing supplier evaluation model consists of two criteria regarding costs and pricing, *Cost reduction & goal* and *Price development*. Both are vital criteria for supplier evaluation but eliminated from the model and replaced by a couple of new criteria discussed in this chapter. Cost reduction was not mentioned as a specifically important factor in the general interviews or as central criterion. Price development was further not mentioned as a central criterion, when exclusively price was found to be both mentioned during the general interviews as important and further seen as a central criterion. Price solely is on the other hand considered as an issue discussed and negotiated in the very last step of the supplier selection process and further seen as a negotiable variable, hence price development is a criterion more suitable for the supplier evaluation process. Therefore price is not directly included in the supplier evaluation but concerned in a subsequent phase when a well-performing supplier has been identified. The cost reduction goal aspect has been removed from the criterion definition when no support for assessing supplier goals concerning costs has been found in the literature. It is further a criterion that is complex to define and assess on whether it is good or not and perform the assessment similarly for different suppliers. The subjectivity of the supplier evaluation increases with such a criterion.

7.7.1 Responsiveness

Criteria description: Evaluates availability and accessibility of the supplier and communication language regarding general purchasing issues.

During the workshops with Cederroth representatives the criterion *Responsiveness* was suggested to be included in the model. The criterion is supposed to evaluate the availability and accessibility of the supplier and communication language regarding general purchasing issues. Dickson (1966) describes

attitude as one component in the service category which can be interpreted to include responsiveness in the definition. Availability and accessibility regarding communication with the supplier can be derived to the supplier's attitude to a certain extent. Neeraj (2004) further articulates the supplier's support as important to take into consideration regarding service aspects, which also can be interpreted as correlated with communication responsiveness. Good support requires clear communication and good communication responsiveness. Hence, responsiveness should be interpreted as a more concrete and detailed level of evaluating supplier's support or attitude.

This criterion is qualitative and needs to be assessed based on judgment, however what to look for when evaluating this criterion is quite clear and should be how often supplier representative searched for is reached, if there is a language problem or not and how quickly and accurate the supplier respond to questions and attend meetings with Cederroth.

In the case study CCS was given score 4 based on that they always respond quickly and accurately to requests concerning product development. CMCS was given score 4 with the motivation that they are fast and always responds competently. PCS's responsiveness was given score 4 since the communication and responsiveness generally works out well, though sometimes the response time could be reduced.

7.7.2 Cost reducing initiatives

Criteria description: Evaluates supplier's cost-reducing initiatives, actions and attitude.

This criterion is present in Cederroth's existing supplier evaluation model under the name *Cost reduction & goals*. First, the criterion was modified and named *Cost reduction*, defined to measure annual total cost reduction for logistics operations. During the workshops it was discussed that the criterion should assess the supplier's willingness and probability for future actions instead of assessing current stand. Hence it was renamed *Cost reducing initiatives*. Sen et al (2008) conversely have chosen cost, but not cost reduction, as a criteria category for supplier evaluation, consisting of criteria such as net price, price breaks, operating cost, maintenance cost etc. Oskarsson et al (2006) discuss cost for logistics operations as warehousing costs, handling costs, transportation costs, administrative costs and other logistics related costs such as information costs, wrapping costs, material costs and costs related to logistics. Kuo et al (2010) also define cost as a criteria category including price performance value, compliance with sectorized price behavior and transportation cost. Conclusively focus is on price except for transportation cost. For supplier selection several authors highlight price as an essential criterion but regarding cost reduction there is little mentioned in the literature. This may be in order to the fact the literature mainly handles criteria for supplier selection, hence not considering criteria that only are applicable for evaluating already existing suppliers with a track record. When this supplier evaluation model will be applied on both new and existing suppliers the criterion *Cost reducing initiatives* is considered more suitable to evaluate than using a criterion that requires a track record and which mainly assesses historical performance.

Cost reducing initiatives aims at assessing a supplier's awareness, attitude and action in the area of cost reduction that can benefit Cederroth. Since this criterion is evaluating soft aspects it is difficult to define specific facts that a supplier needs to fulfill to get a certain score. Examples of cost reducing initiatives could be:

- Improved collaboration with second tier suppliers resulting in higher coordination, reduced waste, price reduction on raw materials and change of raw materials.
- More efficient manufacturing processes through new equipment, more efficient use of time, improved production planning and automated production lines.
- Improved wrapping of products resulting in reduced costs.
- Initiative to cut logistics costs.

The case studies concluded that CCS do not suggest any cost reducing actions why they were appointed such a low score as 1. Purchasing Manager Maguns Andersson explains that this can be related to that Cederroth performs intense price discussions with the supplier. CMCS was given score 4 since they suggest cost reducing initiatives themselves, such as change to cheaper material. PCS has previously not been exposed to competition why no initiatives have been presented to Cederroth to reduce costs, hence score 3 was assigned.

7.7.3 Supply chain risk assessment

Criteria description: Assesses supply chain risk e.g. delivery problem due to defect tools, second tier supplier delivery problems, actions taken by supplier to secure supply, collaboration with fire department and existence of fire boxes for important tools etc.

Supply chain risk assessment was suggested as a criterion to include in the strategic supplier evaluation during workshops and was discussed intensively. The notion to assess a supplier's risk level originated in the fact that one of Cederroth's supplier's plants recently was burned out resulting in supply difficulties. The criterion has not been a part of the existing supplier evaluation model but mentioned during general interviews with Cederroth representatives.

The criterion intends to assess the supplier's risk awareness and actions taken by the supplier to reduce the level of risk. *Supply chain risk assessment* primarily aims at evaluate risk for supply difficulties which for example can be a consequence of:

- Fire in the production, a risk which can be reduced through collaboration with fire department and storing vital tools in fire safety boxes.
- Machinery breakdown, a risk which can be reduced by having equipment that is multifunctional.
- Supply shortage from second tier supplier, which can be prevented by requesting risk management from second tier supplier or request the supplier to apply dual sourcing.

The case study concerning CMCS resulted in score 4, motivated by high average demands in stock, availability of optional machines and the possibility to change to three-shift production if necessary. CCS can also produce on several different sites and is given score 4. PCS is further given score 4 since they recently have extended their productions with sites in Norrköping and Denmark. Conclusively the case studies shows that in reality the availability of alternative production sites is what the evaluators look for. However, this merely assesses the supplier's ability to keep producing when an accident has occurred. Preventive actions is likely more important to reduce supply chain risk but it is also more difficult to assess.

7.7.4 Investment plans and future visions

Criteria description: Evaluates investment plans and future visions of relevance for Cederroth e.g. investments in new equipment, tools, R&D or training that Cederroth can benefit from.

Investment plans and future visions has been developed from the original criterion *Investment plans in production* in Cederroth's existing supplier evaluation model. *Investment plans in production* has not been discussed during the general interviews or as a central criterion. *Production facilities and capacity* is a criterion ranked as number four in Weber et al (1991)'s analysis of Dickson (1966)'s criteria. Sen et al (2008) further mention the criteria *Process capability*, *Process flexibility* and *Future manufacturing capabilities* which all suppress the fact that production facilities and investments in these are important in supplier selection. Kuo et al (2010) evaluate the criterion *Process Improvement*, which can be seen as a result of investments in production. During workshops the criterion was discussed and conclusively only investments relevant for Cederroth should be assessed in this criterion as well as future visions. When taking general investments into consideration a supplier could achieve a high score when large investments were made regardless of the investments' relevance for Cederroth, resulting in that the criterion would measure irrelevant aspects and not be reliable. Since not all the supplier's planned activities that are relevant for Cederroth can be assessed by measuring investments, the criterion was also suggested to consider future visions of the supplier that Cederroth can benefit from.

The criterion includes both quantitative and qualitative aspects, hence the assessment becomes complicated. A simplifying solution is to define the criterion as a qualitative criterion and apply a qualitative view on quantitative data. The supplier's response to questions regarding investments, future plans and their possible benefit for Cederroth is an example of how to collect information for assessing this criterion.

In the case studies performed CMCS provided examples that they have renewed their liquid mixing department, ERP-system, built new warehouses and have high interest in developing their operations with Cederroth, therefore they were awarded score 4. For CCS on the other hand this criterion is "Not applicable". It is in general insignificant for chemical suppliers. PCS are awarded score 4 since they are a large supplier with means available for continuous investments. Conclusively the criterion needs to be assessed qualitatively on the evaluators' experience.

7.7.5 Capacity for increased demand

Criteria description: Assessment of supplier's capacity for long-term increased demand.

Capacity for increased demand intends to assess a supplier's capability to handle larger order volumes from Cederroth in the future. That would be relevant if Cederroth increase their sales volume of existing products or extend their product portfolio with new products, which requires components from the supplier to be evaluated. The selection of this criterion is supported by several authors in the shape of *Production facilities and capacity* (Dickson, 1966), *Process capability*, *Process flexibility* and *Future manufacturing capabilities* (Sen, Basligil, Sen, & Baracli, 2008). This criterion partly assesses the supplier's stock availability, that was suggested as a criterion in the initial model, supported by (Oskarsson, Aronsson, & Ekdahl, 2006). However, the workshops provided information regarding that Cederroth has previously experienced problems with suppliers that cannot handle a long-term and consistent increase of Cederroth's demand. To assess a supplier's capacity for

increased demand several aspects require attention such as a supplier's current production utilization rate and supplier's customer base that compete for the supplier's production utilization.

When evaluating the case suppliers on capacity for increased demand, CMCS achieved score 4 as there is a high capacity for increased demand. Since CCS is a large supplier it is concluded that regarding production the capacity flexibility in regard of increased demand from Cederroth is high when the volume delivered to Cederroth is fairly small in comparison to CCS's other customers. CCS is awarded with score 5. PCS is just like CCS regarded to have no significant problems with handling increased demand from Cederroth and scores 4. Conclusively availability of capacity is evaluated qualitatively based on experience which is appropriate since Cederroth have long relationships with all three suppliers.

7.7.6 Knowledge about second tier suppliers

Criteria description: Supplier's general knowledge about second tier suppliers.

Knowledge about second tier suppliers aims at evaluating the supplier on how deep its knowledge about second tier suppliers is and whether second tier suppliers fulfill general requirements and governmental restrictions and legislations. This is also a fairly abstract and judgmental criterion complicated to assess. If the supplier can present documents signed by the second tier supplier which assure that regulations and restrictions are fulfilled, they could be accepted as indication of knowledge and assurance that the second tier supplier is fair and takes responsibility. This criterion was mentioned as a central criterion during the special interviews and is included in the existing evaluation model and also included in the proposed evaluation model. When it already has been applied as an evaluation criterion and further considered as vital for Cederroth when evaluating suppliers, it is assumed having high relevance.

The criterion will constitute a qualitative criterion and be assessed due to how well a supplier can prove with documents that they have knowledge about their suppliers. This could be proved in form of supply agreements or second tier suppliers' Code of Conduct.

In the case studies CMCS was given score 3 as they apply Cederroth's contract template and store documentation about their suppliers. CCS on the other hand do not disclose information about their second tier suppliers. PCS is assessed to have good communication and knowledge about their second tier suppliers and appointed score 4.

7.7.7 Cost structure

Criteria description: Evaluates transparency in supplier cost drivers and how prices are correlated to raw material indices.

Price is a frequently appearing criteria category in the literature and price development is applied as a criterion in the existing supplier evaluation. Mandal et al (1993) mention price as a criterion for vendor selection, Dickson (1966) rates price as the sixth most important criterion, Sen et al (2008) have chosen *net price* as a criterion under the cost category and Kuo et al (2010) suggest *price performance value* to be a criterion. The authors last mentioned have a similar view of how to include the price issue in the evaluation just like Cederroth's existing supplier evaluation model, namely focusing on measure price performance and not actual price.

The price development criterion was further developed resulting in the criterion *Cost structure*. During interviews performed with Cederroth's purchasing leader Magnus Andersson the supplier's cost structure was suggested to be of more relevance to assess than solely price development (Andersson, 2010). The cost focus in the evaluation model was found to be low and to include another cost-related criterion was considered to be a sound solution to increase the cost focus in the supplier evaluation. The new criterion is highly correlated to price but attacked from another point of view. By getting insight into the supplier's cost structure the potential for price pressure will increase and consequently a pressure on the supplier to reduce its costs. The criterion will assess the transparency in the supplier's costs and cost drivers but also assess how prices are correlated to raw material indices. Positively assessed will price agreements be where product price is correlated to relevant raw material index and fluctuate according to index when index changes are significant and further a supplier which openly shares its cost structure with Cederroth.

The case studies strengthens this reasoning; CMCS is given score 3 based on that Cederroth have fairly limited insight their cost structure, CCS is appointed score 1 as the insights are nonexistent, the insights in cost structure towards PCS is also limited and score 3 is awarded.

7.8 Environmental criteria

The existing supplier evaluation model included the five environmental criteria; Environmental management system, Environmental policy, Environmental key indicators, Transportation efficiency and Cederroth's impact on the supplier's environmental performance. However, these criteria are recently integrated and some of them found to be complicated to assess and not be useful resulting in that all criteria were excluded from the model. The criterion Environmental policy was found to be complicated to assess on a five point scale and only possible to assess as good or not. The criterion Environmental key indicators were further excluded. Which environmental key indicators a supplier has chosen to monitor does not reflect the environmental performance of the supplier or how well it will be able to support Cederroth in the environmental work. The performance of the key indicators monitored would on the other hand be of more interest to Cederroth, hence not a criterion that could be included in the evaluation model since different suppliers tend to have diverse key indicators, if any at all and how to compare them to each other would be a complex task.

Transportation efficiency was found to be a criterion "Not applicable" for all supplier categories or for all suppliers within a category. Packaging suppliers apply incoterm EXW to a large extent while chemicals suppliers principally apply incoterm DDP. Transportation of chemicals is mainly executed by the chemicals supplier in special trucks and therefore occupancy level for chemicals transportation is difficult for Cederroth to influence compared to influence on occupancy level for packaging transportation, where Cederroth are responsible for the transportation and free to select occupancy level and route themselves. Further, incoterms applied differ within one supplier category as well, resulting in transportation efficiency as an incomparable criterion.

Suppliers that were asked to estimate Cederroth's impact on their environmental performance conveyed the complexity in the question and found it complicated returning a somewhat true estimation (Andersson, 2010). Consequently, the criterion *Cederroth's impact on supplier's environmental impact* was excluded from the evaluation model. The criterion was further only applicable on already existing suppliers and not on potential suppliers, which considerably reduced its usefulness. Cederroth's impact on the supplier's environmental impact should have been analyzed

with respect to Cederroth's share of the supplier's production volume, otherwise it would not have been possible to draw any useful conclusions from such information.

Due to lacking of response from PCS it has not been possible to include their data regarding environmental aspects in this criteria category.

7.8.1.1 Cederroth's environmental strategy

Chapter 3.4.1 discusses environmental management strategies. Several authors agree that specifically two distinct strategies can be derived, a reactive strategy and a proactive strategy (Min & Galle, 1997; Noci, 1997 ; Walton, Handfield, & Melnyk, 1998). According to the authors' definitions of reactive/proactive strategies, it can be argued that Cederroth are applying a mix of both. This analysis is supported by the fact that Cederroth have a code of conduct which includes an extensive environmental chapter describing how environmental performance will be improved by certain activities (Cederroth AB, Code of Conduct). Environmental actions are suggested to be concentrated principally to the beginning of the value chain concerning purchasing and R&D, but additionally energy, waste-, resource efficiency and environmental certifications are expressed as environmental-caring actions which are examples of actions recommended applying the reactive approach. A combination of internal and external functions integrated in the environmental work further strengthens the point of view that Cederroth have a mixed environmental strategy. Suppliers to a company that has taken on a proactive environmental strategy must be able to support the company in the introduction of new green products, hence supplier evaluation criteria in the new model concerning environmental aspects should be chosen with respect to strategy applied. The environmental strategy applied is suggested to be viewed upon as a development process where starting in the reactive strategy approaching the proactive strategy accordingly as time proceeds. Cederroth's position can be found to be in the middle of those two strategies but a little bit closer on the scale towards the proactive strategy than the reactive strategy.

A trade-off must on the other hand be respected when criteria suitable for a proactive approach tend to be more difficult to measure than criteria suggested for the reactive approach such as fulfillment of regulations and implementation of environmental management systems. When Cederroth have expressed wish that the evaluation model should be easy to use and not require too much resource this aspect of criteria selection must be noticed. Critics against the reactive strategy have been articulated meaning that it lacks focus on external functions and only take internal functions into consideration (Walton, Handfield, & Melnyk, 1998). Without integrating its suppliers a company cannot succeed becoming environmental-friendly and greening the supply chain, therefore co-operation with suppliers is a necessity and moreover an activity resulting from a proactive environmental approach. Mulder (1998) articulates that green purchasing effectiveness easily can be improved if only purchasing managers use simple and straightforward questions and require understandable guidelines and input from the suppliers, a statement that supports the importance of selecting criteria that are easily measured and understood by both the purchasers and the suppliers.

7.8.1.2 Reactive/proactive criteria

As a summarization, the criteria selected for the strategic supplier evaluation model is categorized into criteria supporting a reactive environmental strategy and criteria supporting a proactive strategy visualized in Table 27.

Table 27 Categorization of environmental criteria in reactive and proactive criteria

Reactive criteria	Proactive criteria
Compliance to environmental regulations and risk material assessment	Potential for environmental cooperation
Location distance	Environmental management system
Environmental waste parameters	
Public disclosure of environmental record	
Second tier supplier environmental evaluation	
Package performance	

7.8.2 Second tier supplier environmental evaluation

Criteria description: Assessment of the supplier's evaluation of second tier supplier's environmental performance, criteria characteristics and to what extent they are evaluated.

Second tier supplier evaluation is argued being the second most important criterion for supplier environmental performance but contradictory difficult to assess (Handfield, Walton, Sroufe, & Melnyk, 2002). Exclusively second tier supplier environmental evaluation is not mentioned as a significantly important criterion during interview with Cederroth representatives, however general second tier supplier evaluation and knowledge is expressed as important. Environmental aspects of that evaluation may not be as highly ranked as the general second tier supplier evaluation but should get attention and is therefore included as an independent criterion in the strategic supplier evaluation model. The task of weighting the criteria against each other is directed to the weighting model. Second tier supplier environmental evaluation is articulated to be important for evaluation of strategic suppliers in the near future, however not conducted today when assessing suppliers (Karlström, 2010). Even though many of Cederroth's strategic suppliers are Nordic or European companies where environmental regulations and restrictions are found to be fairly strict, assuring that they fulfill environmental regulations and proactively engage themselves in reducing their environmental impact is essential for Cederroth to assess and follow up.

The assessment of this criterion should be performed based on if the supplier evaluates the second tier supplier on environmental aspects and if so to what extent. First the question should be articulated whether the supplier evaluates second tier suppliers on environmental criteria and thereafter the characteristics of environmental criteria considered should be assessed and to which extent they are assessed by the supplier.

In the case studies it is established that CMCS has no structured way of evaluating their second tier suppliers' environmental performance though they still care about the issue; hence they are seen as average performers and given score 3. CCS mean that it is not possible to evaluate their suppliers on this criterion why it becomes "Not applicable". The criterion is further believed to be non applicable for all chemical suppliers.

7.8.3 Location distance

Criteria description: Evaluates location distance from supplier to Cederroth's production site or the end market in relative alternative supplier's geographical location. Hence this is not the absolute distance.

Location distance is a new criterion not included in the existing supplier evaluation model. Location of the supplier is twice highlighted during general interviews as an aspect interesting to consider

when selecting strategic suppliers. The criterion has primarily two effects, reduced transportation cost and reduced environmental impact. In this strategic supplier evaluation model the latter effect is the main purpose of assessing location distance and reduced transportation costs seen as a positive bi-affect. Generally, the opposite situation is more common when companies principally focus on costs and the positive environmental effects get realized automatically. Dickson (1966) has selected *Geographical location* as a criterion for supplier selection ranked as number 20 in his early study. Further Weber et al (1991) have addressed the criterion derived from the study by Dickson (1966) when looking at criteria relevant for Just-In-Time-suppliers and they ranked the supplier's geographical location as the fourth most important criterion among 13 criteria in total, which implies the relevance. Currently, Cederroth is running a project concerning Just-In-Time (JIT) which strengthens the selection of this criterion. Kuo et al (2010) present a structure for green supplier selection including a cost category, where transportation cost is one included criterion. As previously discussed, location distance can be found to be strongly correlated to transportation costs.

In the case studies it was further discovered that location distance should be a relative criterion. In the case that the nearest available option is placed for example in Germany, this supplier would achieve a low score if compared to other kinds of suppliers located within Sweden. Also the end market for products supplied by that specific supplier should be taken into consideration. CMCS received score 4 since they are based in Finland and the alternative would be India, the end market is the Nordics. CCS was scored 4 with the same reasoning, they are located in Germany and alternatives are located in Asia or the U.S.

7.8.4 Environmental management systems

Criteria description: Assessment of supplier's environmental policies, goals, action plans, and corrective actions. Evaluation of ISO 14001 certification, EMAS or internal environmental management system should be included in the assessment.

This criterion is suggested to contribute to evaluation of supplier environmental performance. Critics have been formulated that implementing an environmental management system such as ISO 14001 does not automatically guarantee that the supplier actually follows the guidelines, processes and policies stated within (Noci, 1997). On the other hand several authors describe this criterion as a commonly used criterion for evaluating supplier environmental performance (Walton, Handfield, & Melnyk, 1998). Suggestions are made that aspect such as ISO 14001 certification should be considered when assessing environmental performance. In the article by Handfield et al (2002) a ranking is presented showing that ISO 14001 certification as a criterion for supplier environmental performance is the most easily assessed criterion and the sixth most important criterion for supplier evaluation. Implementation of environmental management system can also be interpreted as an indication of top management commitment to environmental management, mentioned as an environmental performance factor by (Wee & Quazi, 2005). Further Jabbour et al (2009) articulate the broader term of environmental management system which would include ISO 14001, EMAS and other internal systems.

This criterion may be difficult to assess on a five point scale. Hence, the criterion could be defined as whether the supplier has been certified according to ISO 14001, EMAS or have applied an internal environmental management system or not and how well the supplier appears to fulfill the guidelines. This can be controlled by requesting documents indicating that actions have been taken in according

to the system used. Environmental policies, mission, visions, goals, action plans and corrective actions should further be assessed to acquire a more complete picture of environmental focus and determination on top management level. It is suggested that internal environmental management systems should be awarded a lower score than a supplier that is certified according to ISO 14001, even though there may be cases when a small supplier using an internal system performs just as good as a larger supplier certified to ISO 14001 regarding environmental aspects. Those cases are however considered to be rare (Karlström, 2010).

This criterion can be found to embrace the aspect of environmental policy that was included in the existing supplier evaluation model, according to the literature review regarding critical factors for effective environmental management performed by (Wee & Quazi, 2005). Wee et al (2005) have in their literature review identified *Top management commitment to environmental management* as one of seven critical factors for environmental management, which significantly strengthen the decision to include this criterion in the supplier evaluation model. The borders between assessing top management commitment and environmental management system was found to be fuzzy though, hence the two aspects were merged and summarized under the criterion *Environmental management system*. Moreover, the criterion takes a long-term, future environmental perspective and not focusing on measuring historical or present environmental performance, which supports the by the literature advocated proactive environmental strategy.

In the case studies it was however found that the actual application of environmental management systems is difficult to assess. CMCS has no official system but have specified goals for how they work with environmental issues. However, since the goals lack of substance they were awarded score 3. The much larger chemical supplier CCS on the other has an extensive officially accepted environmental management system in use but provide no ability to check what their actual goals are; though CCS was appointed score 5. Strive when assessing this criterion should be to assess the way that suppliers actually work with the issue.

7.8.5 Compliance to environmental regulations and risk material assessment

Criteria description: Evaluates how well the supplier follows environmental laws and regulations and to what extent risk materials and hazardous materials are used by the supplier.

A qualitative environmental criterion is *Compliance to environmental regulations and risk material assessment*. It supports both the proactive and reactive environmental strategy assessing the supplier's current environmental performance in terms of compliance to environmental regulations and restrictions and how they work with materials classified as risk materials. The latter aspect supports the proactive strategy by having a future perspective while compliance to regulations is rather reactive. Min et al (2001) declare in their research that US firms prefer *State environmental regulations* and *Federal environmental regulations* as criteria when selecting suppliers and just like Walton et al (1998), they identify a tendency towards applying a reactive environmental strategy in practice among firms. Handfield et al (2002) discuss violation against government regulations as aspects worth considering when evaluating suppliers on environmental criteria.

Risk material assessment is referred to during general interviews and workshops. There are materials not listed as hazardous, however in the risk zone for being listed or considered as unfavorable due to environmental and ethical aspects. Continuous efforts trying to reduce the usage of these materials are prioritized by Cederroth and the suppliers' assistance is vital for a successful result. Therefore

evaluating strategic suppliers on to what extent they work with risk materials, plans and actions taken to reduce the usage of risk materials is essential. This aspect of the criterion can be coupled to the supplier's R&D department when it comes to development and innovation of alternative materials.

