



TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

JESSE KIVILÄ
FORMATION OF SUSTAINABLE VALUE IN INDUSTRIAL PRO-
CESSES

Master of Science thesis

Examiner: Professor Miia Martinsuo
Examiner and topic approved by the
Faculty Council of the Faculty of
Business and Built Environment
on 14th of January 2015

ABSTRACT

JESSE KIVILÄ: FORMATION OF SUSTAINABLE VALUE IN INDUSTRIAL PROCESSES

Tampere University of Technology

Master of Science Thesis, 99 pages, 1 Appendix (3 pages)

June 2015

Master's Degree Programme in Industrial Engineering and Management

Major: Industrial Management

Examiner: Professor Miia Martinsuo

Keywords: sustainable development, sustainable value, external service provider, sustainable operations, R&D, manufacturing, marketing

Sustainability and sustainable development, understood to include economic, environmental and societal aspects, are receiving even more attention. Companies are facing ever growing pressure to modify their operations to fit sustainable development. Academic literature offers various models and methods to be used in industry to enhance the sustainability of companies' operations. The objective was to create new knowledge on how sustainable value is created as a part of industrial processes. What are the tools, indicators and actions used in the sustainability work? How can an external service provider assist in sustainable value creation? The main research question was: *How is sustainable value formed in industrial processes?*

Research design was a multiple case study, and two case companies were selected by a service provider that is a partner company in this study. The two cases are Finnish process industry companies. Data for the study was collected through interviews, observations and informal discussion with the case companies and through workshop meetings with the service provider. The interviews were completed as semi-structured to ensure rich and extensive answers. Interviews were audio-recorded, transcribed and coded. The coded interviews were analyzed with ATLAS.ti computer program to ensure systematic analysis. The results of each case were discussed in a workshop meeting with the service provider.

The results indicate that companies have understood the threefold nature of sustainability. Reasons to operate sustainably include customers' demand, law and regulations, and competition. Value of sustainability is a complex issue, and case companies had no difficulties in mentioning benefits of sustainable operations to all related stakeholders. Quite surprisingly, tools and methods are not used in identifying and assessing of sustainable value. All studied functions (strategic level, R&D, manufacturing, marketing) were identified to have many actions that can foster sustainable development. However, in R&D the actions are based more on common sense than on any clear set of actions. External service providers are used as part of sustainable value creation, and one of the case companies had been able to reach significant sustainability benefits from an industrial symbiosis formed with a service provider. Customers should ensure that enough resources are allocated to integrating the service provider into the operations. The service provider should take a leading role when needed and take care of a specific set of issues at a time, instead of trying to do it all at once.

TIIVISTELMÄ

JESSE KIVILÄ: KESTÄVÄN ARVON MUODOSTUMINEN TEOLLISISSA PROSESSEISSA

Tampereen teknillinen yliopisto

Diplomityö, 99 sivua, 1 liite (3 sivua)

Kesäkuu 2015

Tuotantotalouden diplomi-insinöörin tutkinto-ohjelma

Pääaine: Teollisuustalous

Tarkastaja: professori Miia Martinsuo

Avainsanat: kestävä kehitys, kestävä arvo, ulkopuolinen palveluntarjoaja, kestävät toiminnot, T&K, tuotanto, markkinointi

Kestävyys ja kestävä kehitys, joihin kuuluu taloudellinen, ekologinen ja sosiaalinen näkökulma, saavat yhä enemmän huomiota. Yrityksiin kohdistetaan jatkuvasti enemmän painetta, jotta ne muuttaisivat toimintaansa kestävä kehityksen mukaiseksi. Akateeminen kirjallisuus tarjoaa paljon erilaisia malleja, joita voidaan käyttää kestävä kehityksen edistämiseksi yrityksissä. Työn tarkoitus oli lisätä tietoisuutta kestävä arvon luonnista teollisissa prosesseissa. Mitkä ovat työkalut, indikaattorit ja toimet, joilla kestävyttä edistetään? Miten ulkopuoliset palveluntarjoajat voivat auttaa? Päättökysymys esitettiin seuraavasti: *Miten kestävä arvo muodostetaan teollisissa prosesseissa?*

Tutkimusmenetelmä oli monicasetutkimus ja tutkimukseen osallistui eräs palveluntarjoaja ja kaksi tämän palveluntarjoajan nimittämää case-yritystä suomalaisesta prosessiteollisuudesta. Tutkimuksen aineisto kerättiin case-yrityksistä haastatteluilla, havainnoinnilla sekä epävirallisilla keskusteluilla sekä työpajatapaamisilla, jotka järjestettiin palveluntarjoajan kanssa kunkin casen tulosten esittämiseksi. Haastattelut olivat puoliaivoimia, jotta aineistosta saatiin mahdollisimman rikas. Haastattelut nauhoitettiin, litteoitiin ja koodattiin. Koodatut haastattelut analysoitiin ATLAS.ti tietokoneohjelmalla, jotta varmistettiin analyysityön systemaattisuus.