Since CMCS's production results in less waste and additionally CMCS recycle actively, they are given score 4. The information from CCS in this area was limited, however since it is a large European corporation, the relationship with Cederroth is good and that the mass media would react if CCS was found to not follow regulations, they are regarded as complying to regulations and laws and score 4 was awarded. As discussed, this criterion is difficult to assess in reality and experience from evaluations can be used to improve the criterion.

7.8.6 Energy and waste parameters

Criteria description: Evaluates supplier's performance in regard of energy consumption and relevant waste parameters such as air, water and land emissions.

Waste is heavily discussed in the literature as important to consider when assessing environmental performance. Handfield et al (2002) mention waste management as an environmental performance attribute including solid waste tonnage and disposition of hazardous materials. Resource reduction is discussed in the literature in terms of waste reduction as a factor of process efficiency by Wee et al (2005), while Carter et al (1998), Carter et al (2000), Murphy et al (1995) prefer to converse about resource reduction as an approach for handling environmental issues defined as describing activities to minimize waste to achieve forward and reverse distribution processes that are more efficient than previous. Minimizing waste follows the thinking of lean processes which also focuses on waste minimization, however driven by diverse reasons (Zsididin & Siferd, 2001). Noci (1997) means that quantitative criteria suitable for measuring suppliers' current environmental impact are waste water, air emissions, solid wastes and energy consumption, hence also mentioning waste both expressed as solid waste and waste water.

Since Cederroth's strategic suppliers belong to different supplier categories with significantly different characteristics, some waste parameters may be more suitable for some supplier than others, while energy efficiency can be applied to all kind of suppliers. Jabbour et al (2009) mention the importance of selecting environmental criteria that are suitable for suppliers regardless of industry or size, which is an issue handled by making the criterion definition general but with situation-specific guidelines for how to assess the criterion. The main purpose of the criterion is to assess the supplier's waste management in terms of measuring waste water, energy consumption, air emissions and solid waste for example. Chemicals suppliers may preferably be assessed by measuring their energy consumption or waste water usage while packaging suppliers preferably should be assessed on other parameters such as solid waste and air emissions. As mentioned, the selection of suitable parameter must be determined for every specific supplier evaluation in regard of which supplier that is to be evaluated and the characteristics of its largest environmental impact area considering waste. The criterion assessment should thereafter be conducted due to acquired parameter data indicating how well the supplier handles waste in form of emissions to land, air and water. Information required from the supplier may be found in the environmental report and be public information.

In the case studies the small supplier CMCS was found to show improvements with substance, but since the timeframe was undefined score 4 was assigned. CCS on the other hand presents a defined time frame with the goal to reduce emissions by 20%, but it is found to be rather unclear what this means in reality, why they were given score 3.

7.8.7 Public disclosure of environmental record

Criteria description: Evaluates existence, exhaustiveness and transparency of supplier environmental record.

As the very most important criterion for supplier environmental performance is *Public disclosure of environmental record* considered (Handfield, Walton, Sroufe, & Melnyk, 2002). If the supplier can show a disclosure it is assumed that it is accurate and accepted as a strong proof for environmental awareness. Out of 55 indicators the criterion is listed as one of the ten most easily assessed as well, indicating that the criterion may be relevant to include in the evaluation model being both important and easily assessed, two factors that normally are negatively correlated to each other. None of Cederroth's representatives has mentioned it as one of the most important criteria, though purchasing leader Magnus Andersson expressed a public disclosure being one way to control supplier environmental performance (Andersson, 2010).

Similarly with second tier supplier environmental evaluation, this criterion should be assessed based on degree of fulfillment. First, question is whether there is a public disclosure at all and second how exhaustive and trustworthy the disclosure is assumed to be.

In the case studies CMCS was found not to have any public disclosure why the criterion became non applicable. CCS on the other hand have some extensive material explaining how they work with the environment, but due to the lack of clear environmental record the criterion became non applicable. Since none of the case suppliers have a public disclosure of environmental record it has been impossible to evaluate this criterion. When requesting the information from suppliers, Cederroth should put pressure on them to develop environmental records, why the criterion is suggested to remain in the model.

7.8.8 Potential for environmental cooperation

Criteria description: Assessment of supplier's openness for mutual projects focusing on lowering environmental impact, initiatives, attitude and current status of relationship.

Another criterion suggested by Min et al (2001) is environmental partnership with suppliers. This criterion has been slightly modified into *Potential for environmental cooperation* in the evaluation model since it was found to be of more interest to investigate and highlight the potential and willingness, aiming at making the criterion more suitable for new and potential suppliers as well as for already existing suppliers. The criterion should assess to what extent the supplier has intention for future cooperation regarding environmental projects with Cederroth and how likely an environmental cooperation is. The criterion has a clear proactive environmental approach when taking on a long-term perspective.

The assessment of the criterion should be performed by asking the supplier about their opinions regarding future environmental cooperation and their open-mindedness for mutual projects that would have positive environmental impact. Questions regarding which kind of cooperation and within which areas should further be asked to gather a true picture of the situation. Financial,

organizational and technical aspects should further be considered when they all have significant impact in potential for environmental cooperation.

Today, projects regarding raw material substitution are running together with some of Cederroth's strategic suppliers, strengthening the usefulness of the criterion.

When assessing this criterion in the case studies it was found that the evaluators reasoned according to Cederroth's influence on the supplier. Since Cederroth constitutes CMCS's largest customer they were assigned score 4. CCS was also given score 4 but with the motivation that CCS are open with their environmental activities and efforts taken. Cederroth's power to change CCS's processes is however expected to be limited. Concluding, the relationship and size in relation to the supplier is of great importance for the potential for environmental cooperation.

7.8.9 Package performance

Package performance was highlighted during workshops as relevant to consider when evaluating a supplier on its environmental performance. Environmental impact can be reduced by using environmental-friendly materials instead of materials hazardous to the environment when packing and palleting. Further, by package more effectively the transportation filling degree can be increased. Resulting in reduced transportation costs and reduced environmental impact. Handfield et al (2002) highlight package as one important environmental performing factor while Min et al (1997) articulate biodegradable package as another factor as well as low-density packaging. This further strengthens the idea of evaluating the strategic suppliers on their package performance.

Practically, the criterion will be assessed on what material the supplier use as package regarding if it is recyclable, biodegradable or have to be disposed after being used once and how efficient the package is in regard of space and weight.

Packaging performance is not possible to evaluate CCS on due to the fact that they distribute chemicals and transport them in large bulk trucks. The size or design of the bulks is generally European standards, which eliminates the possibility to evaluate performance of this criterion. CMCS has been awarded with score 3 when they package in stock keeping units as well as apply double palleting. PCS has also achieved score 3 based on that they adopt single palleting at the moment but are working heavily towards double palleting and additionally use corrugated cardboard for packaging.

7.9 Criteria interconnectivity

Criteria for supplier evaluation are not independent from each other but a significant share of the criteria can be seen as correlated, either positively or negatively. Mandal et al (1993) discuss criteria interconnectivity and show that the common criteria price, delivery and after sales-services are highly correlated to each other. They point out that criteria can affect each other and focus should be on selecting a supplier based on underlying criteria such as technical capability and communication convenience instead of based on price, when price is suggested to be dependent on for example technical capability. Interconnectivity between criteria will not be deeply investigated in this study; however criteria correlations are briefly discussed below as well as in the sensitivity analysis, see chapter 10.5. When price is not directly included in the strategic supplier evaluation model proposed, the aspect expressed by Mandal et al (1993) is respected and the issue they reveal is tried to be avoid. After sales-services are further not a criterion relevant for Cederroth to evaluate their

strategic suppliers on, hence the interconnectivity between price, delivery and after sales-service is not a problem in the evaluation model proposed in this study.

Cederroth have earlier repeatedly substituted European suppliers with Swedish suppliers aiming at increasing the degree of local production. This has successfully reduced the transportation cost and also had a positive environmental impact. The aspect can consequently be argued to be integrative between cost and environmental impact. Other positive effects occur in Cederroth's marketing strategy; it reinforces the marketing argument of being a local producer.

Mandal et al (1993) explain that the attitude and willingness to do business is an underlying criterion for supplier development, which is also what that criterion intends to determine possibilities for. A supplier is normally more interested in cooperation if communication is convenient and when the supplier's financial position is stable. In these cases the supplier feels like it can gain on the cooperation and have a positive attitude towards developments initiated by the customer company. The criteria *Responsiveness* and *General attention from supplier* included in the evaluation model proposed can be found to be slightly correlated to each other with support from the discussion above concerning willingness to do business. General attention from supplier is one way of assessing the supplier's focus on Cederroth as a customer and responsiveness is intended to assess the communication between the parties. When responsiveness is good it may be assumed that the business environment between the supplier and Cederroth is improved and the general attention from the supplier is increased.

The criterion Potential for environmental cooperation has been evaluated based on Cederroth's power of influence on the supplier, which is also included in other criteria such as General attention from the supplier and in Responsiveness.

8 Analysis of criteria weighting

After analyzing criteria and criteria categories included in the strategic supplier evaluation model proposed, chapter 8 addresses the weighting of the criteria and the criteria categories. The analysis in this chapter is the basis of step 4 in the model creation introduced in chapter 5.2.3.4, the weights determined in this chapter is then combined with Model 3 to become Model 4. The reader will be introduced to an analysis regarding weighting model selected for the execution of the weighting, weighting scale applied and how responsibilities for executing the weighting have been defined. The chapter will thereafter constitute input to the analysis of the complete model presented in chapter 9.

8.1 Selection of weighting model

The goal with the supplier evaluation model designed in this thesis is that the evaluation of a supplier should be comparable both between different time instances and between different suppliers. To achieve this comparability, it is necessary to evaluate each supplier independently. Aim of the weighting model is therefore to weight criteria with purpose of enabling computation of a summarized value for comparison.

When selecting model for assigning weights to the strategic supplier evaluation criteria it is relevant to make the selection based on the characteristics and structure of the supplier evaluation model and the included criteria. Criteria in model 3 suggested in this thesis have the following characteristics that need to be considered in the selection of weighting model:

- 41 criteria grouped in seven criteria categories
- Mix of quantitative and qualitative criteria

As discussed in chapter 3.6 there are a number of models presented in the literature, all with different characteristic. Ho et al (2010) analyze the difference among combined models and individual models. With respect to the applicability and usefulness at Cederroth an individual model has been selected instead of a combination of two or more models.

When analyzing the approaches presented in 3.6, the DEA method was found to be the most popular approach used between 2000 and 2008 (Ho, Xu, & Dey, 2010). The DEA method is also suggested to have high robustness due to the authors. The second most popular method is mathematical programming, which forces the decision maker to initially state a goal function. Neither the DEA approach nor the mathematical programming can however handle qualitative criteria, why they are not compatible with the characteristics of the supplier evaluation model presented in this study. The AHP model on the other hand is ranked the third most popular approach; it is easy to use, has a high flexibility and can handle both quantitative and qualitative criteria combined. These three characteristics for the AHP model mentioned are highly requested by Cederroth since the model should be easy to use, the suppliers have significantly different characteristics and the model proposed for strategic supplier evaluation consists of both qualitative and quantitative criteria. Ho et al (2010) are not discussing the models proposed in detail, however since the AHP model is ranked as number three as the most popular model for criteria weighting in their study, its quality and usefulness are considered to be high enough for using the model in the weighting procedure in this study.

Noci (1997) also evaluates approaches for weighting of criteria with the purpose of determining which approach can be suitable to apply on weighting of environmental criteria. In the author's study, the AHP method is the only method among the evaluated methods that is capable of handling a combination of qualitative and quantitative criteria. Further the author highlights the fact that all evaluated approaches have low completeness of the assessment procedure, which means that the weights most likely will need to be modified over time. Additionally, the objectivity of the assessment procedure is pointed out to be very high for the AHP method when letting several users weight the criteria, hence the objectivity increases. In this study, some criteria will be weighted by only one person since the number of people with the right competence is limited. For example, there is only Head of Logistics that has the competence requested for weighting logistics criteria. The same applies to the criteria in quality and environment where the quality and environment manager is the single one found to have the competence required for weighting those criteria. For criteria concerning purchasing, general criteria and criteria concerning product development three to four users have been involved in the weighting and therefore the objectivity is found to be higher. It has been discussed to let additional users weight criteria in logistics, quality and environment aiming at increasing the objectivity. However, the risk for decreasing the validity when letting users not having sufficient insight into logistics, quality or environmental aspects weight those criteria were found to be too high.

One disadvantage with the AHP model is that when having many criteria the model becomes exhaustive to run. This is however not a problem in this study since different persons will weight a limited number of criteria each and not letting one single person weight all criteria.

As introduced in 3.6, the foundation of the AHP model is a pairwise comparison of criteria and thereafter the criteria categories are also pairwise weighted against each other. The weightings are thereafter normalized. The purpose of this proceeding is to eliminate the problem that a category consisting of few criteria gets higher weight than a category consisting of many criteria if the categories are not weighted against each other as well as normalized. The existing supplier evaluation model did not pay attention to this issue previously described. Hence, criteria categories such as *Quality* and *Environment* did influence the total score of the supplier performance to a larger extent than criteria concerning costs, logistics or quality since the first mentioned categories did contain more criteria than the other categories.

Even though the AHP-model is mostly used to choose between two or more options, it can also be used to assess weights to criteria in a decision model. In this thesis we will use the AHP-model as proposed in chapter 3.6 applied on the final supplier evaluation model to determine weights to each criteria. The AHP-model will however not be used to pairwise compare suppliers. The main reason for this design is that Cederroth has about 40 suppliers on the strategic supplier list and Cederroth seldom have the need to change suppliers. Hence, focus should be to evaluate existing suppliers.

8.2 Likert scale design

A common scale to use when weighting criteria pairwise is the Likert scale. As described in 3.6.1, a Likert scale can be designed in many different ways, but as concluded by Jacoby & Mattel (1971) the number of response categories does not influence the validity or reliability of the weighting. A small number of response categories are by the authors considered just as good as a larger number of

response categories. In this thesis a 3-point Likert scale is used when making the pairwise comparison of the criteria as well as the criteria categories. The response categories are defined as:

- Criterion 1 are more important than criterion 2 (2)
- Criterion 1 and criterion 2 are equally important (1)
- Criterion 1 are less important than criterion 2 (0)

The categories are awarded with a number (0, 1, 2), identified as the number in brackets above, representing less important, equally important or more important. The subjectivity may increase when having more response categories, since it may be difficult to decide whether a criterion is slightly more important than another criterion or significantly more important, hence in this study it is only taken under consideration if the criterion is more important or not and not important to what extent. The reason for not having many response categories in the Likert scale when weighting the criteria is further due to the easiness requested using the supplier evaluation model. As stated by Noci (1997) the weights will likely need to be modified over time, hence this weighting procedure will take place in the future as well and due to these repetitions a weighting model easy to use will be significantly advantageous.

8.3 Weighting responsibility

The aim with the weighting is to achieve high objectivity and to consider opinions from all parties involved in the supplier evaluation, which would be quite a large number of employees at Cederroth. To involve everyone is however not feasible due to limitations in time and resources. More importantly, if involving everybody's opinion it is not possible to take Cederroth's general business strategy into consideration or to make a purchasing decision based on facts only available to few employees. As mentioned previously, the weighting procedure is split into two parts; pairwise weighting of the criteria within each criteria category and thereafter pairwise weighting of the criteria categories. The initial weighting of the criteria within each criteria category was performed by managers for each category, for some categories by a number of persons whose weighting results were merged into one weighting result and for other categories weighted by simply one person.

Due to significant differences in characteristics between supplier categories such as contract manufacturers, chemicals suppliers and packaging suppliers the weighting for the criteria within the criteria categories were executed by several persons representing the different divisions' departments. To get a comprehensive picture of the weighting for e.g. the product development criteria all R&D departments have been involved in the weighting of the criteria within the category. The same thing applies to the *General*, *Production* and *Purchasing* criteria category. To consider Cederroth's overall business strategy, Purchasing Manager Magnus Andersson was performing the weighting of the criteria categories against each other. He was found to hold the most comprehensive view of the strategic supplier evaluation and Cederroth's general business strategy.

For some criteria categories several representatives were found appropriate to conduct the weighting. Representatives from diverse business units such as Wound Care, Health Care and Packaging, performed the weighting jointly in group. This procedure was applied on the criteria categories *General*, *Production* and *Purchasing*. Concerning the criteria category *Product development*, several representatives were identified as appropriate for conducting the criteria weighting. However, these representatives were located at different sites and therefore it was not

possible perform the criteria weighting jointly. Instead, the representatives weighted the criteria individually and the average weight for each criterion was accepted as a weight and that could replace a weight derived from a jointly performed weighting. A visualization of the representatives responsible for conducting the weighting is presented below in Table 28.

Table 28 Criteria weighting responsibilities

Criteria category	Weighted by	Weighting performed jointly/individually
General	Mira Ludkiewicz (Senior Buyer) Monica Engström (Senior Buyer) Conny Åslund (Senior Buyer) Magnus Andersson (Purchasing Manager)	Jointly
Production	Mira Ludkiewicz (Senior Buyer) Monica Engström (Senior Buyer) Conny Åslund (Senior Buyer) Magnus Andersson (Purchasing Manager)	Jointly
Quality	Jan Karlström (Head Quality Assurance)	Individually
Logistics	Mats Björkqvist (Head of Logistics)	Individually
Product development	Stefan Snell (Product and Process Development) Åsa Knutsson (Nordic R&D Manager – Health and Weight) Yvonne Törnevik (International R&D Director Wound Care Division)	Individually (Average weight used)
Purchasing	Mira Ludkiewicz (Senior Buyer) Monica Engström (Senior Buyer) Conny Åslund (Senior Buyer) Magnus Andersson (Purchasing Manager)	Jointly
Environment	Jan Karlström (Head Quality Assurance)	Individually

The proceeding of the weighting performed individually was practically performed by sending out a matrix questionnaire to the selected representatives. The representatives performed a pairwise comparison of the criteria deciding whether the criteria were equally important, one criterion more important than the other or less important by awarding the cells in the matrix with zero for less important, one for equally important and two for more important. The questionnaires sent out are to be found in Appendix F. The questionnaires were thereafter returned with completed weights. The weight for each criterion was summarized and normalized. This procedure was also applied for the weighting of the criteria categories. When the weighting of the criteria was performed in group, the representatives concerned were gathered in a workshop where the weighting of each criterion was discussed in the group and thereafter for each criterion it was agreed upon if the criterion was more, less or equally important as the criterion compared to and respectively cells in the matrix were marked with two, zero or one. For the criteria category *Product development*, the representatives were not possible to gather in a workshop, hence the representatives filled out the matrix on their own and an average weight for each criterion was calculated.

When integrating the criteria weights in the strategic supplier evaluation model, the weights were normalized to achieve a total sum of one. Hence the weights were divided by the total number of

criteria included in the criteria category. As previously mentioned, when applying the model on new potential strategic suppliers, some criteria are “Not applicable”. These will be temporarily eliminated from the model in such cases. When calculating the normalized weights for criteria within a criteria category where one or more criteria are eliminated due to their inapplicability, the weight for the criterion “Not applicable” is divided by the number of criteria applicable. Thereafter, the weights of the criteria applicable are added with the value of the weight of the criterion “Not applicable” divided by the number of applicable criteria. If a criterion is inapplicable, its weight is changed to zero and other criteria’s weights are recalculated by dividing the weights of applicable criteria with the original number of criteria within the criteria category, including both applicable and inapplicable criteria. The normalized weights of the criteria categories are calculated by dividing the weights with the total number of criteria categories; hence the sum of the normalized weights of the criteria categories is one as well as the sum of the normalized weights within each criteria category. The normalization procedure is conducted according to the AHP-model applied for the weighting.

8.4 Weighting results

The result of the weighting of the criteria and the criteria categories are presented below in Table 29. As can be seen, *General* has been awarded with a relative high weight, 0,29, in comparison to the other categories which have weights between 0,02 and 0,19. This category is considered to be highly important by Purchasing Manager Magnus Andersson, which has performed the weighting of the criteria categories. However, this relative large difference may have large influence on the total supplier performance score. Suppliers awarded low scores for the criteria included in the criteria category *General* will directly achieve a significantly lower total score than other suppliers. This weighting result is suggested to be reviewed and evaluated when the strategic supplier evaluation model has been in use for a certain period and more than three strategic suppliers, as in this study, have been evaluated with the model. Then the total scores of the strategic suppliers evaluated should be analyzed to see if the high weight of this criteria category has too large impact on the total score of the suppliers and if the weight should be adjusted. The criteria category *Production* on the other hand has been awarded a low weight of 0,02. This is nevertheless assumed to correspond well to the importance of production-related criteria since they are considered less important both by the literature and by Cederroth, which has been derived from interviews and workshops. Product development criteria are considered as more important than environmental aspects, logistics aspects, purchasing aspects and quality aspects, which also corresponds well foremost to the attitude and focus of Cederroth but also has support on the literature as well. Positive is the fact that environmental aspects have been given much attention by awarding the category weight 0,14, conclusively higher than three other categories and which the same importance as the criteria category *Quality*. This result underlines the identified need for an improved environmental focus when evaluating strategic suppliers and the priority within Cederroth environmental aspects have been given. The criteria category *Purchasing* has been given weight 0,12, slightly higher than the weight awarded to the criteria category *Logistics*.

Concerning the criteria included in the criteria categories *General* and *Production*, all criteria have been awarded with equal weights within each category. Especially for criteria included in the category *General*, this is suggested to be a sound weighting result since the criteria themselves are considered to assess nearby aspects. Criteria included in the category *Quality* are weighted with larger spread than criteria included in previously mentioned criteria categories. *Quality management system* and *Responsiveness* are weighted with significantly low scores compared to the other criteria.

Most important are *Traceability*, *General product safety risk* and *In process control/inspection*, however the difference between the weights for remaining criteria is not major. Within the criteria category *Logistics*, the weights of the criteria differ. The criterion *Responsiveness* is given weight 0,02, which corresponds to the weight awarded to the same criterion concerning quality. *IT-maturity* has also been given weight 0,02, why this is not a central criterion which additionally seldom is mentioned in the literature. Cederroth should take notice to the criterion when evaluating their strategic suppliers, however it should not have a prioritized role. *Hirate – Quality* and *Hirate – Time* are the two criteria with highest weights, 0,26 each. This is suggested to be a sound result since these two criteria are measurable and give objective directives on how the supplier performs on these aspects. Further information for assessing the criteria can easily be derived from Cederroth's data base. Regarding criteria included in the category *Product development* the spread between weights are fairly equal. Only small differences are noticed. Most important is the criterion *Product documentation* considered to be with weight 0,27. The awarded weight is not surprising since the importance of product documentation has been highlighted during several interviews as well as during workshops. More distinct variations in weights are noticed in the criteria category *Purchasing*. The weight for the criterion *Responsiveness* is in this category 0,24, a large difference from the weight awarded the same criterion in the categories *Quality* and *Logistics*. Reason may be that generally purchasing department is taking care of most of the contact with the supplier and quality respectively logistics department do not contact the supplier as frequently as purchasing department does. Hence, responsiveness should be weighted as more important concerning direct purchasing issues than quality or logistics issues. In many case purchasing department handles the communication when it concerns quality or logistics issues as well. *Capacity for increased demand* has been given weight 0,26 and is the highest weighted criterion in this category. The criterion is highlighted as important in the literature review as well as pointed out by Cederroth and has been an actual problem in some cases before with strategic suppliers. *Knowledge about second tier suppliers* and *Cost structure* are criteria with lowest weights, each awarded 0,04. Transparency in cost structure can be considered to be controversial to a certain extent, because when Cederroth choose to focus on price the suppliers are generally not willing to share their cost structure with Cederroth. Hence it is appropriate that this criterion has been given a fairly low weight. Differences of criteria weights within the criteria category *Environment* are obvious. *Compliance to environmental regulations and risk material assessment* and *Package performance* have been given the highest weights, 0,23 each, which are considered to be sound weights in order to literature studied and Cederroth's attitude. The criteria achieving the lowest weights are *Second tier supplier environmental evaluation* and *Location distance*. Location distance of the suppliers is of interest with respect to the environmental impact deliveries from long distance is causing, however Cederroth have pointed out that it should be assessed based on alternative locations available, which significantly reduces the possibility to use the criterion as a direct application for supplier developments. On the other hand it is usable when selecting a new strategic supplier.

Table 29 Weighting result

Criteria category	Criteria	Weight
General		0,29
	Uniqueness	0,50
	General attention from supplier	0,50
Production		0,02
	Condition facilities/equipment	0,33
	Tidiness in production facilities	0,33
	Production-technical competence	0,33
Quality		0,14
	Total value of complaints	0,14
	Total value of rejections	0,16
	Responsiveness	0,05
	Traceability	0,18
	Complaints management system	0,07
	Quality management system	0,04
	General product safety risk	0,18
	In process control/inspection	0,18
Logistics		0,10
	Responsiveness	0,02
	Accuracy in logistics data	0,14
	Hirate - Quantity	0,26
	Hirate - Time	0,26
	Lead time reduction	0,14
	Short term flexibility in order volume	0,14
	IT-maturity	0,02
Product development		0,19
	Product documentation	0,27
	Responsiveness	0,13
	R&D competence	0,20
	Technical support	0,20
	Product portfolio/Innovation	0,10
	Product development process	0,10
Purchasing		0,12
	Responsiveness	0,24
	Cost reducing initiatives	0,12
	Supply chain risk assessment	0,21
	Investment plans and future visions	0,10
	Capacity for increased demand	0,26
	Knowledge about second tier suppliers	0,04
	Cost structure	0,04
Environment		0,14
	Second tier supplier environmental evaluation	0,04
	Location distance	0,05
	Environmental management systems	0,07
	Compliance to environmental regulations and risk material assessment	0,23
	Energy and waste parameters	0,14
	Public disclosure of environmental record	0,14
	Potential for environmental cooperation	0,09
	Package performance	0,23

9 Analysis of supplier evaluation

In this chapter the strategic supplier evaluation model is analyzed in regard of its applicability. Case studies have been performed on three strategic suppliers to test the performance of the model, consisting of criteria and criteria categories analyzed in chapter 7 and with weights defined in chapter 8. Initially, the proceeding of supplier information collection is described, followed by a discussion about supplier rating including scoring and ranking. An analysis of the case studies performed wraps up the chapter.

9.1 Supplier information collection

As discussed by Gordon (2005) in chapter 3.7, the method for supplier information collection that will constitute input to the evaluation model should be carefully considered (Gordon, 2005). Since the author recommends a mix of the methods proposed in the article, Cederroth is recommended to try to gather information by using a combination of these methods. Today, audits are regularly executed at supplier sites, which are good information sources for the supplier evaluation. These site visits can contribute with much information to the evaluation of the criteria included in the supplier evaluation model. Especially criteria categories such as production criteria will mainly be evaluated based on information and impressions acquired during supplier site visits and audits. Using paper questionnaires for information gathering is not easily applied due to the complexity in constructing a sound questionnaire. Therefore, Cederroth should try to gather the information normally acquired through questionnaires by telephone or personal interviews instead, when questions then can be explained immediately and misinterpretations can be avoided. Additionally, by applying this kind of interviews, immediate response is assured, sending out paper questionnaires does not guarantee answers within the given deadline. Web based questionnaires are not considered as suitable for Cederroth to apply, since it requires resources and competence to develop. It should however be considered as a long-term method for information gathering, but not applied instantly on short-term. The proposed strategic supplier evaluation model should initially be implemented and tested for a longer period of time to assure its applicability and usefulness for Cederroth, and accordingly improvements should be performed when necessary. First then, analysis whether it is economically defendable to implement web based questionnaires or not should be conducted. The other three methods for information collection mentioned by Gordon (2005) are all found to be suitable for Cederroth. Extractions from current systems do not require much extra resources when internal data systems are referred to. Logistics criteria and quality criteria in the supplier evaluation model proposed in this study do require information that easily can be extracted from Cederroth's internal data systems. Therefore, a potential problem such as data integrity issues with the supplier is not assumed to be significant, neither formatting issues will be present. Since most of the criteria included in the supplier evaluation model are qualitative criteria characterized by intangible factors, data extractions from supplier systems are not considered to be relevant. Soft criteria such as competence, attitude and responsiveness will not be evaluated based on tangible metrics and numerical data but rather based on impressions and general feelings. Site visits are already mentioned as a method applicable for Cederroth to gather information and certification to third-party standards is also suggested to be a useful method for gathering information that will constitute the foundation for supplier evaluation. However, as previously discussed by Noci (1997), certification does not guarantee that the supplier deploys best practice and should moreover be seen as a

documentation performance instead of the actual supplier performance of the criterion *Environmental management system* that initially is intended to be measured.

In Table 30 the methods for supplier information collection suggested to be suitable for Cederroth are summarized and presented.

Table 30 Supplier information collection methods recommended for Cederroth

Method	Description
<i>Supplier visits</i>	Information gathering through audits and supplier visits.
<i>Interviews</i>	Interviews performed personally, per e-mail or telephone.
<i>Extracts from current systems</i>	Data extractions from Cederroth's internal data systems.
<i>Certification to third-party standards</i>	Information acquired by certification documents.

9.2 Supplier rating

A method for rating the suppliers according to the defined criteria in the strategic supplier evaluation model has been selected based on theory regarding scales and rating methods as well as ranking methods applied by other organizations when evaluating their suppliers. Aim with supplier rating is at ranking the suppliers to clearly visualize which suppliers that fulfill the requirements and which not and to what extent. The rating process is split into two parts, scoring and ranking. The scoring process constitutes the foundation for the ranking process, where the suppliers are categorized into classes depending on total score achieved.

9.2.1 Scoring

As described in chapter 5.2.3.4, the scoring of the strategic suppliers will be conducted by awarding the supplier with a score depending on their performance of each criterion. As the literature review reveals, there are numerous ways of how to design a rating scale suitable for supplier scoring. Saaty (2004) declares that measurements can be either qualitative or quantitative, where qualitative criteria can be measured based on experiences or based on data information (Saaty, 2004). This theory corresponds well to the strategic supplier evaluation recommended for Cederroth in this study, where the supplier evaluation model includes both experience-based criteria and fact-based criteria.

Even though the strategic supplier evaluation model proposed contains both experience-based qualitative criteria and fact-based qualitative criteria, it is suggested to handle all qualitative criteria as experience-based. That is because Cederroth's supplier base is fairly broad due to diverse supplier characteristics and consists of suppliers diversified in size, collaboration level, industry etc. Otherwise the definition of each fact-based qualitative criterion would need to consider several exceptions to be able to be applicable on suppliers of different characteristics, and the model would become significantly heavy to run and comparison among suppliers would not be possible.

As discussed in chapter 3.8.1 a scale can be defined to include different amounts of points available for scoring. Dawes (2008) analyzed the difference in result between some common amounts of scoring points on a scale and concluded that a 5-point scale is a scale with high validity and robustness without being too detailed (Dawes, 2008). A 5-point scale was used in Cederroth's existing supplier evaluation model, hence there can be expected that the users already have a grasp about how to use a 5-point scale when awarding scores to suppliers. The 5-point scale in the strategic supplier evaluation model proposed in this study is defined as:

1. Poor
2. Not sufficient
3. Satisfactory
4. Good
5. Excellent

Definitions of the scores are made so that confusion and difficulties can be avoided. Instead of selecting definitions such as “good” and “very good”, “excellent” is selected to describe the highest score when it may be difficult to decide whether a supplier performs “good” or “very good” since they are more similarly interpreted than “good” and “excellent”. “Satisfactory” can be interpreted as a neutral score when the supplier performs sufficient, however does not exceed expectations. “Not sufficient” is to be interpreted as a minor performance failure but not as bad as “poor”.

The score of each criterion will be multiplied with the normalized weight for the criterion concerned and following all scores multiplied with the normalized weights respectively will be summarized and multiplied with the criteria category weight, which will result in a total score for the criteria category. Finally, total scores for all criteria categories are summarized and consequence in a total score of supplier performance. The maximum total score that is possible for a supplier to achieve is 5 since the criteria and criteria categories are normalized, hence the lowest possible total score to get is 1.

9.2.2 Ranking

As the literature reveals, it is of significant importance to rank the suppliers evaluated according to their total performance (Lasch & Janker, 2005)(Bayer AG, 2010) . Scoring models are proposed suitable for supplier classification and further they constitute qualitative models, which is a necessity for ranking the suppliers evaluated by the evaluation model proposed in this study. The ranking aims at highlighting suppliers with insufficient performance so that actions can be taken to improve their performance as well as suppliers with such poor performance so that their existence in the supplier base should be questioned. Also suppliers with good or excellent performance can be identified by the ranking from which can be learned and Cederroth may be able to improve its own processes through these suppliers. These high-performing suppliers could further be developed into becoming close strategic suppliers to Cederroth and in a long-term perspective partners. The supplier classification discussed by (Lasch & Janker, 2005) is to be interpreted as a variant of supplier ranking since it is based on results from the strategic supplier evaluation.

When defining how to rank the suppliers according to their performance, Bayer AG has been used as a role model, when the global player within the chemicals industry has proceeded far in supplier relationship management and put large weight on supplier management. The company also applies a cross-functional and collaborative approach when selecting, evaluating and developing suppliers, according to the approach recommended for Cederroth in relation to the strategic supplier evaluation model proposed. The ranking of the suppliers within Bayer AG is performed based on quantitative results between 0 and 100, where four classes of suppliers correlated to what score the supplier has reached has been identified. The highest class, the supreme class, contains suppliers that scores over 90 points on a 100 point-scale, the second class named standard class are suppliers scoring between 70 and 90, the third class which is the poor class are suppliers scoring between 50 and 70 and finally bad-performing suppliers are those with a total score lower than 50 and are defined as desourced. (Bayer AG, 2010)

Based on Bayer's system for supplier ranking, a similar structure has been set up for Cederroth. Since the maximum total score in the strategic supplier evaluation model proposed is 5,00, a percental classification is defined based on Bayer's classification system. The supreme class constitutes a percental score of 10 %, the standard class and the poor class 20 % and the desourced class 50 %, which is visualized in Table 31.

Table 31 Bayer AG supplier classification with corresponding percental score

Classification	Score (0-100)	Percent of total score
Supreme	> 90	10%
Standard	70 < 90	20%
Poor	50 < 70	20%
Desourced	< 50	50%

Translated to the scoring scale presented in the evaluation model for this study, following classification is defined and can be seen below in Table 32. Suppliers with a total score over 4,60 will be positioned in the supreme class, supplier with a total score between 3,80 and 4,60 will be categorized into the standard class, a total score between 3,00 and 3,80 places the supplier in the poor class and supplier with a total score that falls below 3,00 are to be categorized as desourced.

Table 32 Supplier classification for the evaluation model proposed in this study

Classification	Score (1-5)	Percent of total score
Supreme	> 4,60	10%
Standard	3,80 < 4,60	20%
Poor	3,00 < 3,80	20%
Desourced	< 3,00	50%

Suppliers that are to be found in the supreme class should be considered as preferred partners for more intense strategic relationships, standard suppliers should be developed to reach the highest class since at the moment they only fulfill standards and poor suppliers need special attention and support to lift them over to the standard class and are characterized by having many potential improvement areas. Just like Bayer AG treats its suppliers that are classified as desourced, Cederroth should review their relationships with suppliers that fall into the desourced class and suppliers with such a low performance should not be considered as long-term or strategic suppliers.

9.3 Case studies

The final phase defined in the study is to run the strategic supplier evaluation model on Cederroth's strategic suppliers to prove its applicability. The selection of exclusively three of Cederroth's strategic suppliers was mainly based on the limitation of time in this investigation. The case suppliers, CCS, CMCS and PCS, were selected with respect to level of current supplier cooperation with Cederroth and supplier relationship status. The selection has been made in correspondence with the three main strategic supplier categories; chemicals suppliers, contract manufacturers and packaging suppliers. CCS is a strategic chemicals supplier, CMCS is a strategic contract manufacturer and PCS is a strategic packaging supplier of Cederroth. These supplier categories are showing diverse characteristics and therefore it was found to be relevant to try the model proposed in this study on all three categories to gain a comprehensive view of the model performance.

To evaluate the suppliers, information about their performance was required. Main purpose of this step of the model creation was primarily to test the evaluation model and not to evaluate the information acquired. Guidelines for ranking the suppliers evaluated by the model will further be given. A simplification made was consequently to use information about the supplier performance already accessible, in other terms historical information about the supplier performance that had been used as foundation for previous supplier evaluations. The simplification was motivated by the fact that the case studies aim at evaluating the criteria included, not the actual supplier performance. Since the strategic supplier evaluation model assesses some aspects of a supplier's performance that has not been evaluated before, a request for some additional information was identified. Hence, a questionnaire was compiled and sent to the strategic supplier selected for the testing of the model to gather the information missing, primarily information concerning environmental issues, see Appendix F.

At present, a supplier evaluation is performed as articulated in chapter 2.5.3, where representatives from functions involved in supplier management assemble to perform the evaluation jointly. Due to the difficulty in arranging such meetings, when representatives are located both in Upplands Väsby and in Falun, the evaluations in the case studies were performed with each representative separately; the details are accounted for below in Table 33. The categories *General*, *Production*, *Logistics* and *Purchasing* were however performed during a workshop in Upplands Väsby; hence it was possible to include Purchasing Manager Magnus Andersson with respective Senior Buyer when performing the evaluation.

Table 33 Scheme of Cederroth representatives evaluating the case suppliers

Criteria category	CCS	CMCS	PCS
General	Conny Åslund and Magnus Andersson	Mira Ludkiewicz and Magnus Andersson	Monica Engström and Magnus Andersson
Production	"Not applicable" when CCS is a distributor	Mira Ludkiewicz and Magnus Andersson	Monica Engström and Magnus Andersson
Quality	Conny Åslund	Mira Ludkiewicz	Monica Engström
Logistics	Conny Åslund and Magnus Andersson	Mira Ludkiewicz and Magnus Andersson	Monica Engström and Magnus Andersson
Product development	Stefan Snell	Marie Bjurman	Monica Engström
Purchasing	Conny Åslund and Magnus Andersson	Mira Ludkiewicz and Magnus Andersson	Monica Engström and Magnus Andersson
Environmental	Jan Karlström	Jan Karlström	"Not applicable" due to information missing

When performing these case studies, a mix between evaluations executed in team and individually has been used, primarily due to difficulties gathering the evaluation team as previously mentioned. Recommended is however that the evaluation is performed jointly so that scoring motivations can be discussed and misunderstandings prevented. Even though a person may not be head responsible for a certain criteria category, he or she may contribute with important input for the scoring of criteria.

Comparing motivations to scores awarded, different evaluators appear to have awarded different scores even though the actual performance of the supplier is described similarly. Explanation is partly that different evaluators may put different meanings into the description itself and partly because the score that a certain performance should correspond to is subjective. This can be handled by

sharing experience between evaluators. The case studies also highlight the fact that some criteria were evaluated on different information than the information intended by the criteria description. This may be a consequence of that the case study constituted the first time the evaluators evaluated some of the criteria, who had not paid enough attention to what the criteria intended to assess in detail.

Conclusively, the performance of the suppliers due to their achieved total scores when being evaluated according to the strategic supplier evaluation model proposed in this study corresponds well to the general apprehension of the suppliers' performance in practice, supported by Cederroth representatives. CMCS is considered to be performing well while PCS have obvious problems with maintaining high quality and CCS are not showing cost reducing initiatives and offer transparency in cost structure, facts that are supported by the evaluation model. Hence the result of the classification is considered as sound, classifying CMCS into the standard class and PCS and CCS into the poor class.

A summarization of the total scores of the case suppliers is presented below in Table 34.

Table 34 Summarization of case suppliers' total score

	CCS	CMCS	PCS
Total score	3,62	4,26	3,80
Supplier ranking	Poor class	Standard class	Poor class
Percental fulfillment of total score per category			
General	50%	90%	80%
Production	Not applicable	60%	100%
Quality	95%	89%	73%
Logistics	85%	93%	77%
Product development	86%	91%	80%
Purchasing	73%	84%	77%
Environment	67%	65%	60%

Evaluation of the criteria in the category *Environment* has been performed based on the responses from sending out a questionnaire to the case suppliers, see Appendix G and Appendix H. The responses from the case suppliers varied. CCS, being a large chemical supplier chose not to answer the questions directly but rather to attach extensive documentation about their environment activities consisting of a hundred pages including certification documents. To assess CCS's performance of the environmental criteria in the model, the material achieved was briefly reviewed and a good overview of the performance was acquired. The material did however not include any information about CCS's public disclosure of environmental record. Generally, large companies are used to being asked about their environmental activities and impact, hence they may be more likely to provide such information when requested. Especially the chemicals industry is strictly regulated due to environmental aspects, including the documentation. Therefore responses from large suppliers within industries with strict environmental regulations may respond more quickly to these kinds of requests. On the other hand, CMCS being a fairly small contract manufacturer, replied

directly and detailed on each of the questions stated but attachments asked for to strengthen the information were not achieved, however the information was extensive enough to evaluate CMCS on. A conclusion can be drawn that CMCS put effort in compiling the information requested because of the good relationship with Cederroth and their apprehension of Cederroth being an important customer. Considering the exhaustiveness of the information provided by CMCS, it can be assumed that considering Cederroth as an important customer is more or less a prerequisite for providing environmental information requested. PCS was reminded about the questionnaire several times, though did not provide the information requested. The lack of answer can be interpreted as a result based on several reasons; lack of time to contribute to this study, lack of interest in environmental issues or lack of time for other reasons.

Conclusively, the method selected for gathering environmental information turned out to be successful in two out of three cases.

9.3.1 Chemical case supplier

In the case study of CCS criteria were evaluated by the evaluators presented in Table 33. Some criteria were however “Not applicable” for CCS, mainly in order to that chemicals suppliers of Cederroth are distributors, and so is CCS. “Not applicable” criteria were all three criteria in the criteria category *Production*, the criteria *General product safety risk* and *In process control/inspection* in the criteria category *Quality*, *Investment plans and future visions* and *Knowledge about second tier suppliers* included in criteria category *Purchasing* as well as criteria *Second tier supplier environmental evaluation* and *Package performance* in the criteria category *Environment*. It is difficult to draw specific conclusions about which criteria are exclusively “Not applicable” for CCS and which are “Not applicable” for chemicals suppliers in general since no other chemical suppliers have been evaluated. According to Senior Buyer Conny Åslund, none of the criteria in the criteria category *Production* or the criteria *General product safety risk* or *In process control/inspection* are applicable for chemical suppliers in order to them being distributors. The criterion *Investment plans and future visions* was considered to be “Not applicable” because of the supplier’s large-size investments, which were found to be not directly beneficial for Cederroth. Investments in a small supplier company could be easier to determine advantages for Cederroth of, since Cederroth then may have significant impact on the supplier’s production and processes. However, for such a global supplier as CCS, Cederroth is a small customer which cannot directly benefit from the global supplier’s investments. Since there is confidential information regarding second tier supplier in the chemical industry, evaluation of the criterion concerning second tier supplier was not possible to conduct. Chemicals purchased from CCS are delivered in large containers on European standard bulk trucks, hence evaluating *Package performance* was not found to be relevant. The total score of 3,62 places CCS in the poor class. During previous interviews Senior Buyer Conny Åslund has given indications that CCS is performing fairly good, which does not entirely accurately correspond with the score and classification achieved. The somewhat low score compared to the apprehension of the supplier’s performance is mainly due to awarding the lowest score to some criteria concerning cost structure and cost reducing initiatives as well as uniqueness and public disclosure of environmental record. When reviewing the individual scores of each criterion awarded to CCS, categories with largest potential for improvements are the criteria categories *General*, *Environment* and *Purchasing*. Regarding the criteria category first mentioned, general attention is assessed to be good respectively uniqueness assessed as low, nevertheless improving uniqueness is not a feasible suggestion since it is not a prerequisite for chemicals suppliers, which delivers products to Cederroth mainly being

commodities. In the criteria category *Environment* CCS would receive higher scores if a public disclosure of environmental record was available. In criteria category *Purchasing* the criteria *Cost reducing initiatives* and *Cost structure* have high potential for improvements. Achieving a score only 50% of the maximum score for the criteria category *General* is a result of only two criteria included in the category where one is awarded score 1 due to lack of uniqueness. The applicability of the criterion *Uniqueness* can be questioned for chemicals suppliers since they mainly are distributors and deliver commodity products with less uniqueness, hence the suppliers themselves are found to have low uniqueness. On the other hand, the weight awarded to the criteria category *General* can be questioned. The category has been awarded with weight 0,29, which is high in comparison to the weights of the other categories which are between 0,02 and 0,19, resulting in that *Uniqueness* and *General attention from supplier* impact the total score of the supplier performance significantly. If chemicals suppliers tend to get low total score in general due to constantly being evaluated with low scores from the criterion *Uniqueness*, the weighting of the criteria category *General* should be reviewed for this supplier category or the criterion *Uniqueness* should be assessed as “Not applicable”.

9.3.2 Contract manufacturer case supplier

In the case study of CMCS the criterion *Product development process* was considered “Not applicable” since Cederroth develops products bought from CMCS together with other suppliers, hence their insight in CMCS’s product development process is too limited for being evaluated. CMCS is a contract manufacturer having limited product development project running jointly with Cederroth. Consequently, little experience regarding their product development processes and competence of product development is present at Cederroth which implies that other criteria in the category have been evaluated based on general impressions and information provided by CMCS. In the strategic supplier evaluation model CMCS received a total score of 4.26, consequently being classified as standard supplier. Senior Buyer Mira Ludkiewicz and Purchasing Manager Magnus Andersson imply that the relation with CMCS is very good, which can be seen as an indication that the total score achieved in the evaluation is sound and that the classification mirrors the situation. Analyzing individual scores, the criteria categories *Production*, *Environment* and *Purchasing* are those achieving low scores. In the criteria category *Environment* the criteria *Public disclosure of environmental record*, *Package performance* and *Second tier supplier environmental evaluation* are criteria with low scores respectively *Knowledge about second tier suppliers* in the purchasing criteria category.

9.3.3 Packaging case supplier

PCS could not be evaluated completely on all criteria categories since the supplier did not provide information needed for evaluation regarding environmental issues. Therefore the environmental criteria have not been evaluated, which affects the total score of the category. The only environmental criterion that could be evaluated despite of information not provided by PCS was *Packaging performance*. Hence, one criterion represents the entire criteria category. Additionally Senior Buyer Monica Engström performed the evaluation of the criteria category *Product development* since representatives from R&D Packaging could not attend the evaluation, which may affect the scoring of the criteria included in this category since the evaluator may lack some detailed information relevant for evaluating PCS on product development criteria. Consequently the total score of the supplier may have been affected due to this fact but to which extent is difficult to assess. Conclusively, total score of PCS is 3.80, placing PCS in the poor class. The three criteria categories with poor performance are *Quality*, *Logistics* and *Purchasing*, *Logistics* and *Purchasing* on 77% of the

criteria category's maximum score and *Quality* on 73% of maximum category score. The result indicates bad performance regarding quality as well as improvement actions should be taken for criteria included in *Logistics* and *Purchasing*. The criteria category *Environment* cannot be properly analyzed since evaluating results are missing for almost all criteria, however low score for the criterion *Packaging performance* implies that focus also should be on improving the packaging to minimize environmental impact. Regarding quality issues focus should be on improving the performance concerning complaints, rejections and responsiveness. Concerning logistics the criterion *Short term flexibility in order volume* shows potential for improvements and within purchasing the criteria *Cost reducing initiatives* and *Cost structure* received low scores, hence should be addressed in supplier development.

10 Conclusions and recommendations

The last chapter of the study assures the reader that the purpose of the study presented in chapter 1.2 has been fulfilled and that the questions stated in chapter 4.6 have been answered. Following recommendations to Cederroth on how to use the model are presented as well as suggestions for future actions. A sensitivity analysis is performed to describe how the strategic supplier evaluation model reacts to different inputs. Finally, the authors of the study discuss delimitations and priorities made and additionally the generalness of the study and its theoretical contribution is addressed.

10.1 Purpose fulfillment

In the following the purpose of the investigation will be answered by merging the partial results from each part of the study into one final result. The purpose presented in chapter 1.2 follows:

“This study aims at presenting a strategic supplier evaluation model that can assist Cederroth in strategic supplier selection and give indications on potential areas for strategic supplier development. The evaluation model aims at assessing supplier performance also including environmental aspects.”

The model presented as a result of the study will rate the strategic suppliers by scoring and ranking them according to their overall performance. This proceeding will contribute to the fulfillment of the assistance of the model in strategic supplier selection concerning new potential strategic suppliers. The scoring and ranking will further consequence in giving indications for strategic supplier development concerning existing strategic suppliers when the overall supplier score can be broken down into supplier performance scores for each criteria category, highlighting potential improvement areas. The environmental criteria will assist with an increased focus on assessing supplier environmental performance and can be a basis highlighting areas for improvement and development in supplier related environmental actions, a wish clearly articulated by Cederroth.