Tuloksien mukaan yritykset ovat ymmärtäneet kestävyden kolmikantaisen rakenteen. Yritykset toimivat kestävästi asiakkaiden antaman paineen, lakien ja asetusten sekä kilpailun takia. Kestävä arvo on moninainen asia, ja case-yritykset pystyivät nimeämään helposti kestävä toiminnan tuomia hyötyjä jokaiselle sidosryhmälle. Yllättäen näyttää siltä, että työkaluja ei käytetä apuna kestävä arvon tunnistamisessa ja arvioinnissa. Kaikilla tutkimustasoilla (strateginen taso, T&K, tuotanto, markkinointi) tunnistettiin monia toimia, joilla kestävyttä voidaan edistää. T&K -toiminnassa huomattiin kuitenkin, että toiminta perustuu enemmän hyvään maalaisjärjen käyttöön kuin mihinkään määrättyyn ryhmään toimintoja. Ulkopuolisia palveluntarjoajia käytetään kestävä arvon luonnissa ja toinen case-yrityksistä oli pystynyt luomaan merkittävää kestävä hyötyä muodostamalla teollisen symbioosin palveluntarjoajan kanssa. Asiakkaiden tulisi varmistaa, että palveluntarjoajan integrointiin varataan tarpeeksi resursseja. Toisaalta palveluntarjoajan pitäisi ottaa tarvittaessa johtava rooli ja huolehtia tietyistä asioista kerrallaan, eikä yrittää tehdä kaikkea mahdollista kerralla.

PREFACE

Roughly 19 years ago I started going to school at the Piispanristi Elementary School. The boy that walked in from the doors of Piispanristi has changed a lot. After high school this boy landed to Tampere University of Technology and it was the best thing that ever happened to him. In the year 2008 began a journey that would turn out to be legendary. This thesis ends the legendary journey and I am happy to finally graduate, after so many years of school and studying. Writing my thesis would have not been possible without several people. First, I thank my supervisor, Professor Miia Martinsuo for the support I needed during writing my thesis. Second, I thank my colleagues at the Department of Industrial Engineering and especially my friends in the same office for great working atmosphere. Third, I thank the people and the partner company of StraSus, and the people at case companies for making this study possible.

During my studies in Tampere I have found out who I really am. I have had the best time in my life with thousands of laughs and also some sorrows. I have had the honor to be surrounded by people who have accepted me as I am. I have made lifelong friends and met hundreds of interesting people. Most important of them all is my precious Tiia who has been there for me when I needed her the most. Always and selfless. Thank you my love. For everything.

In addition, I thank my parents, sister and grandparents for supporting me whenever I needed guidance. I thank my father for giving me the push to go to university and my mother for encouraging me to leave behind the things that I did not like. I thank my sister for being one of my best friends, even when I did not realize it. I thank my grandparents for everything they did for me. I suppose you agree that your efforts were not in vain.

I also thank my friends that I have made in Tampere for unforgettable studying time. You have given me memories that will not fade and I really hope that we will keep in touch in the future. I also thank my earlier friends that are the reason that I made it this far in the first place. It is amazing how much energy and strength you can extract from a few important people around you. You know who you are, thank you.

Tampere, 19.05.2015

Jesse Kivilä

CONTENTS

1.	INTRODUCTION	1
1.1	Background of the Research	1
1.2	Research Questions and Objective	3
1.3	Structure of the Thesis.....	5
2.	THEORETICAL BACKGROUND.....	6
2.1	Towards Sustainable Value Creation	6
2.2	Identifying and Assessing Sustainable Value	7
2.2.1	Value Stream Mapping	7
2.2.2	Mapping of Sustainable Value Stream.....	9
2.2.3	Balanced Scorecard.....	11
2.2.4	Sustainability Balanced Scorecard.....	13
2.2.5	Synthesis of the Frameworks	22
2.3	Building Blocks of Sustainable Value	23
2.3.1	Overview of the Indicators in Use	24
2.3.2	Issues Enhancing Sustainability in R&D	27
2.3.3	Issues Enhancing Sustainability in Production	29
2.3.4	Issues Enhancing Sustainability in Marketing	30
2.3.5	Issues Enhancing Sustainability at Strategic Level.....	32
2.4	External Service Provider as Enabler of Sustainability	36
2.4.1	Sustainability Services	36
2.4.2	The Role of External Service Provider	38
3.	RESEARCH METHODOLOGY.....	40
3.1	Research Design.....	40
3.2	Case Companies	40
3.3	Data Collection.....	41
3.4	Data Analysis	43
4.	RESULTS	44
4.1	Sustainability: What, Why and What Is the Value?.....	44
4.1.1	What is Sustainability?.....	44
4.1.2	Why Do Companies Operate Sustainably?.....	46
4.1.3	What is the Value of Sustainability?.....	50
4.2	Tools and Methods Assisting in the Sustainability Work	55
4.3	Building Blocks of Sustainable Value	57
4.3.1	Strategic Level	57
4.3.2	Research and Development.....	61
4.3.3	Production	64
4.3.4	Marketing	67
4.4	External Service Providers as a Part of Sustainability Work	71
5.	DISCUSSION	76