The analysis and conclusions on criteria category level and criteria level covering criteria category selection, criteria selection, criteria definition and criteria description are accounted for in chapter 7, where a total analysis is performed. The analysis of each criteria category and criteria follows the pattern described in chapter 5.2.3. First draft was developed with basis in the mapping and analysis of current stand presented in chapter 6 consisting of interviews with Cederroth representatives, existing supplier evaluation model and the literature review found in chapter 3. The draft was developed in iteration through workshops with representatives from Cederroth. Thereafter another iteration with further interviews added criteria descriptions. Following the weighing was performed. Result of the criteria weighting is illustrated in chapter 8.4. The result is derived from the analysis of weighting model, weighting scale and weighting procedure. Finally, the case studies performed in Step 5 of the method, see chapter 5.2.3.5, have been added to the analysis in chapter 9.

The questions defined as the outcome of the specification of the task, presented in chapter 4.6, are indirectly answered by the final supplier evaluation model presented and directly answered in the analysis in chapter 7 and 8. Together the questions, which cover the selection of criteria categories and criteria, criteria definition and criteria description as well as criteria weighting, constitute the final supplier evaluation model presented as the main result of this study. Questions 1-5 concerning

selection of criteria and criteria categories as well as criteria definition and description are discussed and responded to on criteria category and criteria level in chapter 7. Question 6 covering criteria rating is discussed in chapter 9.2 and question 7-8 covering weighting of the criteria are discussed in chapter 8.

The model presented is hence developed according to the purpose of the study and the proceeding of the creation of the model has been conducted according to the methodology presented in chapter 5.2.3.

10.1.1 Analysis of answers to posted questions

Following a discussion will be held regarding whether the questions stated in chapter 4.6 have been answered.

Questions (1) and (2) presented in chapter 4.6 are defined as:

- (1) Which traditional evaluation criteria categories and what criteria within are relevant for Cederroth to evaluate their suppliers on?
- (2) What other criteria categories and criteria can be of relevance for Cederroth to evaluate their suppliers on?

As articulated, the strategic supplier evaluation model proposed in this study includes criteria that are categorized in traditional evaluation criteria categories, see Table 35. It is interesting that not all four traditionally held criteria categories proposed in the literature; *Delivery*, *Quality*, *Service* and *Price* are included. The category *Delivery* has changed name to *Logistics*, however still assesses the same aspects of a supplier that the category *Delivery*, proposed by the literature, does. It may at first seem strange that the traditionally held categories *Service* and *Price* are abandoned. Criteria representing these categories can however still be found in other criteria categories, they are simply regrouped and adjusted to Cederroth. For example the criteria *Cost reducing initiatives* and *Cost structure* are strongly related to the traditional category *Price*. And the criteria *Technical support*, *Product development process*, *General attention from supplier*, *Responsiveness* and *Capacity for increases demand* are all a sort of *Service*, illustrated in

Table 36.

Table 35 Traditional criteria categories and corresponding criteria included in the model

Quality	Logistics
Total value of complaints	Responsiveness
Total value of rejections	Accuracy in logistics data
Responsiveness	Hitrate - Quantity
Traceability	Hitrate - Time
Complaints management system	Lead time reduction
Quality management system	Short term flexibility in order volume
General product safety risk	IT-maturity
In process control/inspection	

Table 36 Specific criteria categories and corresponding criteria included in the model

General	Production	Product development	Purchasing
Uniqueness	Condition facilities/equipment	Product documentation	Responsiveness
General attention from supplier	Tidiness in production facilities	Responsiveness	Cost reducing initiatives
	Production-technical competence	R&D competence	Supply chain risk assessment
		Technical support	Investment plans and future visions
		Product portfolio/Innovation	Capacity for increased demand
		Product development process	Knowledge about second tier suppliers
			Cost structure

Aim of this study is further to include environmental aspects in the strategic supplier evaluation model, addressed specifically in chapter 4.5.1 and resulting in questions (3) and (4).

(3) Which environmental management strategy is applied by Cederroth?

(4) Which criteria can assess environmental performance in accordance with the environmental management strategy applied by Cederroth?

As chapter 3.4.1 points out, many companies aim at using the proactive strategy but finds it impractical and therefore applies the reactive strategy instead. In chapter 7.8.1.1 a discussion is held regarding which environmental management strategy Cederroth is applying and consequently which kind of environmental criteria that should be included in the evaluation model in regard of a proactive or a reactive environmental strategy. A mix of the two environmental management strategies are defined as Cederroth's strategy applied and consequently the model should include environmental criteria which supports both the reactive- and the proactive environmental strategies. The environmental criteria included in the final strategic supplier evaluation model are presented below in Table 37.

Table 37 Categorization of environmental criteria in reactive and proactive criteria

Reactive criteria	Proactive criteria
Compliance to environmental regulations and risk material assessment	Potential for environmental cooperation
Location distance	Environmental management system
Environmental waste parameters	
Public disclosure of environmental record	
Second tier supplier environmental evaluation	
Package performance	

To make sure that the strategic supplier evaluation model proposed in this study is practical to use, delivers relevant results and is applicable for Cederroth, following two questions was derived:

- (5) How should the criteria selected be defined and described so that the criteria assess what they are intended to and are easy to use?
- (6) What type of rating scale should be applied for rating the supplier performance?

During workshops and following interviews in Step 3 of the model creation procedure, see chapter 5.2.3.3, input about how to define and assess criteria in practice was collected. The issues of these two questions have been discussed for each and every criterion included in the final strategic supplier evaluation model, see chapter 7. Further, rating scales have been analyzed in chapter 9.2.1. It was found that a rating scale consisting of 5 points is suitable for the proposed evaluation model. When analyzing the criteria, information needed for assessing the supplier performance for each criterion has been taken under consideration.

The model proposed should furthermore include individual weights for each criterion as well as criteria category, so that a total score representing the overall supplier performance can be derived. The answers to questions (7) and (8) were stated as important in the task of fulfilling the purpose of the study:

- (7) Which weighting model should be selected for criteria weighting?
- (8) Who will perform the weighting of criteria and criteria categories?

As concluded by the analysis performed in chapter 8.1, the AHP model is found to be a suitable model to apply when assigning weights to the criteria. The AHP model was found to be the only model able to handle a combination of qualitative and quantitative criteria, which is the case of the model proposed in this study. The AHP model has further been successfully applied in several other cases including assessing supplier performance of environmental criteria. With the purpose of assuring that the weights are correctly assigned to each criterion and each criteria category, Cederroth representatives were asked to weight the criteria in respective criteria category. The weighting of the criteria categories was executed by purchasing manager Magnus Andersson.

The purpose of this thesis finally declares that the strategic supplier evaluation model should give indications on potential areas for supplier development. The model proposed will rate the strategic suppliers according to their overall performance and thereafter rank them. Suppliers with a low score will easily be detected and actions should be taken to help them improve their performance. When the score for each criteria category easily can be derived from the total score, areas where the supplier performance is significantly low will be identified and consequently give indications within which areas improvements need to be concentrated to. The ranking is therefore a vital part of the evaluation to increase the contribution of the model to Cederroth's supplier management process.

10.2 The strategic supplier evaluation model

The strategic supplier evaluation model proposed in this study is aiming at evaluating potential strategic suppliers to Cederroth and assists as a support in supplier selection as well as evaluating existing strategic suppliers and function as a foundation for supplier development. The model is designed for evaluating strategic suppliers and not designed for evaluation of suppliers of non-strategic importance since the criteria evaluated concerns strategic aspects. The model consists of

seven criteria categories and 41 categorized criteria derived from an exhaustive literature review as well as interviews and workshops with Cederroth representatives. The criteria categories and their respective criteria are presented in Table 38.

Table 38 Criteria and criteria categories included in the strategic supplier evaluation model

Criteria category	Criteria
General	
	Uniqueness
	General attention from supplier
Production	
	Condition facilities/equipment
	Tidiness in production facilities
	Production-technical competence
Quality	
	Total value of complaints
	Total value of rejections
	Responsiveness
	Traceability
	Complaints management system
	Quality management system
	General product safety risk
	In process control/inspection
Logistics	
	Responsiveness
	Accuracy in logistics data
	Hirate - Quantity
	Hirate - Time
	Lead time reduction
	Short term flexibility in order volume
	IT-maturity
Product development	
	Product documentation
	Responsiveness
	R&D competence
	Technical support
	Product portfolio/Innovation
	Product development process
Purchasing	
	Responsiveness
	Cost reducing initiatives
	Supply chain risk assessment
	Investment plans and future visions
	Capacity for increased demand
	Knowledge about second tier suppliers
	Cost structure
Environment	
	Second tier supplier environmental evaluation
	Location distance
	Environmental management systems
	Compliance to environmental regulations and risk material assessment
	Energy and waste parameters
	Public disclosure of environmental record
	Potential for environmental cooperation
	Package performance

All criteria are qualitative criteria that need to be assessed by judgment of the user. The criteria as well as criteria categories have been weighted so that a total score of the supplier performance can be calculated based on criteria's and criteria categories' different weights. The strategic supplier will be evaluated due to each criterion and awarded a score between 1 and 5 depending on its performance. When awarding the scores motivations need to be documented as well to ease the interpretation of the evaluation at a later time and ease the historical comparison between evaluations of one supplier. If a criterion is not possible to evaluate a supplier on, the choice of defining it as "Not applicable" is available. A short description of each criterion is assisting the user in how to interpret the criterion and what the supplier should be evaluated on regarding each criterion. The criteria included in the model are defined and described so that users of the model can interpret the criteria with decreased risk for misunderstandings and diverse interpretations of same criteria, which in that case could result in incomparable results. Further, the weighting of the criteria eliminates the fact that if a criteria category includes many criteria the category is indirectly given a higher weight than a category consisting of few criteria, hence will impact the overall supplier score to a larger extent than a category with few criteria. The scores are then multiplied with the criteria weights and the criteria categories weights and concluded in a total score. Due to the total score achieved the strategic supplier is classified into one of four performance classes, which can be seen in Table 39. The classes imply how the supplier performs compared to Cederroth's expectations and give indications about which actions that may need to be taken.

Table 39 Supplier classifications due to achieved total score

Classification	Score (1-5)
Supreme	> 4,60
Standard	3,80 < 4,60
Poor	3,00 < 3,80
Desourced	< 3,00

Further, the model calculates the supplier's percental fulfillment of each criteria categories maximum score, which eases the interpretation of the evaluation result. For reviewing the complete strategic supplier evaluation model see Appendix O.

The application of the model should be regardless of supplier category such as chemical supplier, packaging supplier or contract manufacturer. The criteria and criteria categories are designed to be suitable for all kind of suppliers, however when criteria are impossible to evaluate due to limited information acquired from supplier or for other reasons, the criterion in questions can be eliminated from the model by adjusting the weight awarded to the criterion to zero. Then the criterion will not be considered in the final supplier performance score.

The criteria are selected according to a strategic perspective and evaluate factors of strategic character such as relationship-related criteria and criteria focused on product development and which gives indications on future cooperation and partnership. Criteria in the category *Environment* have been selected in correspondence with Cederroth's current environmental strategy and include both proactive and reactive criteria, for further explanation see chapter 7.8. Proactive criteria are *Potential for environmental cooperation* and *Environmental management system* aiming at evaluating the suppliers on their engagement in proactively reduce their environmental impact.

Reactive environmental criteria included in the model are on It has been concluded that it is not feasible to only focus on proactive criteria but the model still aims to where possible. Reactive criteria are *Compliance to environmental regulations and risk material assessment*, *Location distance*, *Environmental waste parameters*, *Public disclosure of environmental record*, *Second tier supplier environmental evaluation* and *Package performance*, all of them assessing the suppliers current impact on the environment.

As previously expressed recommendations for frequency of the evaluation is annually evaluation of the strategic suppliers to acquire a consistent performance record for existing suppliers and to form a sound foundation for future supplier development. Regarding new potential strategic suppliers the evaluation should be performed after an initial qualification has been conducted and approved, since it is an in-depth analysis of supplier performance and not a shallow screening of potential suppliers. To acquire information from the supplier needed to evaluate the criteria a good relationship will ease the information gathering part. This is also a support for the application of the model primarily on strategic suppliers and not on the entire supplier base. The supplier must be willing to put some effort on gathering the information requested from Cederroth and be willing to let Cederroth perform site visits or audits to get a comprehensive picture of the supplier's performance. Performing supplier visits is a resource-demanding activity and should exclusively be performed at strategic suppliers or in special occasions for other suppliers due to extraordinary occurrences or situations.

10.3 Directives

Following directives for how to use the model and recommendations are derived from the analysis presented and discussed in chapter 7, 8 and 9 and should assist Cederroth in selecting and developing their strategic suppliers. Implementing the model developed in this thesis, the performance of new and existing suppliers can be tracked in detail and indications for supplier improvement areas can be derived.

To use the model, the first step is to classify and select which strategic suppliers are to be evaluated according to the model. With basis in that the developed strategic supplier evaluation model is more extensive than Cederroth's original model and that Cederroth has limited amount of resources available for supplier evaluation is recommended that a group of the most strategic suppliers are selected from current strategic supplier list. Thereby a fewer number of suppliers can be evaluated with higher detail, as the model suggests.

To evaluate the selected suppliers it is firstly needed to collect information about the supplier to be the basis of the evaluation. This information is suggested to be gathered through personal, e-mail or telephone interviews with the supplier, through extractions from Cederroth's own systems such as hitrate for quality and quantity and complaints registered and rejections made. Supplier visits and control of certifications to third-party standards are other sources of information. Supplier visits can be conducted through audits. Considering the environmental aspect, the information collection needed for this strategic supplier evaluation model proposed is more extensive than previous information needed for performing evaluation. The questionnaire attached in Appendix F can be used for gathering relevant information in the environmental area. When requesting environmental information it is vital to consider size and type of supplier. Large suppliers will more likely reply with

a standardized set of information in brochures while smaller suppliers will need to put more effort replying on each single question. The exhaustiveness of responses will therefore naturally vary.

The evaluation of the strategic suppliers is recommended to be executed by a team consisting of Cederroth representatives from the internal stakeholders such as purchasing, R&D, logistics and quality department. The team should meet and evaluate the supplier together, each representative being head responsible for the evaluation of corresponding criteria category, but with evaluation assistance from the other team members. This procedure assures that the motivation of the score for each criterion is explained to and understood by the entire team. Full notice should be taken to the criteria description when awarding scores to the suppliers. It is of high importance that the users of the model do not evaluate the suppliers upon criteria which they think they interpret correctly, but assure themselves that they have understood the meaning of each criterion correctly by thoroughly reading the description of the criteria and exclusively evaluate the suppliers accordingly to the description. This is to avoid misinterpretation when some criteria can be found to be fairly similar; however the description highlights the diverse meanings. The team should award a score for the supplier performance of each criterion accordingly but also write a short motivation to the score awarded aiming at facilitating the tracking of the supplier performance over time and simplify the supplier development process. When awarding scores, the complete scoring scale (1-5) should be respected and the users should not be reluctant to use the lowest or highest score when it is justified by the supplier performance. By using the complete scoring scale when evaluating the suppliers more diversified results can be acquired. When awarding primarily middle scores in the range of 2-4 the results will become less distinct and will be less useful when selecting or developing strategic suppliers.

According to the total score obtained by each supplier, a ranking is performed where the suppliers are categorized into four different classes depending on their total performance score. Each class should function as a signal for whether supplier performance is entirely satisfactory, if there are areas where the performance can be improved or if the supplier performance is so low that the supplier's future existence in Cederroth's supplier base should be proved. The classes are defined as; supreme class, standard class, poor class and desourced class. The total score of the supplier performance and consequently the ranking of the supplier should be used as a foundation for the selection of a new strategic supplier and as indication in which areas the supplier should develop to increase its performance when it concerns an existing strategic supplier of Cederroth. When the total supplier score can be derived into partial scores for each criteria category, it will be obvious within which areas the supplier does not perform as expected and within which areas there are potential for development. Further, areas can be identified where the supplier performs excellent, from which Cederroth may learn and use to improve their own internal performance. If a supplier has been classified as desourced, its existence in Cederroth's supplier base should be questioned. If it falls into the poor class, the supplier needs special attention so that poor areas can be improved and right corrective actions taken immediately. Being a strategic supplier in the standard class means performing sufficient good but with potential to improve its performance further by the right actions taken. Finally, a supplier classified in the supreme class is a top-performer and should be used as role model for other suppliers.

To follow up improvements taken from the supplier and to improve the model, it is recommended that the strategic supplier base is continuously reviewed and the effect of taken corrective actions

and improvements are followed up. Thereby the effects within the strategic supplier evaluation model can also be seen and used to further improve the model. The learning from previously performed strategic supplier evaluations will thereby not be lost and it can be assured that the strategic supplier evaluation model is constantly improved and developed according with external and internal changes, which consequences in a better-performing strategic supplier base.

10.4 Suggestions on future actions

As a recommendation for future actions for Cederroth, the definition of strategic supplier should be analyzed and reviewed. It is important that relevant suppliers are evaluated with this strategic supplier evaluation model proposed; hence Cederroth should look deeper into which suppliers in their supplier base that should be categorized as strategic. At present, strategic suppliers are categorized based on purchasing volume, purchasing value or if they have other extraordinary characteristics that justifies the suppliers to be especially important suppliers to Cederroth. The level of purchasing volume and value should be reviewed to check their validity and the extraordinary factors should be described in detail and exemplified. As mentioned earlier Cederroth has about 350 suppliers whereof 40 are classified as strategic suppliers based on annual order volume exceeding 4 million SEK or that the supplier somehow is unique and important to Cederroth. Cederroth's owner, CapMan, have suggested Cederroth to reduce their supplier base and reduce number of products in the product portfolio to achieve greater leverage and easier handling. Cederroth have already started this process and therefore a further suggestion is to continue this process by tracking down what products that use raw material from what suppliers. Thereafter it will be possible to classify suppliers as strategic based on the supply of raw materials to what products contribute to Cederroth's earnings the most.

The model proposed in this study should be applied for Cederroth's strategic suppliers since it is an evaluation that is focused on evaluating suppliers with significant importance to Cederroth. However, at present Cederroth have approximately 40 suppliers which are defined as strategic to Cederroth. When the strategic purchasing department is a relatively small department consisting of four employees, 40 strategic suppliers to evaluate with the model proposed would require many more hours than the time available for supplier evaluations. Therefore, it is suggested that Cederroth classify their strategic suppliers into categories depending on their strategic level.

Since this proposed model for strategic supplier evaluation is general for all supplier categories on request from Cederroth customizations for each of the different supplier categories has been left for the future. If Cederroth wants to customize the model for each of the different supplier categories, it is recommendation to modify the criteria included in the criteria categories, their individual definitions and weights for each supplier category. This may improve the usefulness of the evaluation model and further improve assessment.

The proposed model has been tested on a limited number of Cederroth's strategic suppliers, why there may be criteria or criteria categories in the model which can be improved further. In that occurs it is recommended to firstly improve definition and method to assess suppliers on the criteria. Some criteria may be difficult to assess due to limited information available, an issue that was not revealed when testing the model in this study. Therefore, Cederroth is suggested to make continuous improvements of the model.

The strategic supplier evaluation is one part of the supplier management process and closely linked to the supplier qualification concerning selection of new suppliers. Therefore Cederroth is recommended to review their supplier qualification process in regards of compatibility with the strategic supplier evaluation model proposed in this thesis. The development of the model has been performed with some respect to the existing qualification; however focus has been on creating an evaluation model based on theory and Cederroth's needs and requirements with thoughts that related processes may need to be updated. Together the supplier qualification and evaluation should constitute an exhaustive assessment of a potential strategic supplier and contribute with sufficient information for Cederroth to make a selection. Same things concerns the supplier development process, which could be modified based on the evaluation model proposed. By improving the supplier development process according to the evaluation process and as a module connected to the evaluation model, supplier optimization can be realized.

Environmental criteria included in this model proposed is a combination of reactive criteria and proactive criteria with respect to Cederroth's current environmental strategy and suggestions for environmental strategies presented in the literature review, see chapter 3.4.1. However, scientific research advocate a proactive environmental approach and therefore Cederroth is recommended to review their environmental strategy and focus more on proactive solutions and actions than on current environmental impact such as emissions, energy usage, recycling and reuse, even though reactive activities tend to be more easily assessed. A proactive strategy considers management engagement in environmental issues, environmental image, environmental competence and environmental visions etc, hence taking on a long-term perspective focusing on sustainability and prevention. In pace with changing environmental strategy the environmental criteria in the strategic supplier evaluation model should also be reviewed and reactive criteria should continuously be substituted by proactive criteria. Important is that the criteria included in the model correspond to Cederroth's environmental strategy at all time. Therefore it is reasonable to continuously review the relevance for Cederroth where some aspects to consider are; the society's view of environmental protection, suppliers' availability of information, Cederroth's environmental strategy and reserved resources for the environment. Since proactive criteria generally lead to more sustainable improvements, goal is at having exclusively proactive environmental criteria included in the model, which can be reached when the environmental focus has matured at both Cederroth and their strategic suppliers. Examples on proactive criteria to include in the model can be found in chapter 3.4.1.

10.5 Sensitivity analysis

Sensitivity of the proposed strategic supplier evaluation model is analyzed below. Firstly the structure of the model in terms of criteria categories and criteria are discussed, thereafter the criteria weighting and finally the supplier rating.

10.5.1 Discussion of criteria and criteria categories

A discussion can be held concerning how other criteria categories than those selected would have influenced the strategic supplier evaluation model. The categorization could have been performed differently, clustering criteria in a different way than proposed in the final model. A result could be that representatives from Cederroth may have been responsible for weighting different criteria than proposed in the final model. The affect on the total score of the supplier is however found to be relatively vague since the evaluation procedure is recommended to be performed jointly in team

consisting of representatives from all departments involved in the strategic supplier evaluation process when possible. The evaluation process is based on an open discussion about the supplier performance conducted in a group of representatives from respective function within Cederroth. Therefore it can be assumed that the categorization's influence on the scoring of each criterion is limited. Interpretation of the criteria can be affected though, since a criterion for example that is categorized as a logistics criterion is assumed to be paid more attention by the logistics representative than other criteria. To assess the resulting impact on the total supplier performance score is on the other hand difficult.

Further it can be questioned whether criteria categories should be used at all. In the literature criteria categories are commonly recommended, why categorization have also been proposed in this model. If the criteria had been included in the model without belonging to a certain category, the same situation can be assumed to arise as discussed above. The criteria categories aim at giving directions about what the criteria included in each category intend to assess on a general level, hence assisting the users of the model in the interpretation of the criteria. When criteria would be present in the model without belonging to a certain category, the risk for misinterpretations would increase and the criterion *Responsiveness* for example would not be possible to assess from different perspectives as possible in the final model by being located under diverse categories aiming at assessing responsiveness within different departments. Furthermore, if criteria would not have been categorized it would not have been possible to use the AHP-model to weight criteria since the effort of pair wise weighting 41 ungrouped criteria needs extensive efforts.

The reliability of the model is assumed to be high. This is based in that the criteria and criteria categories are supported by several different sources presented in the literature review as well as by representatives at Cederroth with extensive knowledge and experience of Cederroth's strategic suppliers and supplier evaluation in general. The literature review consists of primarily modern research but has also been supplemented by older research which is still up-to-date. The empirical information has been collected through interviews and workshops. Different methods for collecting empirical data strengthen the assurance that all important aspects have been derived. Due to this discussion the criteria, criteria categories as well as criteria descriptions and the criteria weights are also considered to be reinforced.

Interconnectivity of the criteria is not investigated deeply in this study. The attempt to analyze interconnectivity between the criteria included in the proposed strategic supplier evaluation model is considered to be sufficient for this model. Nevertheless, there may be interconnectivities that are not identified and which may affect the total supplier performance score. If one criterion is found to be correlated to one or more other criteria, achieving high score on this specific criterion will directly impact the performance of the correlated criteria as well, hence increasing the total score significantly, especially when the criteria concerned have high weights. As an example for how the model should function as foundation for supplier development, old machinery or poor maintained machinery may lead to quality concerns, hence low score on quality concerns such as complaints may not be corrected with actions directly addressed to the complaints but rather addressed to issues concerning machinery maintenance. This is a direct cause of interconnectivity between the criteria.

10.5.2 Criteria weighting

One aspect influencing the total score of the suppliers evaluated heavily is the accuracy of weights assigned to the criteria. For some criteria categories, the weights on criteria level used in the proposed strategic evaluation model have been derived jointly by teams weighting the criteria. This concerns the criteria categories *General*, *Production*, *Purchasing* and *Product development*. Criteria in the first three mentioned categories have been weighted jointly in team while criteria in the last category have been weighted individually by users and the average weight has been calculated in each pair wise comparison. The details are accounted for in chapter 8.3. An alternative method to calculate the weights was discussed; being each user weighting the criteria individually and calculating the weights for all criteria. Thereafter an average weight for each criterion would be derived based on the individual weights awarded. The weights derived according to the alternative procedure described for criteria in the criteria categories *General*, *Production*, *Purchasing* and *Product development* can be found in Appendix J. Generally, total scores achieved by the suppliers in the case studies are found to be lower when using the average of individually awarded weights, see Table 40. The difference in total score achieved by the suppliers can mainly be traced to the criteria category *General*, where the difference in total score is most significant for all three suppliers participating in the case studies. An explanation is that this category exclusively contains two criteria and change of weights on criteria level therefore has larger impact on the total score than for other criteria categories. However, the suppliers are still ranked in the same supplier classes as before.

Table 40 Total score changes due to different weighting method used

		Average weight		Average weight		Average weight
Supplier	PCS	PCS	CCS	CCS	CMCS	CMCS
Total score	3.80	3.64	3.62	3.33	4.26	4.18
Supplier ranking	Poor class	Poor class	Poor class	Poor class	Standard class	Standard class
Percental fulfillment of total score in each category						
General	80%	70%	50%	35%	90%	85%
Production	100%	100%	Not applicable	Not applicable	60%	60%
Quality	73%	73%	95%	95%	89%	89%
Logistics	77%	77%	85%	85%	93%	93%
Product development	80%	80%	86%	86%	91%	91%
Purchasing	77%	75%	73%	61%	84%	82%
Environment	60%	60%	67%	67%	65%	65%

As discussed in chapter 8.3, the selection of representatives performing the weighting also influences the outcome of the weighting, especially in the case when there is only one representative weighting criteria. To illustrate the influence following example is given. The weights awarded to criteria within the category *Product development* were defined by individual weighting of the criteria by three representatives and then the average weights were calculated and used in the model. To investigate the impact on the total score if other weights have been used regarding criteria in this category, an analysis on CMCS has been performed. The test constituted a comparison of total score achieved by

the supplier when the individual weights awarded the criteria by the three representatives was used instead of the average weight. The representatives weighting the criteria individually were Åsa Knutsson, Yvonne Törnevik and Stefan Snell, all representing different R&D departments within Cederroth. In Table 41 the achieved total scores and the percental fulfillment of total score for the criteria category *Product development* are compared with the total score achieved according to the original strategic supplier evaluation model.

Table 41 Total scores achieved by CMCS due to different weights used

	Original evaluation	Åsa Knutsson	Yvonne Törnevik	Stefan Snell
Total score	4.26	4.30	4.25	4.24
Percental fulfillment of total score for <i>Product development</i>	91%	95%	90%	89%

As seen in the table above, the total score differs only slightly with most 0.06 points between Stefan Snell's and Åsa Knutsson's weights used. Total score for the category *Product development* achieved differ maximum 6%. Concluding, regardless of whose weights are used for the criteria in this criteria category the supplier CMCS is classified in the standard class. This implies that the sensitivity of the weighting method described in this case is relatively low.

Another interesting factor to investigate is how the outcome of the strategic supplier evaluation model reacts when criteria are assessed as "Not applicable". Since the model handles these cases by distributing the weights from "Not applicable" criteria evenly on other criteria in the same criteria category, this aspect is investigated on criteria level for one criteria category. The category *Logistics* has been selected as an example, see Table 42.

Table 42 Change in weights when one criterion is "Not applicable"

Criteria included in <i>Logistics</i>	Weights when no criteria are "Not applicable"	Weights when <i>Hirate - Time</i> is "Not applicable"	Percental weight change
Responsiveness	0.024	0.067	183%
Accuracy in logistics data	0.143	0.187	31%
Hirate - Quantity	0.262	0.306	17%
Hirate - Time	0.262	0.000	-100%
Lead time reduction	0.143	0.187	31%
Short term flexibility in order volume	0.143	0.187	31%
IT-maturity	0.024	0.067	183%

When setting a criterion with relatively high weight to "Not applicable", all criteria in that category are assigned an equal part of that criterion's weight. This assures that relative importance of criteria remains the same. When using the number of criteria in the criteria category as basis for dividing the weight that will be distributed, each criterion's importance in the category is neglected. An exhaustive method would be to go back to the original weighting matrix and delete this criterion's

weight pairwise, this would however demand many additional computations. The amount of work performing those computations is not defensible in regard of the resulting impact. A consequence is however that if a criterion with relative large weight is “Not applicable”, this method described to assign its weight to the other criteria in the criteria category will be inaccurate. When assigning an equal part of the “Not applicable” criterion’s weight to criteria with significant difference in weight, the influence will be more significant on criteria with relative small weights. As illustrated in Table 42 the criteria *Accuracy in logistics data*, *Lead time reduction* and *Short term flexibility in order volume* are given 17% higher weights, while the criteria *Responsiveness* and *IT-maturity* are assigned weights with relative increase of 183%. This rather high difference originates from the fact that the original weights assigned to these criteria constitute less than 10% of the original weight assigned to the criterion assessed as “Not applicable”, *Hitrate – Quantity*. One method to deal with this bias would be to return to the weighting matrix and recalculate weights for each criterion, but since this would demand extensive computations it is suggested as not suitable for the strategic supplier evaluation model presented in this thesis when it should focus on being easy to use and demand less effort.

When more than one criterion in a category is set as “Not applicable” other criteria in that category are assigned even higher weights. One extreme case is that if all criteria in a category are set as “Not applicable” except for one criterion. In this case the single criterion in that category would be assigned the whole weight of its category. Nevertheless it is most unlikely that such many criteria within a single criteria category is set to “Not applicable” since then the evaluation of the strategic supplier would not be exhaustive enough to draw conclusions from the total score and ranking achieved.

Another case of interest is when an entire criteria category is set to “Not applicable”. The model would handle this by reassigning that category’s original weight to remaining categories by the same principle as described for the criteria. This would be by reassigning each criteria category an equal part of the weight of the criteria category set “Not applicable”.

Table 43 exemplifies the two scenarios when the category *Production* is set “Not applicable” and when the category *General* is set “Not applicable”. The category *Production*, which has shown likely to be set “Not applicable” in the case studies, influences other categories with similar percentage. Hence the method to reassign weights is found to be suitable. In the scenario that evaluators would set both criteria in the category *General*, originally assigned the most weight, the reassignment of weights gives a different result. This since the relative weight of this category is the highest and the reassignment method is still linear. With that said, it is still extremely unlikely that evaluators would set both criteria in this category “Not applicable”.

Table 43 Analysis of the influence on the total score from each criteria category

Criteria category	Original weight	Weight when <i>Production</i> "Not applicable"	Percental change	Weight when <i>General</i> "Not applicable"	Percental change
General	0.286	0.290	1%	0.000	-100%
Production	0.024	0.000	-100%	0.072	200%
Quality	0.142	0.146	3%	0.190	34%
Logistics	0.096	0.100	4%	0.144	50%
Product development	0.190	0.194	2%	0.238	25%
Purchasing	0.118	0.122	3%	0.166	41%
Environment	0.142	0.146	3%	0.190	34%

10.5.3 Supplier rating

It is of interest to discuss the evaluation model's sensitivity in regard of different input data. One interesting aspect is to evaluate the model's response if a supplier performs significantly low in one of the criteria categories. A test has therefore been performed where all criteria were given the score 5 except for criteria in the test category where criteria were given the scores 1, 2 and 3 respectively, see Table 44. The table should be interpreted such as that the total scores of the suppliers are visualized when for example awarding all criteria within the first category, *General*, with score 1, the next column total score of the supplier when the criteria within *General* are awarded score 2 and so on. The next row describes the same scenarios but concerning low scores for the criteria in the category *Logistics*.

Table 44 Total supplier score achieved when performing poor in one category respectively. Total score resulting in classification in the supreme class is underlined; all other total scores are resulting in standard class.

Criteria category	Score 1	Score 2	Score 3
General	3.86	4.14	4.43
Production	<u>4.90</u>	<u>4.93</u>	<u>4.95</u>
Quality	4.43	4.57	<u>4.71</u>
Logistics	<u>4.62</u>	4.71	<u>4.81</u>
Product development	4.24	4.43	<u>4.62</u>
Purchasing	4.53	<u>4.64</u>	<u>4.76</u>
Environmental	4.43	4.57	<u>4.71</u>

As can be seen in Table 44, in quite many cases a supplier can achieve a total score high enough to be classified as supreme supplier when given criteria in all criteria categories score 5 except for criteria in one category. It is for example noticeable that a supplier get classified as supreme in the extreme case that either the criteria in the category *Production* or *Logistics* are all given score 1, meaning that if a supplier would fail dramatically in the logistics performance it would still be classified as supreme.

11 Discussion

This chapter highlights the delimitations and priorities made in the study, followed by a discussion about the generalness of the study and its theoretical contribution.

11.1 Delimitations and priorities

It is of interest to discuss how delimitations made may impact the result of the study. Focus has been on adopting the buyer's, Cederroth's, perspective of supplier evaluation. However, a supplier evaluation involves two actors, the supplier and the customer, which implies that it could have been relevant to adopt the supplier's perspective of a supplier evaluation as well as the customer's perspective. To a minor extent this has been conducted by testing the final strategic supplier evaluation model on three of Cederroth's existing strategic suppliers and evaluating them according to the model proposed in this study. The result of the study could have been different in regard of criteria and criteria categories included in the model if the supplier's perspective had been considered to a larger extent, but also considered earlier in the study than towards the end, as was the case in this study.

A discussion can be held about the borders of the studied system, see chapter 4.3, since these might have had an impact on the result of the study. The strategic supplier evaluation is a subsequent step in the supplier selection process after the initial supplier qualification, but also a preceding step to the supplier development process. If the supplier qualification had been included in the study as well as the supplier evaluation, the synchronization between the two processes could have been worked on, adjusting the qualification and evaluation to complement each other in the complete supplier selection process and jointly constitute an exhaustive assessment of a supplier. The strategic supplier evaluation has been developed with some respect to the existing supplier qualification, however not entirely matched assuring that the two processes together covers all aspects of the supplier selection. Nevertheless, priority has been developing a new model for strategic supplier evaluation, hence additionally the supplier qualification phase could not be considered due to the study's delimitation in time. It is difficult to assess the impact of the delimitation on the result of the study. Further, a process for supplier development could have been relevant to develop according to the proposed model for supplier evaluation, but due to the same reasons as previously mentioned it was referred to as delimitation. The quality of the strategic supplier evaluation model proposed is on the other hand not considered to be affected to any significant extent by this delimitation. Same criteria, criteria categories and criteria weighting is suggested to be the result also when the evaluation model had been created together with a supplier development process.

11.2 Generalness

The strategic supplier evaluation model proposed in this study may be general in terms of criteria and criteria categories included in the model. The criteria have large support from the literature and are recommended by a number of authors as criteria relevant for supplier evaluation, which strengthens the assumption of generalness regardless of industry or supplier characteristics. However, some industries may require industry-specific criteria that are not included in this model proposed, hence a straight application of this model by other organizations may not be possible but a modification may be needed to assure exhaustiveness.

Contradictory, the criteria weighting is most likely not general in terms of other organizations or industries. The weighting procedure is performed by Cederroth representatives, hence the weightings awarded each criterion in this model are strongly specific for Cederroth. The same thing applies to the weighting of the criteria categories, which is highly correlated to the organization's business strategy and may vary significantly between industries and organizations. Though, the weighting procedure according to the AHP model can be found to be general and applicable for other organizations weighting supplier evaluation criteria.

Additionally, in terms of geographical location the supplier evaluation model is considered as general.

11.3 Contribution

Theoretical contribution of the report is considered to be limited. By classifying environmental criteria due to their environmental management strategy characteristics it may contribute to a certain extent to the research covering the topic of evaluating supplier environmental performance. Though, it is difficult to assess the contribution to future research areas. The study is fairly broad covering many aspects such as supplier evaluation criteria, weighting models and supplier environmental performance, which may be one reason for the limited theoretical contribution.

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Appendix

APPENDIX A. PRO 02 12 01 - REQUEST FOR NEW AGREEMENT/NEW SUPPLIER.	1
APPENDIX B. PRO 02 12 02 - PURCHASE OF MATERIAL TO PRODUCTION	3
APPENDIX C. BLA 12 02 03 - SUPPLIER QUALIFICATION FOR STRATEGIC SUPPLIERS	4
APPENDIX D. BLA 12 02 07 - SUPPLIER EVALUATION FOR STRATEGIC SUPPLIERS	5
APPENDIX E. RUT 12 01 01 - PURCHASE PREPARATION	8
APPENDIX F. QUESTIONNAIRE SENT TO CASE SUPPLIERS	10
APPENDIX G. QUESTIONNAIRE RESPONSE FROM CCS	15
APPENDIX H. QUESTIONNAIRE RESPONSE FROM CMCS	18
APPENDIX I. WEIGHTING MODELS	23
APPENDIX J. WEIGHTS.....	31
APPENDIX K. MODEL 1	32
APPENDIX L. MODEL 2.....	33
APPENDIX M. MODEL 3	35
APPENDIX N. MODEL 4.....	37
APPENDIX O. MODEL 5 – FINAL MODEL	39
APPENDIX P. EVALUATION OF CASE SUPPLIER CMCS	41
APPENDIX Q. EVALUATION OF CASE SUPPLIER CCS	43
APPENDIX R. EVALUATION OF CASE SUPPLIER PCS	45

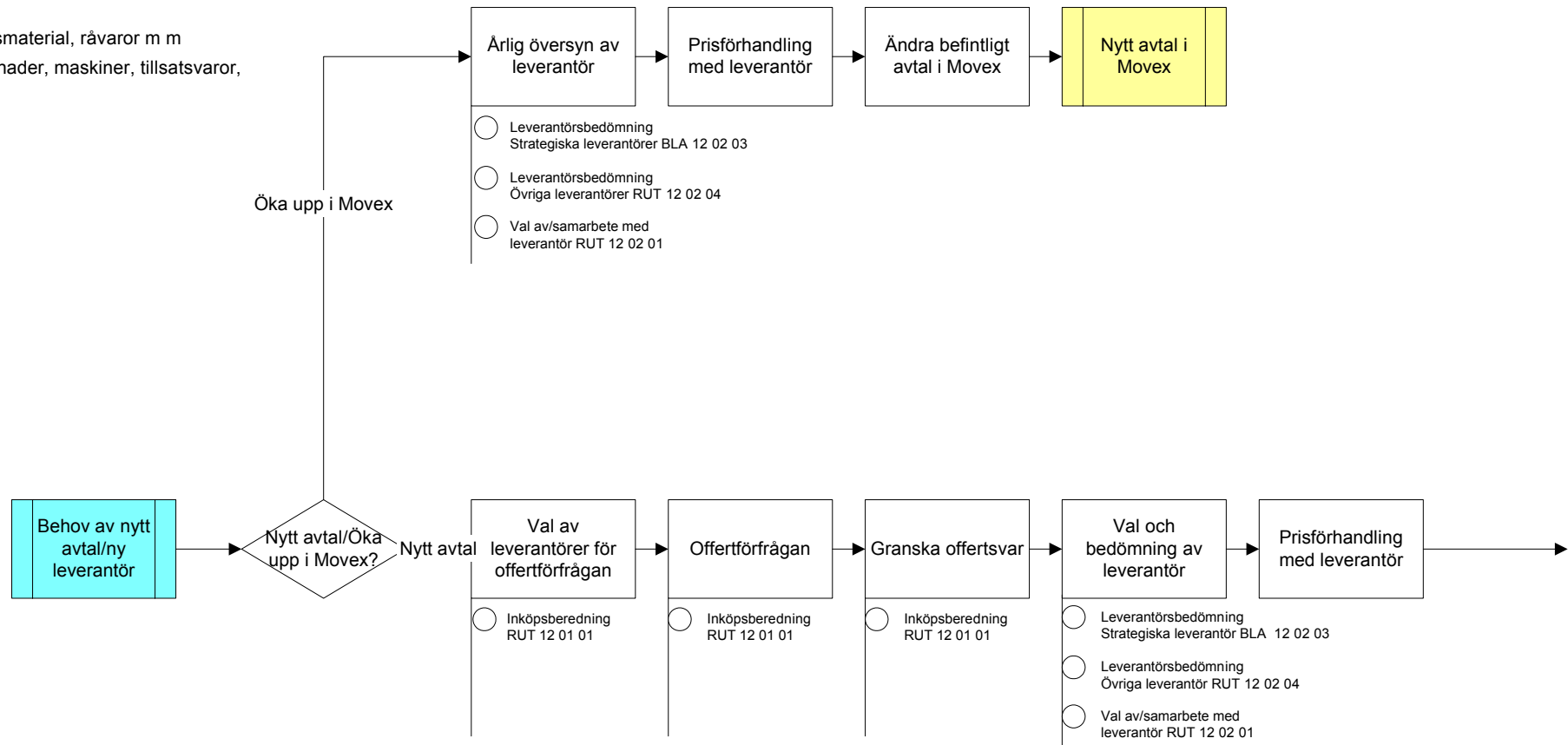
PRO 02 12 01.vsd - Behov av nytt avtal/ny leverantör

Version: V3:07-08-29

Ersätter version: V2:04-03-10

Första utgåva: 03-03-19

Processägare: Se RUT 01 02 03

Insatsmaterial = förpackningsmaterial, råvaror m m**Övriga inköp** = tjänster, byggnader, maskiner, tillsatsvaror, reservdelar m m

Övergripande dokument till processen:

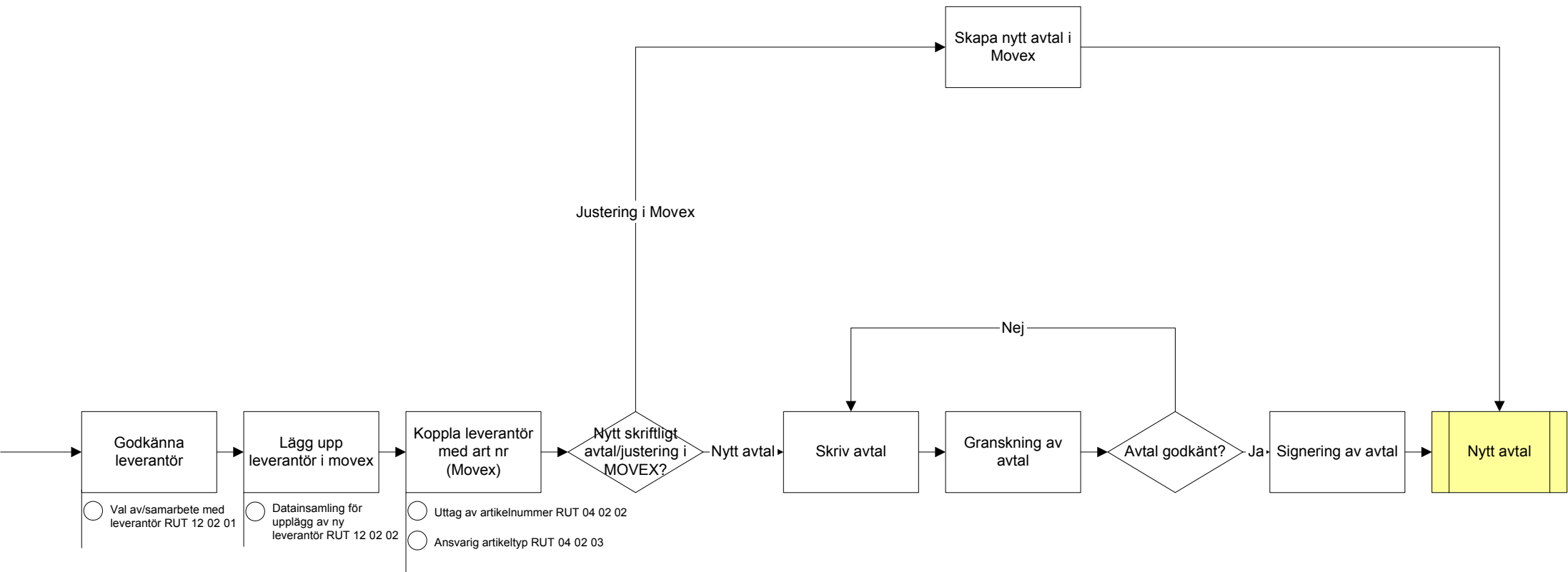
Dokument till stöd för processen:

Appropriation Request BLA 10 02 01

Förstudie BLA 10 02 02

Beskrivning av idé. Best av ett projekt BLA 10 04 04

Avslutning/Utvärdering av projekt BLA 10 02 06



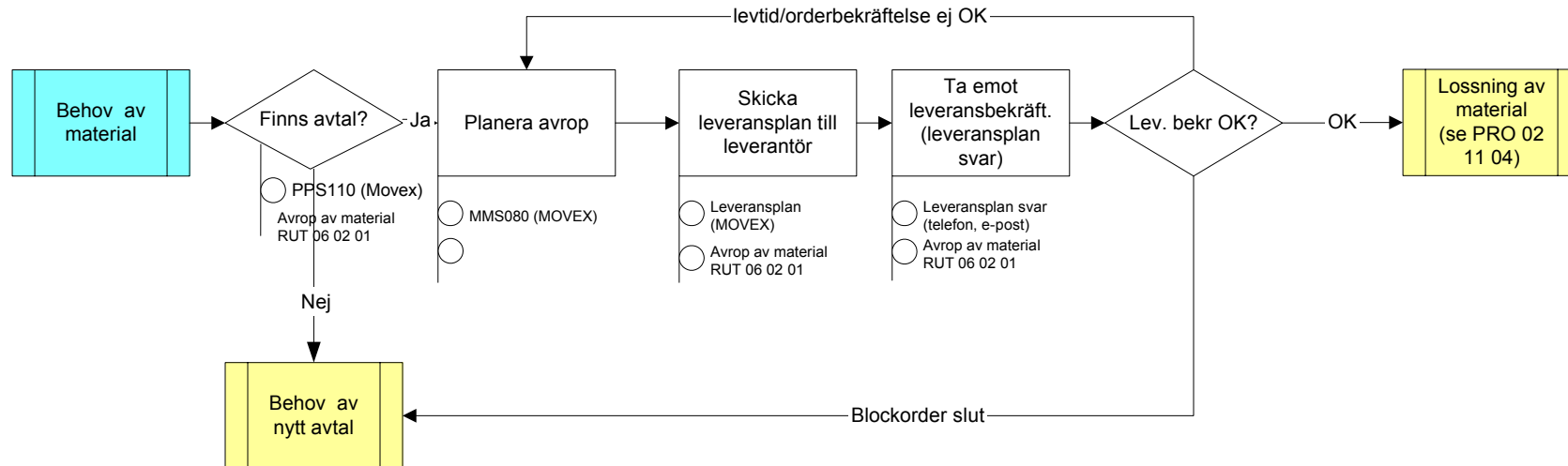
PRO 02 12 02.vsd- Inköp av material till produktionen

Version: V4:09-02-27

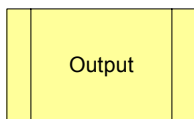
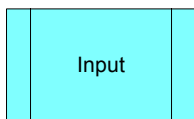
Ersätter version: V3:07-08-29

Första utgåva: 03-03-06

Processägare: Se RUT 01 02 03



Övergripande dokument till processen:



Övriga dokument till stöd för processen:

	Dokument: BLA 12 02 03	Version: V3:04-12-03	Sida: 1(1)
Kapitel: 12. Inköp	Avsnitt: Val av/samarbete med leverantör	Ersätter version: V2:03-03-21	
Utfärdat av: Ulf Danielsson	Granskat av:/Godkänt av: Magnus Andersson	Första utgåva: 02-10-22	

Leverantörsbedömning Strategiska leverantörer

20.....Bedömning utförd av:	Datum:
-----------------------------	--------

Företagsfakta

Nr	Kontrollpunkt	Noteringar
1.1	Firmanamn	
1.2	<i>Leverantörsnummer</i>	
1.3	Kort Historik	
1.4	Huvudprodukter	
1.5	Antal anställda	
1.6	Ägare	
1.7	Kvalitetssystem/ Miljöledningssystem	
1.8	Viktiga krävande kunder	
1.9	Underleverantörer	

Nr	Kontrollpunkt	Noteringar
1.10	Logistikupplägg	
1.11	<i>Unik Kompetens/Strategi</i>	
1.12	Utvecklingspotential	
1.13	Övrigt	

Ekonomi

Nr	Kontrollpunkt	Noteringar
2.1	Årsomsättning samt Cederroths del av årsomsättningen	
2.2	Resultat	
2.3	Soliditet	
2.4	Kreditvärdighet	

Dokument: BLA 12 02 07		Version: V2:10-06-02	Sida: 1(3)
Kapitel: 12. Inköp	Avsnitt: Val av/samarbete med leverantör	Ersätter version: V1:04-12-06	
Utfärdat av: Conny Åslund	Godkänt av: Magnus Andersson	Första utgåva: 04-12-03	

Leverantörsvärdering Strategiska leverantörer

20.....Värdering utförd av:	Datum:	Firmanamn:
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1. Lokaler, maskiner och utrustning

Utseende/Kondition

Produktionslokaler

Viktig utrustning

Mät och provnings-
utrustning

Kalibreringssystem

Investeringsplaner

Ordning och reda

Ej till- lämp.	1p	2p	3p	4p	5p	Kommentar

2. Kvalitet

Kvalitet på produkt/tjänst

Kvalitetskontroll

Reach SDS

Spårbarhet

Hantering av
reklamationer

Uppföljningssystem

Ej till- lämp.	1p	2p	3p	4p	5p	Kommentar

3. Logistik

Leveranssäkerhet

Ledtid

Kommunikation

Flexibilitet

Ej till- lämp.	1p	2p	3p	4p	5p	Kommentar

4. Kompetens

Produktionsteknisk

Ej till- lämp.	1p	2p	3p	4p	5p	Kommentar

Dokument: BLA 12 02 07		Version: V2:10-06-02	Sida: 2(3)
Kapitel: 12. Inköp	Avsnitt: Val av/samarbete med leverantör		Ersätter version: V1:04-12-06
Utfärdat av: Conny Åslund	Godkänt av: Magnus Andersson		Första utgåva: 04-12-03

Leverantörsvärdering Strategiska leverantörer

5. Produktutveckling

Produktutvecklings-
processen

Konstruktionserfarenhet

Dokumentation

FoU Kompetens

Ej till- lämp.	1p	2p	3p	4p	5p	Kommentar

6. Produktivitet

Kostnadsreduktion & Mål

Prisutveckling

Ej till- lämp.	1p	2p	3p	4p	5p	Kommentar

7. Inköp

Inköpsprocessen

Kunskap om
underleverantörer

Ej till- lämp.	1p	2p	3p	4p	5p	Kommentar

8. Miljöarbete

Miljöstyrningssystem

Miljöpolicy

Miljönyckeltal

Transporteffektivitet

Cederroths påverkan på
leverantörens
miljöpåverkan

Ej till- lämp.*	1p	2p	3p	4p	5p	Kommentar

TOTALT:

--	--	--	--	--	--	--

Värderingsskala

- 1p Underkänd
- 2p Ej acceptabelt
- 3p Godkänd
- 4p Bra, förbättringspotential
- 5p Utmärkt


Kapitel: 12. Inköp	Dokument: BLA 12 02 07	Version: V2:10-06-02	Sida: 3(3)
	Avsnitt: Val av/samarbete med leverantör	Ersätter version: V1:04-12-06	
	Utfärdat av: Conny Åslund	Godkänt av: Magnus Andersson	Första utgåva: 04-12-03

Leverantörsvärdering Strategiska leverantörer

Gradering i procent:

80-100%	Utmärkt
60-80%	Bra, förbättringspotential
20-60%	Ej acceptabelt
0-20%	Underkänd

* Ej Tillämp. – Punkten ej tillämpbar, minska maxpoängen i motsvarande grad.

 CEDERROTH INTERNATIONAL	Dokument: RUT 12 01 01	Version: V3:06-06-14	Sida: 1(2)
	Avsnitt: Inköpsberedning	Ersätter version: V2:03-03-21	
Kapitel: 12. Inköp	Godkänt av: M Andersson	Första utgåva: 02-10-22	
Utfärdat av: Ulf Danielsson			

Inköpsberedning

Syfte: Inköpsberedningen skall vid första köp säkerställa varor och tjänster av rätt kvalitet, leverans vid rätt tidpunkt samt rätt kvantitet till lägsta totalkostnad.

Ansvar och befogenh: Personen som ska utföra inköpet ansvarar för insamling av det underlag/specifikation som köpet kräver. Samt ansvara för första köp av insatsmaterial.
Personen ansvarar även för in- och utfasning vid relansering/nedläggning av material.

Personen som ska utföra inköpet beslutar i samråd med till exempel FoU, Förpackningsutveckling, Teknik, Produktion och Distribution vilken leverantör som skall väljas.

FoU och Förpackningsutveckling ansvarar för att ta fram specifikationer och hålla dessa uppdaterade på råvaror och förpackningsmaterial.


Beskrivning: Offertförfrågan skall minst innefatta.

- Årsvolym
- Orderkvantitet
- Leveransvillkor
- Betalningsvillkor
- Specifikationer

Dock styrs omfattningen av offertförfrågan hur väsentlig eller kritisk produkten/materialet är för Cederroth, samt tidigare erfarenhet av leverantören. Vid val av ny leverantör ansvarar personen som gör valet att initial bedömning görs enligt RUT 12 02 01.

Offertförfrågan bör om möjligt skickas till fler än en leverantör.

Offertsammanställning baserat på offertsvaren görs av personen som ska utföra inköpet.

 CEDERROTH INTERNATIONAL	Dokument: RUT 12 01 01	Version: V3:06-06-14	Sida: 2(2)
	Avsnitt: Inköpsberedning	Ersätter version: V2:03-03-21	
Kapitel: 12. Inköp	Godkänt av: M Andersson	Första utgåva: 02-10-22	
Utfärdat av: Ulf Danielsson			

Inköpsberedning

Nya material skall finnas tillgängliga för produktion senast 14 dagar före planerad produktionsstart.

Vald leverantör läggs in Movex, om den är ny, av
Ekonomiavdelningen BLA 12 02 02.

Kopplingar i Movex mellan leverantören och artiklarna som
möjliggör köp görs av Inköp.

Befintlig leverantör uppdateras med den nya artikeln/artiklarna i
Movex.

Examensarbete - Leverantörsvärdering med miljöfokus

Vi efterfrågar information för att utvärdera en leverantörsvärderingsmodell skapad som en del i ett examensarbete vid Linköpings tekniska högskola utfört hos Cederroth AB. Examensarbetet syftar till att ta fram en modell för leverantörsvärdering som tar hänsyn till miljöaspekter och avser värdering av Cederroths strategiska leverantörer.

För att utvärdera modellens anpassning till verkligheten behöver vi Er hjälp som strategisk leverantör att bistå med information angående frågorna på nästa sida. Er information kommer användas för att testa tillämpbarheten av modellen samt att undersöka möjligheter att värdera strategiska leverantörers arbete inom miljöfrågor.

Som en strategisk leverantör till Cederroth uppskattar vi verkligen Er medverkan!

Emma Nordling & Jens Egeröd

Upplands Väsby, 2010-10-25

Master thesis – Supplier evaluation with environmental focus

We request information to evaluate a supplier evaluation model created as a part of a master thesis for Cederroth AB performed by two students of Industrial Engineering and Management at Linköping University. The purpose of this thesis is to design a model for strategic supplier evaluation that takes environmental aspects into consideration and regards Cederroth's strategic suppliers.

As to evaluate the model's applicability to reality we ask for your help as one of Cederroth's strategic suppliers to assist with information regarding the questions posted on the next page. Your information will be used to determine the applicability of the model and to analyze possibilities to assess strategic supplier's environmental efforts.

As one of Cederroth's strategic suppliers we really appreciate Your contribution!

Emma Nordling & Jens Egeröd

Upplands Väsby, 2010-10-25

Instructions

This supplier evaluation model includes criteria that have not been present in the previous evaluation model of Cederroth, which is the reason why we ask for Your assistance to supply with information that is missing. Your information is important to us and we appreciate Your helpfulness!

Please send answers on following questions:

Supply chain risk assessment

1. What actions have been taken to secure the supply of goods to Cederroth?
 - Availability of extra tools in case of tools becoming defect
 - Actions preventing shortages in supply from second tier supplier
 - Dual supply
 - Safety stock
 - Collaboration with fire department, storing vital tools in fire safety boxes etc.
 - Actions preventing shortage in supply due to machinery breakdown
 - Other actions
2. How is the supply to Cederroth prioritized in case of limited production and high demand of your products?

Investment plans and future visions

3. What investment plans and future developments are your company planning that can benefit Cederroth? How will these benefit Cederroth?

Knowledge about second tier suppliers

4. What kind of documentation about your suppliers is being stored?

Second tier supplier environmental evaluation

5. To what extent is your company evaluating the environmental performance of your suppliers? Please attach documentation if available.

Environmental management systems

6. To what extent is your company adopting an environmental management system?
7. What are your goals/planned actions for improving your environmental performance?
Please attach action plan or list of corrective actions if available.

Compliance to environmental regulations and risk material assessment

8. To what extent is your company following EU-directives concerning environmental regulations regarding packaging, chemicals etc.?
9. How is your company working towards reduced usage of risk materials (materials not yet listed as hazardous but with risk being listed in the near future) and hazardous waste?

Energy and waste parameters

10. How are your company working with reducing energy consumption? Which actions are taken and what actions are planned?

11. How are your company working with reducing air emissions? Which actions are taken and what actions are planned?
12. How are your company working with reducing land emissions? Which actions are taken and what actions are planned?
13. How are your company working with reducing water emissions? Which actions are taken and what actions are planned?

Public disclosure of environmental record

14. Please attach information about your company's public disclosure of environmental record.

Instruktioner

Leverantörsvärderingsmodellen innehåller kriterier som tidigare inte använts vid utvärdering av leverantörer hos Cederroth, varför vi behöver ytterligare information angående Er verksamhet inom nedanstående områden. Ert bidrag med denna information är viktig för oss och vi uppskattar att Ni tar Er tid!

Riskvärdering av logistikkedjan

1. Vilka förebyggande åtgärder har tagits för att säkra leverans till Cederroth?
 - Tillgång till extra verktyg utifall viktiga verktyg blir defekta.
 - Åtgärder som förebygger konsekvensen av begränsad tillgång på råvaror från Era leverantörer
 - Möjlighet till leverans från olika underleverantörer
 - Säkerhetslager
 - Samarbete med brandkår, förvaring av viktiga verktyg i brandskåp
 - Åtgärder för att förhindra leveransbrist orsakade av produktionsproblem
 - Övriga åtgärder
2. Hur är leveranser till Cederroth prioriterade vid händelse av begränsad produktion och hög efterfrågan på Era produkter?

Investeringsplaner och framtida visioner

3. Hur ser investeringsplaner och visioner för framtida utveckling ut, som kan vara av intresse för Cederroth? Hur kan dessa skapa värde för Cederroth?

Kunskap om underleverantörer

4. Vilken typ av information besitter och dokumenterar Ni angående underleverantörer? Bifoga gärna exempel.

Miljöutvärdering av underleverantörer

5. Hur utvärderas leverantörers miljömedvetenhet och miljöarbete för att minska klimatpåverkan? Bifoga gärna exempel.

Miljöledningssystem

6. I vilken utsträckning används miljöledningssystem?
7. Hur ser mål/planerade aktiviteter för att minska Er miljöpåverkan ut? Bifoga aktivitetsplan samt förbättringsåtgärder.

Överensstämmelse med miljörestriktioner och värdering av riskmaterial

8. Hur väl uppfylls EU-direktiv angående miljörestriktioner för exempelvis förpackningar, kemikalier etc.?
9. Hur arbetar Ni med att reducera användandet av riskmaterial (material som ännu inte klassats som farliga men som bedöms vara på gränsen) och farligt avfall?

Energi- och avfallsparametrar

10. Hur arbetar Ni med att reducera energiförbrukning? Vilka åtgärder är vidtagna och vilka åtgärder är planerade att utföras?
11. Hur arbetar Ni med att reducera utsläpp till luft? Vilka åtgärder är vidtagna och vilka åtgärder är planerade att utföras?

12. Hur arbetar Ni med att reducera utsläpp till land? Vilka åtgärder är vidtagna och vilka åtgärder är planerade att utföras?
13. Hur arbetar Ni med att reducera utsläpp till vatten? Vilka åtgärder är vidtagna och vilka åtgärder är planerade att utföras?

Offentlig redovisning av miljöprotokoll

14. Bifoga Ert företags offentliga redovisning angående miljöpåverkan.

Master thesis – Supplier evaluation with environmental focus

We request information to evaluate a supplier evaluation model created as a part of a master thesis for Cederroth AB performed by two students of Industrial Engineering and Management at Linköping University. The purpose of this thesis is to design a model for strategic supplier evaluation that takes environmental aspects into consideration and regards Cederroth's strategic suppliers.

As to evaluate the model's applicability to reality we ask for your help as one of Cederroth's strategic suppliers to assist with information regarding the questions posted on the next page. Your information will be used to determine the applicability of the model and to analyze possibilities to assess strategic supplier's environmental efforts.

As one of Cederroth's strategic suppliers we really appreciate Your contribution!

Emma Nordling & Jens Egeröd

Upplands Väsby, 2010-10-28

Instructions

This supplier evaluation model includes criteria that have not been present in the previous evaluation model of Cederroth, which is the reason why we ask for Your assistance to supply with information that is missing. Your information is important to us and we appreciate Your helpfulness!

Please send answers on following questions:

Supply chain risk assessment

1. What actions have been taken to secure the supply of goods to Cederroth?
 - Availability of extra tools in case of tools becoming defect
 - Actions preventing shortages in supply from second tier supplier
 - Dual supply
 - Safety stock
 - Collaboration with fire department, storing vital tools in fire safety boxes etc.
 - Actions preventing shortage in supply due to machinery breakdown
 - Other actions

Difficult to answer as we are chemical supplier. Most of our products are usually on stock, most of the products are or can be produced on different production sites

2. How is the supply to Cederroth prioritized in case of limited production and high demand of your products?

All our regular customers have first priority in case of shortages. We do not commit our selves to quantities we are not able to produce. In case of raw material shortages we cut at customers which are not committed to our services. Cederroth has a high priority in our ranking of customers.

Investment plans and future visions

3. What investment plans and future developments are your company planning that can benefit Cederroth? How will these benefit Cederroth?

We are frequently developing new products with improving price / performance. Recent examples: active ingredients with a high level of documentation and cost optimised emulsifiers.

Knowledge about second tier suppliers

4. What kind of documentation about your suppliers is being stored?

N/A

Second tier supplier environmental evaluation

5. To what extent is your company evaluating the environmental performance of your suppliers? Please attach documentation if available.

N/A

Environmental management systems

6. To what extent is your company adopting an environmental management system?

7. What are your goals/planned actions for improving your environmental performance?
Please attach action plan or list of corrective actions if available.

See attached documentation

Compliance to environmental regulations and risk material assessment

8. To what extent is your company following EU-directives concerning environmental regulations regarding packaging, chemicals etc.?
9. How is your company working towards reduced usage of risk materials (materials not yet listed as hazardous but with risk being listed in the near future) and hazardous waste?

See attached documentation

Energy and waste parameters

10. How are your company working with reducing energy consumption? Which actions are taken and what actions are planned?
11. How are your company working with reducing air emissions? Which actions are taken and what actions are planned?
12. How are your company working with reducing land emissions? Which actions are taken and what actions are planned?
13. How are your company working with reducing water emissions? Which actions are taken and what actions are planned?

See attached documentation

Public disclosure of environmental record

14. Please attach information about your company's public disclosure of environmental record.

Attached

Master thesis – Supplier evaluation with environmental focus

We request information to evaluate a supplier evaluation model created as a part of a master thesis for Cederroth AB performed by two students of Industrial Engineering and Management at Linköping University. The purpose of this thesis is to design a model for strategic supplier evaluation that takes environmental aspects into consideration and regards Cederroth's strategic suppliers.

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As one of Cederroth's strategic suppliers we really appreciate Your contribution!

Emma Nordling & Jens Egeröd

Upplands Väsby, 2010-10-25

Instructions

This supplier evaluation model includes criteria that have not been present in the previous evaluation model of Cederroth, which is the reason why we ask for Your assistance to supply with information that is missing. Your information is important to us and we appreciate Your helpfulness!

Please send answers on following questions:

Supply chain risk assessment

1. What actions have been taken to secure the supply of goods to Cederroth?
 - Availability of extra tools in case of tools becoming defect
We have a systematic pre-maintenance program for all major production machines. In addition to this we are storing spare parts according to suppliers advice and our long time experience of needed spares.
 - Actions preventing shortages in supply from second tier supplier
 - Dual supply
 - Safety stock
Our material purchase is based on demand forecasts. We practically never produce our material inventory to empty status. As an average we have 1-3 months demand of customer specific raw materials in our inventory
 - Collaboration with fire department, storing vital tools in fire safety boxes etc.
We have an automatic fire, warming, air condition and burglar alarm system contacting directly to officials.
 - Actions preventing shortage in supply due to machinery breakdown
Almost all of Cederroth products can be manufactured with two optional machines. We produce ready products as an average covering 3-6 months demand. New production is scheduled so that we normally have 3-9 week demand in our stock. This system helps us to prevent supply shortages in machine breakdown situations
 - Other actions
**Good long term relationships with all major material suppliers
Long term supply and delivery time planning with suppliers
Flexible manufacturing agreed with personnel. Normal 2 shift production can be very quickly changed to three shifts for decided machines.**
2. How is the supply to Cederroth prioritized in case of limited production and high demand of your products?
We are working with all our customers using similar planning and safety stock systems. This system prevents very well out of stock systems and also informs us early (3-6 months) in advance possible capacity bottlenecks. This means that we have enough time to adjust

our capacity. In case something like this anyhow would happen, we would negotiate with all our major customers to establish an approved plan to minimize shortage situations. Cederroth as one of the strategic partners would of course be in important position.

Investment plans and future visions

3. What investment plans and future developments are your company planning that can benefit Cederroth? How will these benefit Cederroth?

We are continuously investing in order to improve our quality and production efficiency.

Current major ongoing investments are

- renewal of liquid mixing department,
- renewal of ERP system
- building of new warehouse space
- implementation of flexible pouch with spout production line

These and other investments benefit Cederroth by enabling us to keep production costs as low as possible and improve the quality of products.

As discussed earlier with Cederroth representatives we are always interested in developing our operations.

Knowledge about second tier suppliers

4. What kind of documentation about your suppliers is being stored?

We store the following documentation: specifications of materials, safety data sheets, documents confirming swan label approval of materials, dimensional drawings (die cutting drawings), printing proofs, price lists, orders, order confirmations, delivery forecasts and order status reports, material quality inspection reports, list of complaints, supplier agreements, meeting memos

Second tier supplier environmental evaluation

5. To what extent is your company evaluating the environmental performance of your suppliers? Please attach documentation if available.

Our supplier evaluation includes getting a general picture of the environmental values of each supplier. Our general requirement for materials and suppliers are that they shall be Swan Label approved. This is documented as a list of supplier and materials that are swan label approved. Any additional requirements concerning the environmental performance level, than EU laws require, has not been set.

Environmental management systems

6. To what extent is your company adopting an environmental management system?

In our yearly strategic planning process environmental issues is one the key subjects. We specify yearly actions for environmental development projects.

7. What are your goals/planned actions for improving your environmental performance?

Environmental measures are following:

Recycling% of production waste, sorting% of production waste, Energy usage MWh/added production value, CO2 emission, Customer quantity using stacked pallets.

Major current actions are following

- improving of energy efficiency in our facility
- establishing written environmental management system
- study of replacing current oil heating with more ecological one (earth warm)

Compliance to environmental regulations and risk material assessment

8. To what extent is your company following EU-directives concerning environmental regulations regarding packaging, chemicals etc.?

We follow all EU-directives in our operational field.

9. How is your company working towards reduced usage of risk materials (materials not yet listed as hazardous but with risk being listed in the near future) and hazardous waste?

There is very little quantities of risk materials or hazardous waste we have in our production. Practically mainly production equipment and facility related items. (Oil, grease, batteries, fluorescent lamps) For these we have a collecting containers in the factory. Where from it is transported to Ekokem (Finnish hazardous waste disposal plant)

Energy and waste parameters

10. How are your company working with reducing energy consumption? Which actions are taken and what actions are planned?

Taken

- Air-source heat pumps installed
- Air conditioning and heating system renewed with advanced control system
- lights renewed to low energy versions
- heating system renewed for better efficiency
- double stacking of delivery pallets to reduce transporting needs
- production waste minimizing projects (more products with less energy)

Planning

- Change to earth heating system
- Further develop heat and air-conditioning control
- Non pallet tissue deliveries (transport minimizing)

11. How are your company working with reducing air emissions? Which actions are taken and what actions are planned?

As answered on previous question; Oil heating renewal, transport both in deliveries and raw material supplies.

12. How are your company working with reducing land emissions? Which actions are taken and what actions are planned?

Continuous programs on reducing landfill waste.

13. How are your company working with reducing water emissions? Which actions are taken and what actions are planned?

Our main water emissions are washing waters of production equipments. Quantity is not big. Not much can be done on water emissions.

Public disclosure of environmental record

14. Please attach information about your company's public disclosure of environmental record.

We don't have public disclosure of our environmental record.

Design Analysis

Customer Requirements Priorities

11/3/2010

15:09:43

Pairwise comparison 0 for less, 1 for equal, 2 for more.

	General	Production	Quality	Logistics	Product development	Purchasing	Environmental
General							
Production							
Quality							
Logistics							
Product development							
Purchasing							
Environmental							

Priority

Normalise
d Priority

Instruktion: Vikta varje kriteriepar parvis.
Rad X mot Kolumn Y, om Rad X är viktigare än
Kolumn Y fyll i 2 i det vita fältet, om Rad X är
mindre viktig än Kolumn Y fyll i 0, om lika viktiga
fyll i 1.

Fyll enbart i de vita fälten.

Tack för din medverkan!
Jens och Emma

Design Analysis

Customer Requirements Priorities

11/1/2010

14:26:04

Pairwise comparison 0 for less, 1 for equal, 2 for more.

Instruktion: Vikta varje kriteriepar parvis.
Rad X mot Kolumn Y, om Rad X är viktigare än Kolumn Y fyll i 2 i det vita fältet, om Rad X är mindre viktig än Kolumn Y fyll i 0, om lika viktiga fyll i 1.

	Uniqueness	General attention from supplier	Priority	Normalise d Priority
Uniqueness				
General attention from supplier				

Criteria weighting

Customer Requirements Priorities

11/1/2010

14:20:02

Pairwise comparison 0 for less, 1 for equal, 2 for more.

	Condition facilities/equipment	Tidiness in production facilities	Production-technical competence	Priority	Normalise d Priority
Condition facilities/equipment					
Tidiness in production facilities					
Production-technical competence					

Instruktion: Vikta varje kriteriepar parvis.

Rad X mot Kolumn Y, om Rad X är viktigare än Kolumn Y fyll i 2 i det vita fältet, om Rad X är mindre viktig än Kolumn Y fyll i 0, om lika viktiga fyll i 1.

Fyll enbart i de vita fälten.

Tack för din medverkan!

Jens och Emma

Design Analysis

Customer Requirements Priorities

11/1/2010

14:27:35

Pairwise comparison 0 for less, 1 for equal, 2 for more.

	Complaints management system	Responsiveness	Quality management system	General product safety risk	In process control/inspection	Total value of complaints	Total value of rejections	Traceability
Complaints management system								
Responsiveness								
Quality management system								
General product safety risk								
In process control/inspection								
Total value of complaints								
Total value of rejections								
Traceability								

Priority

Normalise
d Priority

Instruktion: Vikta varje kriteriepar parvis.

Rad X mot Kolumn Y, om Rad X är viktigare än Kolumn Y fyll i 2 i det vita fältet, om Rad X är mindre viktig än Kolumn Y fyll i 0, om lika viktiga fyll i 1.

Fyll enbart i de vita fälten.

Tack för din medverkan!
Jens och Emma

Criteria weighting

Customer Requirements Priorities

11/1/2010

14:29:15

Pairwise comparison 0 for less, 1 for equal, 2 for more.

	Responsiveness	Accuracy in logistics data	Hitrate - Quantity	Hitrate - Time	Lead time reduction	Short term flexibility in order volume	IT-maturity
Responsiveness							
Accuracy in logistics data							
Hitrate - Quantity							
Hitrate - Time							
Lead time reduction							
Short term flexibility in order volume							
IT-maturity							

Priority

Instruktion: Vikta varje kriteriepar parvis.
 Rad X mot Kolumn Y, om Rad X är viktigare än Kolumn Y fyll i 2 i det vita fältet, om Rad X är mindre viktig än Kolumn Y fyll i 0, om lika viktiga fyll i 1.

Fyll enbart i de vita fälten.

Tack för din medverkan!
 Jens och Emma

Normalise
 d Priority

Criteria weighting

Customer Requirements Priorities

11/1/2010

14:28:25

Pairwise comparison 0 for less, 1 for equal, 2 for more.

	Product documentation	Responsiveness	R&D competence	Technical support	Product portfolio/Innovation	Product development process
Product documentation						
Responsiveness						
R&D competence						
Technical support						
Product portfolio/Innovation						
Product development process						

Priority

Normalise
d Priority

Instruktion: Vikta varje kriteriepar parvis.
Rad X mot Kolumn Y, om Rad X är viktigare än
Kolumn Y fyll i 2 i det vita fältet, om Rad X är mindre
viktig än Kolumn Y fyll i 0, om lika viktiga fyll i 1.

Fyll enbart i de vita fälten.

Tack för din medverkan!
Jens och Emma

Criteria weighting

Customer Requirements Priorities

11/1/2010

14:30:05

Pairwise comparison 0 for less, 1 for equal, 2 for more.

	Responsiveness	Cost reducing initiatives	Supply chain risk assessment	Investment plans and future visions	Capacity for increased demand	Knowledge about second tier suppliers	Cost structure
Responsiveness							
Cost reducing initiatives							
Supply chain risk assessment							
Investment plans and future visions							
Capacity for increased demand							
Knowledge about second tier suppliers							
Cost structure							

Priority

Normalised
Priority

Instruktion: Vikta varje kriteriepar parvis.
Rad X mot Kolumn Y, om Rad X är viktigare
än Kolumn Y fyll i 2 i det vita fältet, om Rad X
är mindre viktig än Kolumn Y fyll i 0, om lika
viktiga fyll i 1.

Fyll enbart i de vita fälten.

Tack för din medverkan!
Jens och Emma

Criteria weighting

Customer Requirements Priorities

11/1/2010

14:18:21

Pairwise comparison 0 for less, 1 for equal, 2 for more.

Instruktion: Vikta varje kriteriepar parvis.
 Rad X mot Kolumn Y, om Rad X är viktigare än
 Kolumn Y fyll i 2 i det vita fältet, om Rad X är
 mindre viktig än Kolumn Y fyll i 0, om lika viktiga
 fyll i 1.

Fyll enbart i de vita fälten.

Tack för din medverkan!
 Jens och Emma

	Second tier supplier environmental evaluation	Location distance	Environmental management systems	Compliance to environmental regulations and risk material assessment	Energy and waste parameters	Public disclosure of environmental record	Potential for environmental cooperation	Package performance
Second tier supplier environmental evaluation								
Location distance								
Environmental management systems								
Compliance to environmental regulations and risk material assessment								
Energy and waste parameters								
Public disclosure of environmental record								
Potential for environmental cooperation								
Package performance								

Priority

Normalised
Priority

Appendix J

Weights used in the final supplier evaluation model are marked in the bold cells.
Weights in the column "Total normalized weights" have been used in the sensitivity analysis

	Conny Åslund	Mira Ludkiewicz	Monica Engström	Magnus Andersson	Total Normalized Weights:	Weighting performed in Group
General						
Uniqueness	2.00	1.00	2.00	1.00	1.50	1.00
General attention from supplier	0.00	1.00	0.00	1.00	0.50	1.00
Production						
Condition facilities/equipment	1.50	1.50	0.86	0.50	1.09	1.00
Tidiness in production facilities	1.00	0.00	0.86	0.50	0.59	1.00
Production-technical competence	0.50	1.50	1.29	2.00	1.32	1.00
Quality						
Jan Karlström						
Complaints management system	0.57					
Responsiveness	0.43					
Quality management system	0.29					
General product safety risk	1.43					
In process control/inspection	1.43					
Total value of complaints	1.14					
Total value of rejections	1.29					
Traceability	1.43					
Logistics						
Mats Björkqvist						
Responsiveness	0.17					
Accuracy in logistics data	1.00					
Hitrate - Quantity	1.83					
Hitrate - Time	1.83					
Lead time reduction	1.00					
Short term flexibility in order volume	1.00					
IT-maturity	0.17					
Product development						
Åsa Knutsson Yvonne Tornevik Stefan Snell						
Product documentation	1.00	1.40	1.80		1.40	1.60
Responsiveness	1.80	0.20	0.80		0.93	0.80
R&D competence	0.40	1.40	1.60		1.13	1.20
Technical support	0.80	1.20	0.80		0.93	1.20
Product portfolio/Innovation	0.20	1.40	0.40		0.67	0.60
Product development process	1.80	0.40	0.60		0.93	0.60
Purchasing						
Conny Åslund Mira Ludkiewicz Monica Engström Magnus Andersson						
Responsiveness	1.00	1.00	1.33	2.00	1.33	1.67
Cost reducing initiatives	1.17	0.83	1.33	1.17	1.13	0.83
Supply chain risk assessment	0.00	1.17	1.33	1.17	0.92	1.50
Investment plans and future visions	1.83	1.33	0.50	1.00	1.17	0.67
Capacity for increased demand	0.50	0.83	1.33	1.17	0.96	1.83
Knowledge about second tier suppliers	1.17	1.00	0.33	0.50	0.75	0.25
Cost structure	1.33	0.83	0.83	0.00	0.75	0.25
Environment						
Jan Karlström						
Second tier supplier environmental ev	0.29					
Location distance	0.43					
Environmental management systems	0.57					
Compliance to environmental regulatio	1.86					
Energy and waste parameters	1.14					
Public disclosure of environmental rec	1.14					
Potential for environmental cooperati	0.71					
Package performance	1.86					

Model 1

<i>Criteria category</i>	<i>Criteria</i>
<i>Production</i>	<ul style="list-style-type: none"> Condition facilities/equipment Investment plans Orderliness Production-technical competence
<i>Quality</i>	<ul style="list-style-type: none"> Frequency of claims Frequency of rejections Traceability Claims Management Quality management system
<i>Service</i>	<ul style="list-style-type: none"> Delivery security Delivery reliability Leadtime Flexibility Stock availability
<i>Product development</i>	<ul style="list-style-type: none"> Supplier investment in R&D Documentation R&D competence R&D cooperation
<i>Price/Cost</i>	<ul style="list-style-type: none"> Cost reduction Price development
<i>Environmental efforts</i>	<ul style="list-style-type: none"> ISO 14001 certification Top management commitment to environmental management Utilization of hazardous materials Reusable wrapping materials Recycling Labelling Second tier supplier environmental evaluation Solid waste tonnage Public disclosure of environmental record Supplier's advances in providing environmental friendly packages Willingness to environmental cooperation
<i>Miscellaneous</i>	<ul style="list-style-type: none"> Communication Location distance Cooperation willingness Reputation Cederroth's share of supplier's turnover Ordering process Quality in suppliers purchasing process Knowledge about second tier suppliers

Model 2

<i>Criteria category</i>	<i>Criteria</i>	<i>Criteria</i>
<i>Production</i>		
	Condition facilities/equipment	Condition facilities/equipment
	Investment plans and future visions	Investment plans and future visions
	Capacity for increased demand	Capacity for increased demand
	Tidiness in production facilities	Tidiness in production facilities
	Production-technical competence	Production-technical competence
<i>Quality</i>		
	Claims Management systems	Ask the supplier how they will handle claims. Ask for documents.
	Responsiveness	Availability, accessibility and language.
	Quality management system	Talk to Lena Carlson/Carlström
	Total value of claims	Total value of claims/purchasing value
	Total value of rejections	Total value of rejections/purchasing value
	Traceability	Traceability
<i>Logistics</i>		
	Responsiveness	Availability, accessibility and language.
	Accuracy in basic data	Tagging, logistic related figures
	Delivery security	Delivery security
	Delivery reliability	Delivery reliability
	Leadtime	Leadtime
	Short term flexibility in order volume	Season varieties, emergency orders, trends.
	IT-maturity	APS, EDI, prerequisites for VMI
<i>Product development</i>		
	Supplier investment in R&D	Supplier investment in R&D in relation to turnover
	Product documentation	Drawings, specifications, risk assessment, SDS for included raws, REACH-compliance for chemicals, compliance to EU-directives for packages
	Responsiveness	Availability, accessibility and language.
	R&D competence	R&D competence
	Product portfolio	Breadth, development, complexity, technical level, number of new products. Indicate the quality and awareness in the supplier and in R&D
<i>Purchasing</i>		
	Supply chain risk assessment	Risk for problems in delivery, that Cederroth for some reason can't fulfill their demand. Risk due to Cederroth's share of supplier's turnover
	Responsiveness	Availability, accessibility and language.

Reputation	Reputation
Cost reduction initiatives	Attitude and suggestions from supplier on costreducing activities
Knowledge about second tier suppliers	Knowledge about second tier suppliers
General attention from supplier	Supplier's prioritization and attention of Cederroths needs and requests over all categories
Pricing structure	Length of pricing agreement, correlation to spotprice on raws and transparency in supplier costdrivers.

Environmental aspects

Environmental management systems	ISO 14001 certification, EMAS or internal system
Second tier supplier environmental evaluation	Second tier supplier environmental evaluation
Eco labeling	Availability of eco labelled products/total number of products in the product category. Useful for packages, but perhaps not for chemicals or CM.
Location distance	Location distance
Compliance to environmental regulations and restrictions	Utilization of hazardous materials, Reusable wrapping materials, Recycling
Solid waste tonnage	Solid waste tonnage
Public disclosure of environmental record	Existence and exhaustiveness
Potential for environmental cooperation	Openness for projects focusing on lowering environmental impact. Initiatives, attitude, current relationship, reputation.

Model 3

<i>Criteria category</i>	<i>Criteria</i>	<i>Description</i>
<i>General</i>		
	Uniqueness	Evaluates unique attributes important to Cederroth e.g. unique competences, good fit with Cederroth's strategy, unique product or supplier of strategical importance.
	General attention from supplier	Supplier's prioritization of Cederroth as customer, attention paid to Cederroth's general needs, requests and level of contacts.
<i>Production</i>		
	Condition facilities/equipment	Evaluates the condition and functionality of supplier facilities and equipment.
	Tidiness in production facilities	Evaluates tidiness in production facilities and general orderliness.
	Production-technical competence	General assessment of production-technical competence. Assessment should be based upon the general feeling aquired during audit or other experiences.
<i>Quality</i>		
	Total value of complaints	Evaluation of the total value of complaints divided by the purchasing value.
	Total value of rejections	Evaluation of the total value of rejections divided by the purchasing value.
	Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding quality issues.
	Traceability	Evaluates traceability of the products.
	Complaints management system	Assessment of supplier's complaints management system, plans for how to handle claims and corresponding corrective actions aiming at preventing similar complaints in the future.
	Quality management system	Evaluates the quality management system.
	General product safety risk	Evaluates the risk for product mix-up in production. Products such as capsules and tablets are targeted.
	In process control/inspection	Evaluation of in process controls, if statistic process control (SPC) is applied and how inspections are executed.
<i>Logistics</i>		
	Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding logistics issues.
	Accuracy in logistics data	Evaluates accuracy in basic logistics data e.g. tagging and logistic related figures.
	Hirate - Quantity	Evaluates delivery security by measuring the delivery quantity accuracy.
	Hirate - Time	Evaluates delivery reliability by measuring the delivery time accuracy.
	Lead time reduction	Assessment of lead time and lead time-reducing actions.
	Short term flexibility in order volume	Evaluates supplier performance in flexibility e.g. season varieties, emergency orders and trends.
	IT-maturity	Existance of IT-systems such as APS, EDI and prerequisites for VMI.
<i>Product development</i>		
	Product documentation	Assessment of existance and level of detail of drawings and specifications, risk assessment, existance of SDS for included raw materials, REACH-compliance for chemicals and compliance to EU-directives for packaging.
	Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding R&D issues.
	R&D competence	Evaluates supplier's R&D competence based on experience with the supplier and general feeling aquired.
	Technical support	Assesses technical support available from supplier regarding product defaults and supplier assistance with product specific knowledge.
	Product portfolio/Innovation	Evaluation of breadth, complexity and technical level of product portfolio and development of existing products and share of new products in the portfolio. Level of innovation within the company should also be assessed.
	Product development process	Evaluation of the product development process by controlling that activities are performed in the right order and that key requirements are clearly stated before entering next steps.
<i>Purchasing</i>		

Appendix M

Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding general purchasing issues.
Cost reducing initiatives	Evaluates supplier's cost-reducing initiatives, actions and attitude.
Supply chain risk assessment	Assesses supply chain risk e.g. delivery problem due to defect tools, second tier supplier delivery problems, actions taken by supplier to secure supply, collaboration with fire department and existence of fire boxes for important tools etc.
Investment plans and future visions	Evaluates investment plans and future visions of relevance for Cederroth e.g. investments in new equipment, tools, R&D or training that Cederroth can benefit from.
Capacity for increased demand	Assessment of supplier's capacity for long-term increased demand.
Knowledge about second tier suppliers	Supplier's general knowledge about second tier suppliers.
Cost structure	Evaluates transparency in supplier cost drivers and how prices are correlated to raw material indices.
<i>Environmental</i>	
Second tier supplier environmental evaluation	Assessment of the supplier's evaluation of second tier supplier's environmental performance, criteria characteristics and to what extent they are evaluated.
Location distance	Evaluates location distance from Cederroth's production site where the supplier products are used aiming at reducing environmental impact by reduced supplier distance.
Environmental management systems	Assessment of supplier's environmental policies, goals, action plans, and corrective actions. Evaluation of ISO 14001 certification, EMAS or internal environmental management system should be included in the assessment.
Compliance to environmental regulations and risk material assessment	Evaluates how well the supplier follows environmental laws and regulations and to what extent risk materials and hazardous materials are used by the supplier.
Energy and waste parameters	Evaluates supplier's performance in regard of energy consumption and relevant waste parameters such as air, water and land emissions.
Public disclosure of environmental record	Evaluates existence, exhaustiveness and transparency of supplier environmental record.
Potential for environmental cooperation	Assessment of supplier's openness for mutual projects focusing on lowering environmental impact. Initiatives, attitude and current status of relationship.
Package performance	Assessment of supplier's performance in palleting goods and usage of packaging material.

Model 4

If criterion not
applicable mark
the cell with X

Criteria category	Criteria	Description	Not applicable: X	Normalized weight	Score (1-5)	Motivation
General				0.29		
	Uniqueness	Evaluates unique attributes important to Cederroth e.g. unique competences, good fit with Cederroth's strategy, unique product or supplier of strategic importance.		0.50		
	General attention from supplier	Supplier's prioritization of Cederroth as customer, attention paid to Cederroth's general needs, requests and level of contacts.		0.50		
Production				0.02		
	Condition facilities/equipment	Evaluates the condition and functionality of supplier facilities and equipment.		0.33		
	Tidiness in production facilities	Evaluates tidiness in production facilities and general orderliness.		0.33		
	Production-technical competence	General assessment of production-technical competence. Assessment should be based upon the general feeling acquired during audit or other experiences.		0.33		
Quality				0.14		
	Total value of complaints	Evaluation of the total value of complaints divided by the purchasing value.		0.14		
	Total value of rejections	Evaluation of the total value of rejections divided by the purchasing value.		0.16		
	Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding quality issues.		0.05		
	Traceability	Evaluates traceability of the products.		0.18		
	Complaints management system	Assessment of supplier's complaints management system, plans for how to handle claims and corresponding corrective actions aiming at preventing similar complaints in the future.		0.07		
	Quality management system	Evaluates the quality management system.		0.04		
	General product safety risk	Evaluates the risk for product mix-up in production. Products such as capsules and tablets are targeted.		0.18		
	In process control/inspection	Evaluation of in process controls, if statistic process control (SPC) is applied and how inspections are executed.		0.18		
Logistics				0.10		
	Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding logistics issues.		0.02		
	Accuracy in logistics data	Evaluates accuracy in basic logistics data e.g. tagging and logistic related figures.		0.14		
	Hitrate - Quantity	Evaluates delivery security by measuring the delivery quantity accuracy.		0.26		
	Hitrate - Time	Evaluates delivery reliability by measuring the delivery time accuracy.		0.26		
	Lead time reduction	Assessment of lead time and lead time-reducing actions.		0.14		
	Short term flexibility in order volume	Evaluates supplier performance in flexibility e.g. season varieties, emergency orders and trends.		0.14		
	IT-maturity	Existence of IT-systems such as APS, EDI and prerequisites for VMI.		0.02		
Product development				0.19		
	Product documentation	Assessment of existence and level of detail of drawings and specifications, risk assessment, existence of SDS for included raw materials, REACH-compliance for chemicals and compliance to EU-directives for packaging.		0.27		
	Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding R&D issues.		0.13		
	R&D competence	Evaluates supplier's R&D competence based on experience with the supplier and general feeling acquired.		0.20		
	Technical support	Assesses technical support available from supplier regarding product defaults and supplier assistance with product specific knowledge.		0.20		
	Product portfolio/Innovation	Evaluation of breadth, complexity and technical level of product portfolio and development of existing products and share of new products in the portfolio. Level of innovation within the company should also be assessed.		0.10		
	Product development process	Evaluation of the product development process by controlling that activities are performed in the right order and that key requirements are clearly stated before entering next steps.		0.10		
Purchasing				0.12		

Appendix N

Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding general purchasing issues.		0.24		
Cost reducing initiatives	Evaluates supplier's cost-reducing initiatives, actions and attitude.		0.12		
Supply chain risk assessment	Assesses supply chain risk e.g. delivery problem due to defect tools, second tier supplier delivery problems, actions taken by supplier to secure supply, collaboration with fire department and existence of fire boxes for important tools etc.		0.21		
Investment plans and future visions	Evaluates investment plans and future visions of relevance for Cederroth e.g. investments in new equipment, tools, R&D or training that Cederroth can benefit from.		0.10		
Capacity for increased demand	Assessment of supplier's capacity for long-term increased demand.		0.26		
Knowledge about second tier suppliers	Supplier's general knowledge about second tier suppliers.		0.04		
Cost structure	Evaluates transparency in supplier cost drivers and how prices are correlated to raw material indices.		0.04		
Environment			0.14		
Second tier supplier environmental evaluation	Assessment of the supplier's evaluation of second tier supplier's environmental performance, criteria characteristics and to what extent they are evaluated.		0.04		
Location distance	Evaluates location distance from Cederroth's production site where the supplier products are used aiming at reducing environmental impact by reduced supplier distance.		0.05		
Environmental management systems	Assessment of supplier's environmental policies, goals, action plans, and corrective actions. Evaluation of ISO 14001 certification, EMAS or internal environmental management system should be included in the assessment.		0.07		
Compliance to environmental regulations and risk material assessment	Evaluates how well the supplier follows environmental laws and regulations and to what extent risk materials and hazardous materials are used by the supplier.		0.23		
Energy and waste parameters	Evaluates supplier's performance in regard of energy consumption and relevant waste parameters such as air, water and land emissions.		0.14		
Public disclosure of environmental record	Evaluates existence, exhaustiveness and transparency of supplier environmental record.		0.14		
Potential for environmental cooperation	Assessment of supplier's openness for mutual projects focusing on lowering environmental impact. Initiatives, attitude and current status of relationship.		0.09		
Package performance	Assessment of supplier's performance in palleting goods and usage of packaging material.		0.23		

Model 5
Strategic Supplier Evaluation Sheet

	Fields to be filled in
3	Warning: Low supplier score

Scoring scale	
1	Poor
2	Not sufficient
3	Satisfactory
4	Good
5	Excellent

Ranking scale	
> 4,60	Supreme class
3,80 < 4,60	Standard class
3,00 < 3,80	Poor class
< 3,00	Desourced class

Supplier name:	
Date:	
Total score:	0.00
Supplier ranking:	Desourced class

Percental fullfilment of total assigned weight in each category:	
General	Not applicable
Production	Not applicable
Quality	Not applicable
Logistics	Not applicable
Product development	Not applicable
Purchasing	Not applicable
Environment	Not applicable

				If criterion not applicable mark the cell with X			
Criteria category	Criteria	Description	Not applicable: X	Normalized weight	Score (1-5)	Motivation	
General				0.29			Total score - General: 0.00
	Uniqueness	Evaluates unique attributes important to Cederroth e.g. unique competences, good fit with Cederroth's strategy, unique product or supplier of strategic importance.		0.50			(Max Total score - General:) 0.00
	General attention from supplier	Supplier's prioritization of Cederroth as customer, attention paid to Cederroth's general needs, requests and level of contacts.		0.50			
Production				0.02			Total score - Production: 0.00
	Condition facilities/equipment	Evaluates the condition and functionality of supplier facilities and equipment.		0.33			(Max Total score - Production:) 0.00
	Tidiness in production facilities	Evaluates tidiness in production facilities and general orderliness.		0.33			
	Production-technical competence	General assessment of production-technical competence. Assessment should be based upon the general feeling acquired during audit or other experiences.		0.33			
Quality				0.14			Total score - Quality: 0.00
	Total value of complaints	Evaluation of the total value of complaints divided by the purchasing value.		0.14			(Max Total score - Quality:) 0.00
	Total value of rejections	Evaluation of the total value of rejections divided by the purchasing value.		0.16			
	Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding quality issues.		0.05			
	Traceability	Evaluates traceability of the products.		0.18			
	Complaints management system	Assessment of supplier's complaints management system, plans for how to handle claims and corresponding corrective actions aiming at preventing similar complaints in the future.		0.07			
	Quality management system	Evaluates the quality management system.		0.04			
	General product safety risk	Evaluates the risk for product mix-up in production. Products such as capsules and tablets are targeted.		0.18			
	In process control/inspection	Evaluation of in process controls, if statistic process control (SPC) is applied and how inspections are executed.		0.18			
Logistics				0.10			Total score - Logistics: 0.00
	Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding logistics issues.		0.02			(Max Total score - Logistics:) 0.00
	Accuracy in logistics data	Evaluates accuracy in basic logistics data e.g. tagging and logistic related figures.		0.14			
	Hitrate - Quantity	Evaluates delivery security by measuring the delivery quantity accuracy.		0.26			
	Hitrate - Time	Evaluates delivery reliability by measuring the delivery time accuracy.		0.26			
	Lead time reduction	Assessment of lead time and lead time-reducing actions.		0.14			
	Short term flexibility in order volume	Evaluates supplier performance in flexibility e.g. season varieties, emergency orders and trends.		0.14			
	IT-maturity	Existence of IT-systems such as APS, EDI and prerequisites for VMI.		0.02			
Product development				0.19			Total score - Product development: 0.00
	Product documentation	Assessment of existence and level of detail of drawings and specifications, risk assessment, existence of SDS for included raw materials, REACH-compliance for chemicals and compliance to EU-directives for packaging.		0.27			(Max Total score - Product development:) 0.00

Appendix O

Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding R&D issues.		0.13				
R&D competence	Evaluates supplier's R&D competence based on experience with the supplier and general feeling acquired.		0.20				
Technical support	Assesses technical support available from supplier regarding product defaults and supplier assistance with product specific knowledge.		0.20				
Product portfolio/Innovation	Evaluation of breadth, complexity and technical level of product portfolio and development of existing products and share of new products in the portfolio. Level of innovation within the company should also be assessed.		0.10				
Product development process	Evaluation of the product development process by controlling that activities are performed in the right order and that key requirements are clearly stated before entering next steps.		0.10				
Purchasing			0.12			Total score - Purchasing:	0.00
Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding general purchasing issues.		0.24			(Max Total score - Purchasing:)	0.00
Cost reducing initiatives	Evaluates supplier's cost-reducing initiatives, actions and attitude.		0.12				
Supply chain risk assessment	Assesses supply chain risk e.g. delivery problem due to defect tools, second tier supplier delivery problems, actions taken by supplier to secure supply, collaboration with fire department and existence of fire boxes for important tools etc.		0.21				
Investment plans and future visions	Evaluates investment plans and future visions of relevance for Cederroth e.g. investments in new equipment, tools, R&D or training that Cederroth can benefit from.		0.10				
Capacity for increased demand	Assessment of supplier's capacity for long-term increased demand.		0.26				
Knowledge about second tier suppliers	Supplier's general knowledge about second tier suppliers.		0.04				
Cost structure	Evaluates transparency in supplier cost drivers and how prices are correlated to raw material indices.		0.04				
Environment			0.14			Total score - Environment:	0.00
Second tier supplier environmental evaluation	Assessment of the supplier's evaluation of second tier supplier's environmental performance, criteria characteristics and to what extent they are evaluated.		0.04			(Max Total score - Environment:)	0.00
Location distance	Evaluates location distance from Cederroth's production site where the supplier products are used aiming at reducing environmental impact by reduced supplier distance.		0.05				
Environmental management systems	Assessment of supplier's environmental policies, goals, action plans, and corrective actions. Evaluation of ISO 14001 certification, EMAS or internal environmental management system should be included in the assessment.		0.07				
Compliance to environmental regulations and risk material assessment	Evaluates how well the supplier follows environmental laws and regulations and to what extent risk materials and hazardous materials are used by the supplier.		0.23				
Energy and waste parameters	Evaluates supplier's performance in regard of energy consumption and relevant waste parameters such as air, water and land emissions.		0.14				
Public disclosure of environmental record	Evaluates existence, exhaustiveness and transparency of supplier environmental record.		0.14				
Potential for environmental cooperation	Assessment of supplier's openness for mutual projects focusing on lowering environmental impact. Initiatives, attitude and current status of relationship.		0.09				
Package performance	Assessment of supplier's performance in palleting goods and usage of packaging material.		0.23				
Total score:							0.00

Max total score:

5.00

Min total score:

0.00

Strategic Supplier Evaluation Sheet

	Fields to be filled in
3	Warning: Low supplier score

Scoring scale	
1	Poor
2	Not sufficient
3	Satisfactory
4	Good
5	Excellent

Ranking scale	
> 4,60	Supreme class
3,80 < 4,60	Standard class
3,00 < 3,80	Poor class
< 3,00	Desourced class

Supplier name:	
Date:	
Total score:	4.26
Supplier ranking:	Standard class

Percental fullfilment of total assigned weight in each category:	
General	90%
Production	60%
Quality	89%
Logistics	93%
Product development	91%
Purchasing	84%
Environment	65%

If criterion not applicable mark the cell with X

Criteria category	Criteria	Description	Not applicable: X	Normalized weight	Score (1-5)	Motivation		
General				0.29			Total score - General:	1.29
	Uniqueness	Evaluates unique attributes important to Cederroth e.g. unique competences, good fit with Cederroth's strategy, unique product or supplier of strategic importance.		0.50	4	Unique producers of wet wipes. Alternative suppliers are 20-30% more expensive and their products have shorter sustainability.	(Max Total score - General:)	1.43
	General attention from supplier	Supplier's prioritization of Cederroth as customer, attention paid to Cederroth's general needs, requests and level of contacts.		0.50	5	Cederroth is the largest customer of CMCS.		
Production				0.02			Total score - Production:	0.07
	Condition facilities/equipment	Evaluates the condition and functionality of supplier facilities and equipment.		0.33	3	Mix between new and old machinery. No edge competence in the production.	(Max Total score - Production:)	0.12
	Tidiness in production facilities	Evaluates tidiness in production facilities and general orderliness.		0.33	3	Clean in the new part of the production site, untidy and dirty in the old production site.		
	Production-technical competence	General assessment of production-technical competence. Assessment should be based upon the general feeling acquired during audit or other experiences.		0.33	3	Long machinery experience.		
Quality				0.14			Total score - Quality:	0.63
	Total value of complaints	Evaluation of the total value of complaints divided by the purchasing value.		0.14	5	No complaints the last two years.	(Max Total score - Quality:)	0.71
	Total value of rejections	Evaluation of the total value of rejections divided by the purchasing value.		0.16	5	No rejections the last two years.		
	Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding quality issues.		0.05	5	Fast and attentive.		
	Traceability	Evaluates traceability of the products.		0.18	5	Traceable on batch indetification number.		
	Complaints management system	Assessment of supplier's complaints management system, plans for how to handle claims and corresponding corrective actions aiming at preventing similar complaints in the future.		0.07	3	No defined processes, some routines.		
	Quality management system	Evaluates the quality management system.		0.04	3	No defined systems, some routines.		
	General product safety risk	Evaluates the risk for product mix-up in production. Products such as capsules and tablets are targeted.		0.18	4	Only risk is mix of luqid in the wet wipes, but very minor. Have not occur so far.		
	In process control/inspection	Evaluation of in process controls, if statistic process control (SPC) is applied and how inspections are executed.		0.18	4	in process control applied, can be more standardized.		
Logistics				0.10			Total score - Logistics:	0.44
	Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding logistics issues.		0.02	5	Fast, send root cause reports.	(Max Total score - Logistics:)	0.48
	Accuracy in logistics data	Evaluates accuracy in basic logistics data e.g. tagging and logistic related figures.		0.14	5	Packing slips correct, data correct.		

90%

60%

89%

93%

Appendix P

					100% last year, during two periods previously one failure reduces the performance to 94 %		
Hitrate - Quantity	Evaluates delivery security by measuring the delivery quantity accuracy.		0.26	5			
Hitrate - Time	Evaluates delivery reliability by measuring the delivery time accuracy.		0.26	5	100% last year, during two periods previously one failure reduces the performance to 94 %		
Lead time reduction	Assessment of lead time and lead time-reducing actions.		0.14	4	Reduced lead time normally causes increased costs.		
Short term flexibility in order volume	Evaluates supplier performance in flexibility e.g. season varieties, emergency orders and trends.		0.14	4	Extra production capacity when needed. Cederroth is a prioritized customer. Storing possibilities.		
IT-maturity	Existence of IT-systems such as APS, EDI and prerequisites for VMI.		0.02	2	Use production planning systems and invoice systems.		
Product development			0.19			Total score - Product development:	0.87
Product documentation	Assessment of existence and level of detail of drawings and specifications, risk assessment, existence of SDS for included raw materials, REACH-compliance for chemicals and compliance to EU-directives for packaging.		0.29	5	Cederroth recieve the specifications requested.	(Max Total score - Product development:)	0.95
Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding R&D issues.		0.15	5	Easy to work with, anser rapidly.		
R&D competence	Evaluates supplier's R&D competence based on experience with the supplier and general feeling acquired.		0.22	3	Cederroth develop products with other partners. CMCS is assuemd to assist within product development.		
Technical support	Assesses technical support available from supplier regarding product defaults and supplier assistance with product specific knowledge.		0.22	5	CMCS have shown good knowlegde in historical situations. High detail knowledge.		
Product portfolio/Innovation	Evaluation of breadth, complexity and technical level of product portfolio and development of existing products and share of new products in the portfolio. Level of innovation within the company should also be assessed.		0.12	5	CMCS has broad product portfolio.		
Product development process	Evaluation of the product development process by controlling that activities are performed in the right order and that key requirements are clearly stated before entering next steps.	x	0.00		Not applicable		
Purchasing			0.12			Total score - Purchasing:	0.50
Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding general purchasing issues.		0.24	5	Fast and well-functioning.	(Max Total score - Purchasing:)	0.59
Cost reducing initiatives	Evaluates supplier's cost-reducing initiatives, actions and attitude.		0.12	4	CMCS have implemented some cost-reducing initiatives themselves and do come up with own initiatives.		
Supply chain risk assessment	Assesses supply chain risk e.g. delivery problem due to defect tools, second tier supplier delivery problems, actions taken by supplier to secure supply, collaboration with fire department and existence of fire boxes for important tools etc.		0.21	4	Pre-maintenance programs for major production machines. Average 1-3 months of demans in stock. Almost all Cederroth products can be manufactured with two optional		
Investment plans and future visions	Evaluates investment plans and future visions of relevance for Cederroth e.g. investments in new equipment, tools, R&D or training that Cederroth can benefit from.		0.10	4	Renewal of liquid mixing department, renewal of ERP system, building of new warehouse space, implementation of flexible pouch with spout production line. High interest in developing their operations with Cederroth.		
Capacity for increased demand	Assessment of supplier's capacity for long-term increased demand.		0.26	4	Large possibilities.		
Knowledge about second tier suppliers	Supplier's general knowledge about second tier suppliers.		0.04	3	Documentation stored: specifications of materials, safety data sheets, documents confirming swan label approval of materials, dimensional drawings (die cutting drawings), printing proofs, price lists, orders, order confirmations, delivery forecasts and order status reports, material quality inspection reports, list of complaints, supplier agreements, meeting memos		
Cost structure	Evaluates transparency in supplier cost drivers and how prices are correlated to raw material indices.		0.04	4	Material costs and labour costs transparent. Overhead costs and revenue intransparent.		
Environment			0.14			Total score - Environment:	0.46
Second tier supplier environmental evaluation	Assessment of the supplier's evaluation of second tier supplier's environmental performance, criteria characteristics and to what extent they are evaluated.		0.04	3	Average performance, not good not bad.	(Max Total score - Environment:)	0.71
Location distance	Evaluates location distance from Cederroth's production site where the supplier products are used aiming at reducing environmental impact by reduced supplier distance.		0.05	4	relatively good when the alternative supplier is located in India. Market is Nordic.		
Environmental management systems	Assessment of supplier's environmental policies, goals, action plans, and corrective actions. Evaluation of ISO 14001 certification, EMAS or internal environmental management system should be included in the assessment.		0.07	3	Intangible goals and no system.		
Compliance to environmental regulations and risk material assessment	Evaluates how well the supplier follows environmental laws and regulations and to what extent risk materials and hazardous materials are used by the supplier.		0.23	4	CMCS's products cause less waste. Recycling activities.		
Energy and waste parameters	Evaluates supplier's performance in regard of energy consumption and relevant waste parameters such as air, water and land emissions.		0.14	4	CMCS present clear actions but no time frame.		

Public disclosure of environmental record	Evaluates existence, exhaustiveness and transparency of supplier environmental record.		0.14	1	Not existing		
Potential for environmental cooperation	Assessment of supplier's openness for mutual projects focusing on lowering environmental impact. Initiatives, attitude and current status of relationship.		0.09	4	Cederroth is a large customer and can impact the supplier significantly in regard of environmental actions.		
Package performance	Assessment of supplier's performance in palleting goods and usage of packaging material.		0.23	3	Stock keeping units(STU), pallets 1.25 m high, double palleting for some pallets.		
Total score:							4.26

Max total score: 5.00
Min total score: 0.00

Strategic Supplier Evaluation Sheet

	Fields to be filled in
3	Warning: Low supplier score

Scoring scale	
1	Poor
2	Not sufficient
3	Satisfactory
4	Good
5	Excellent

Ranking scale	
> 4,60	Supreme class
3,80 < 4,60	Standard class
3,00 < 3,80	Poor class
< 3,00	Desourced class

Supplier name:	
Date:	
Total score:	3.62
Supplier ranking:	Poor class

Percental fullfilment of total assigned weight in each category:	
General	50%
Production	Not applicable
Quality	95%
Logistics	85%
Product development	86%
Purchasing	73%
Environment	67%

If criterion not applicable mark the cell with X

Criteria category	Criteria	Description	Not applicable: X	Normalized weight	Score (1-5)	Motivation		
General				0.29			Total score - General:	0.72
	Uniqueness	Evaluates unique attributes important to Cederroth e.g. unique competences, good fit with Cederroth's strategy, unique product or supplier of strategic importance.		0.50	1	Large supplier but without unique competence.	(Max Total score - General:)	1.45
	General attention from supplier	Supplier's prioritization of Cederroth as customer, attention paid to Cederroth's general needs, requests and level of contacts.		0.50	4	Care about Cederroth as customer. Generally very short response time.		
Production				0.02			Total score - Production:	0.00
	Condition facilities/equipment	Evaluates the condition and functionality of supplier facilities and equipment.	x	0.00		Very controlled processes.	(Max Total score - Production:)	0.00
	Tidiness in production facilities	Evaluates tidiness in production facilities and general orderliness.	x	0.00				
	Production-technical competence	General assessment of production-technical competence. Assessment should be based upon the general feeling acquired during audit or other experiences.	x	0.00		Too large supplier so that evaluation in detail is not possible.		
Quality				0.14			Total score - Quality:	0.70
	Total value of complaints	Evaluation of the total value of complaints divided by the purchasing value.		0.20	5	Zero	(Max Total score - Quality:)	0.73
	Total value of rejections	Evaluation of the total value of rejections divided by the purchasing value.		0.22	5	Zero		
	Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding quality issues.		0.11	5	Conny Åslund has assessed this criterion based on his experience as buyer. Short response time and care about Cederroth as customer.		
	Traceability	Evaluates traceability of the products.		0.24	5	Total traceability, perfect labelling.		
	Complaints management system	Assessment of supplier's complaints management system, plans for how to handle claims and corresponding corrective actions aiming at preventing similar complaints in the future.		0.13	3	Handle complaints with seriousness, but also complaint process takes long time.		
	Quality management system	Evaluates the quality management system.		0.10	5	system, ISO		
	General product safety risk	Evaluates the risk for product mix-up in production. Products such as capsules and tablets are targeted.	x	0.00				
	In process control/inspection	Evaluation of in process controls, if statistic process control (SPC) is applied and how inspections are executed.	x	0.00				
Logistics				0.10			Total score - Logistics:	0.42
	Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding logistics issues.		0.02	4	When obstacles CCS show engagement and focus on corrective actions.	(Max Total score - Logistics:)	0.50
	Accuracy in logistics data	Evaluates accuracy in basic logistics data e.g. tagging and logistic related figures.		0.14	5	Well tagged, never errors in invoices or orders.		
	Hitrate - Quantity	Evaluates delivery security by measuring the delivery quantity accuracy.		0.26	5			
	Hitrate - Time	Evaluates delivery reliability by measuring the delivery time accuracy.		0.26	5			
	Lead time reduction	Assessment of lead time and lead time-reducing actions.		0.14	2	No possibility for Cederroth to impact the lead time. Lead time assured is mostly fulfilled.		
	Short term flexibility in order volume	Evaluates supplier performance in flexibility e.g. season varieties, emergency orders and trends.		0.14	3	Strong ambition for being flexible, however seldom succeed.		
	IT-maturity	Existence of IT-systems such as APS, EDI and prerequisites for VMI.		0.02	4	Use SAP, opportunities are significant.		
Product development				0.19			Total score - Product development:	0.83

50%

Not applicable

95%

85%

86%

Product documentation	Assessment of existence and level of detail of drawings and specifications, risk assessment, existence of SDS for included raw materials, REACH-compliance for chemicals and compliance to EU-directives for packaging.		0.27	4	Good documntation, Cederroth recieve what they request. Sometime have tests not been conducted even though Cederroth have requested them, however only occasionally.	(Max Total score - Product development:)	0.97
Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding R&D issues.		0.13	4	Well-functioning, historical cooperation, nothing is working bad but everything can be improved.		
R&D competence	Evaluates supplier's R&D competence based on experience with the supplier and general feeling acquired.		0.20	5	Extremely successful. Cederroth have good technical communication with CCS.		
Technical support	Assesses technical support available from supplier regarding product defaults and supplier assistance with product specific knowledge.		0.20	4	Good with respect to prerequisites.		
Product portfolio/Innovation	Evaluation of breadth, complexity and technical level of product portfolio and development of existing products and share of new products in the portfolio. Level of innovation within the company should also be assessed.		0.10	5	Broad portfolio, mix of hig-technology products and basic products. Slow start up of development projects. Large supplier, hence it takes time to reset.		
Product development process	Evaluation of the product development process by controlling that activities are performed in the right order and that key requirements are clearly stated before entering next steps.		0.10	4	Good documntation thoroughout the entire process.		
Purchasing			0.12			Total score - Purchasing:	0.45
Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding general purchasing issues.		0.26	4	Answer when Cederroth take contact.	(Max Total score - Purchasing:)	0.61
Cost reducing initiatives	Evaluates supplier's cost-reducing initiatives, actions and attitude.		0.15	1	No cost reducing activities are suggested.		
Supply chain risk assessment	Assesses supply chain risk e.g. delivery problem due to defect tools, second tier supplier delivery problems, actions taken by supplier to secure supply, collaboration with fire department and existence of fire boxes for important tools etc.		0.24	4	can produce at different sites simultaneously, however not clearly defined which products that can be produced at which sites. Currently shortage of cocoa oil at the market.		
Investment plans and future visions	Evaluates investment plans and future visions of relevance for Cederroth e.g. investments in new equipment, tools, R&D or training that Cederroth can benefit from.	x	0.00		Not applicable		
Capacity for increased demand	Assessment of supplier's capacity for long-term increased demand.		0.29	5	Production-wise no problems.		
Knowledge about second tier suppliers	Supplier's general knowledge about second tier suppliers.	x	0.00		Confidential information.		
Cost structure	Evaluates transparency in supplier cost drivers and how prices are correlated to raw material indices.		0.06	1	No information about cost structure revealed by CCS.		
Environment			0.14			Total score - Environment:	0.49
Second tier supplier environmental evaluation	Assessment of the supplier's evaluation of second tier supplier's environmental performance, criteria characteristics and to what extent they are evaluated.	x	0.00		Confidential.	(Max Total score - Environment:)	0.73
Location distance	Evaluates location distance from Cederroth's production site where the supplier products are used aiming at reducing environmental impact by reduced supplier distance.		0.10	4	Located in Germany, alternatives located in Asia or North America.		
Environmental management systems	Assessment of supplier's environmental policies, goals, action plans, and corrective actions. Evaluation of ISO 14001 certification, EMAS or internal environmental management system should be included in the assessment.		0.12	5	Exhaustive and detailed environmental management system.		
Compliance to environmental regulations and risk material assessment	Evaluates how well the supplier follows environmental laws and regulations and to what extent risk materials and hazardous materials are used by the supplier.		0.28	4	Large supplier which have eyes on them, hence following regulations strictly. Long-term relationship with Cedrrroth.		
Energy and waste parameters	Evaluates supplier's performance in regard of energy consumption and relevant waste parameters such as air, water and land emissions.		0.19	3	Distinct goals, -20% within next ten years regarding greenhouse gases, water consumption, production waste.		
Public disclosure of environmental record	Evaluates existence, exhaustiveness and transparency of supplier environmental record.		0.19	1	No public disclosure available.		
Potential for environmental cooperation	Assessment of supplier's opennness for mutual projects focusing on lowering environmental impact. Initiatives, attitude and current status of relationship.		0.13	4	Relative open for mutual projects, however Cederroth have little influence on CCS's processes.		
Package performance	Assessment of supplier's performance in palleting goods and usage of packaging material.	x	0.00		Deliver chemicals in large bulk trucks, therefore not applicable.		
Total score:							3.62

Max total score:5.00

Min total score:0.00

Strategic Supplier Evaluation Sheet

	Fields to be filled in
3	Warning: Low supplier score

Scoring scale	
1	Poor
2	Not sufficient
3	Satisfactory
4	Good
5	Excellent

Ranking scale	
> 4,60	Supreme class
3,80 < 4,60	Standard class
3,00 < 3,80	Poor class
< 3,00	Desourced class

Supplier name:	
Date:	
Total score:	3.80
Supplier ranking:	Poor class

Percental fullfilment of total assigned weight in each category:	
General	80%
Production	100%
Quality	73%
Logistics	77%
Product development	80%
Purchasing	77%
Environment	60%

If criterion not applicable mark the cell with X

Criteria category	Criteria	Description	Not applicable: X	Normalized weight	Score (1-5)	Motivation		
General				0.29			Total score - General:	1.14
	Uniqueness	Evaluates unique attributes important to Cederroth e.g. unique competences, good fit with Cederroth's strategy, unique product or supplier of strategic importance.		0.50	3	Other capsule suppliers available.	(Max Total score - General:)	1.43
	General attention from supplier	Supplier's prioritization of Cederroth as customer, attention paid to Cederroth's general needs, requests and level of contacts.		0.50	5	Attentive with daily deliveries. Flexible, Cederroth is an important customer.		
Production				0.02			Total score - Production:	0.12
	Condition facilities/equipment	Evaluates the condition and functionality of supplier facilities and equipment.		0.33	5	Very modern.	(Max Total score - Production:)	0.12
	Tidiness in production facilities	Evaluates tidiness in production facilities and general orderliness.		0.33	5	Clean and tidy. AstraZeneca is another customer which have high requirements.		
	Production-technical competence	General assessment of production-technical competence. Assessment should be based upon the general feeling acquired during audit or other experiences.		0.33	5	High, own department for construction. Professional.		
Quality				0.14			Total score - Quality:	0.52
	Total value of complaints	Evaluation of the total value of complaints divided by the purchasing value.		0.14	3	Problems during 2009/2010 with package for plasters which have caused costs for production adjustments.	(Max Total score - Quality:)	0.71
	Total value of rejections	Evaluation of the total value of rejections divided by the purchasing value.		0.16	3	Rejections not frequently occurring.		
	Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding quality issues.		0.05	3	Keen on that quality issues are taken care of in a proper manner.		
	Traceability	Evaluates traceability of the products.		0.18	4	100%, traceability on batch identification number.		
	Complaints management system	Assessment of supplier's complaints management system, plans for how to handle claims and corresponding corrective actions aiming at preventing similar complaints in the future.		0.07	4	Well-functioning routines.		
	Quality management system	Evaluates the quality management system.		0.04	4	Have ISO-certification. High quality focus.		
	General product safety risk	Evaluates the risk for product mix-up in production. Products such as capsules and tablets are targeted.		0.18	4	Mix up not existing.		
	In process control/inspection	Evaluation of in process controls, if statistic process control (SPC) is applied and how inspections are executed.		0.18	4	Personal stationed at every single machine checks that right version of tool is used. Continuously test.		
Logistics				0.10			Total score - Logistics:	0.37
	Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding logistics issues.		0.02	4	Good communication when ordering. Cederroth uses transportation company.	(Max Total score - Logistics:)	0.48
	Accuracy in logistics data	Evaluates accuracy in basic logistics data e.g. tagging and logistic related figures.		0.14	4	Seldom problems. Use counting machine to secure number of packaging.		
	Hirate - Quantity	Evaluates delivery security by measuring the delivery quantity accuracy.		0.26	4	Generally good performance. Currently some issues due to new cooperation. Closer cooperation is expected in the future.		

80%

100%

73%

77%

					Generally good performance. Currently some issues due to new cooperation. Closer cooperation is expected in the future.		
Hitrates - Time	Evaluates delivery reliability by measuring the delivery time accuracy.			0.26	4		
Lead time reduction	Assessment of lead time and lead time-reducing actions.			0.14	4	Still unrealized potential.	
Short term flexibility in order volume	Evaluates supplier performance in flexibility e.g. season varieties, emergency orders and trends.			0.14	3	Difficult to quickly acquire raw material.	
IT-maturity	Existence of IT-systems such as APS, EDI and prerequisites for VMI.			0.02	4	Have Movex.	
Product development				0.19			Total score - Product development: 0.76
Product documentation	Assessment of existence and level of detail of drawings and specifications, risk assessment, existence of SDS for included raw materials, REACH-compliance for chemicals and compliance to EU-directives for packaging.			0.27	4		(Max Total score - Product development:) 0.95
Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding R&D issues.			0.13	4		
R&D competence	Evaluates supplier's R&D competence based on experience with the supplier and general feeling acquired.			0.20	4		
Technical support	Assesses technical support available from supplier regarding product defaults and supplier assistance with product specific knowledge.			0.20	4		
Product portfolio/Innovation	Evaluation of breadth, complexity and technical level of product portfolio and development of existing products and share of new products in the portfolio. Level of innovation within the company should also be assessed.			0.10	4		
Product development process	Evaluation of the product development process by controlling that activities are performed in the right order and that key requirements are clearly stated before entering next steps.			0.10	4		
Purchasing				0.12			Total score - Purchasing: 0.46
Responsiveness	Evaluates availability and accessibility of the supplier and communication language regarding general purchasing issues.			0.24	4	New contact persons, good communication.	(Max Total score - Purchasing:) 0.59
Cost reducing initiatives	Evaluates supplier's cost-reducing initiatives, actions and attitude.			0.12	3	Have not focused on costs. Have not been challenged.	
Supply chain risk assessment	Assesses supply chain risk e.g. delivery problem due to defect tools, second tier supplier delivery problems, actions taken by supplier to secure supply, collaboration with fire department and existence of fire boxes for important tools etc.			0.21	4	New production sites in Norrköping and Denmark.	
Investment plans and future visions	Evaluates investment plans and future visions of relevance for Cederroth e.g. investments in new equipment, tools, R&D or training that Cederroth can benefit from.			0.10	4	Too large supplier so that Cederroth can gain from their investments.	
Capacity for increased demand	Assessment of supplier's capacity for long-term increased demand.			0.26	4	Cederroth.	
Knowledge about second tier suppliers	Supplier's general knowledge about second tier suppliers.			0.04	4	h/O h s good communication with, and good knowledge about their second tier suppliers.	
Cost structure	Evaluates transparency in supplier cost drivers and how prices are correlated to raw material indices.			0.04	3	Small transparency, can be improved significantly.	
Environment				0.14			Total score - Environment: 0.43
Second tier supplier environmental evaluation	Assessment of the supplier's evaluation of second tier supplier's environmental performance, criteria characteristics and to what extent they are evaluated.	x		0.00			(Max Total score - Environment:) 0.71
Location distance	Evaluates location distance from Cederroth's production site where the supplier products are used aiming at reducing environmental impact by reduced supplier distance.	x		0.00			
Environmental management systems	Assessment of supplier's environmental policies, goals, action plans, and corrective actions. Evaluation of ISO 14001 certification, EMAS or internal environmental management system should be included in the assessment.	x		0.00			
Compliance to environmental regulations and risk material assessment	Evaluates how well the supplier follows environmental laws and regulations and to what extent risk materials and hazardous materials are used by the supplier.	x		0.00			
Energy and waste parameters	Evaluates supplier's performance in regard of energy consumption and relevant waste parameters such as air, water and land emissions.	x		0.00			
Public disclosure of environmental record	Evaluates existence, exhaustiveness and transparency of supplier environmental record.	x		0.00			
Potential for environmental cooperation	Assessment of supplier's openness for mutual projects focusing on lowering environmental impact. Initiatives, attitude and current status of relationship.	x		0.00			
Package performance	Assessment of supplier's performance in palleting goods and usage of packaging material.			1.00	3	Corrugated cardboard, 1.25m high pallets, development to double palleting running.	
Total score:							3.80

Max total score: 5.00
Min total score: 0.00