5.1	Sustainability and Ways to Identify and Assess It	76
5.2	Indicators and Actions Supporting Sustainability	78
5.2.1	Indicators in the Sustainability Work.....	79
5.2.2	Actions Fostering Sustainable Value Creation	80
5.3	External Service Providers Enhancing Sustainable Value	83
6.	CONCLUSIONS.....	85
6.1	Meeting the Objectives.....	85
6.2	Academic Contribution	86
6.3	Managerial Implications.....	87
6.4	Limitations of the Study	89
6.5	Proposals for Future Research.....	90
	REFERENCES.....	91

APPENDIX A: The interview outline (in Finnish)

LIST OF SYMBOLS AND ABBREVIATIONS

ANP = Analytic Network Process

BSC = Balanced Scorecard

EoL = End-of-Life

ENPD = Environmental New Product Development

FDM = Fuzzy Delphi Method

GRI = Global Reporting Initiative

IE = Industrial Ecology

KIBS = Knowledge-Intensive Business Services

KPI = Key Performance Indicator

LCA = Life Cycle Assessment

NPD = New Product Development

PLC = Product Life Cycle

QFD = Quality Function Deployment

QFDE = Quality Function Deployment for Environment

SBSC = Sustainability Balanced Scorecard

SCM = Supply Chain Management

StraSus = Strategic Business Models and Governance for Sustainable Solutions is
the research project that this thesis is part of.

SMM = Sustainable Manufacturing Mapping

SVM = Sustainability Value Methodology

VSM = Value Stream Mapping

VNM = Value Network Mapping

1. INTRODUCTION

The background of the topic and motivation for the study are presented in the following sections. First, background information is presented and the key terms defined. In addition, connection of this thesis to StraSus research project is explained. Second section deals with the research questions and the objective of the study. The last section of this chapter presents the structure of the thesis.

1.1 Background of the Research

The basic idea of sustainability is simply stated in the following phrase by Constanza & Patten (1995, p. 193): “*a sustainable system is one which survives or persists*”. Oxford dictionary defines sustainability in the ecological sense: “*Conserving an ecological balance by avoiding depletion of natural resources*” (Oxford Dictionaries 2014). Sustainability in broader meaning can be seen as a part of sustainable development. Sustainable development is, as adopted most widely in the literature, “*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*” (WCED 1987).

As a part of sustainable thinking, Elkington (1994) has studied new alternatives to the traditional “profits only” approach. Afterwards, in his book *Cannibals with forks: The triple bottom line of 21st century business* he developed these thoughts further to what we nowadays understand as the “triple bottom line” approach (Elkington 1997). The triple bottom line, in a nutshell and in its widest form, is the act of incorporating environmental and societal thinking to decision making and reporting them as equal themes compared to economic aspects. Originally, the term triple bottom line used to refer only to accounting framework (Slaper & Hall 2011). Later on, it has become to reflect general triangle thinking: economy, environment and sociality. This wider triangle thinking, concerning economic, environmental and societal value is the basis of this thesis.

Sustainability and sustainable development are becoming increasingly important as the awareness of climate change, resource scarcity and other environmental problems keeps on growing. To name a few, Graedel (1996) mentions ozone depletion, toxic landfills and heavy metals accumulating to fish as evidence of unsustainable way of life. People are also more aware of societal problems and if companies fail to deliver value also to the society, people view companies more critically (Fearne et al. 2012). Companies must adapt to the ever tightening regulation and to the increasing pressure from the society as a whole. In addition, also customers are putting more and more emphasis to

sustainability and therefore pushing suppliers and manufacturers to develop the sustainability of their operations.

Contributing to more sustainable operations, one possibility to eliminate waste can be the adoption of broader view of industrial systems (Lovins et al. 1999). Broader view might trigger thoughts on more holistic approach to manage and extract value and eliminate waste and thus increase sustainability. The idea of having a very broad view is already present in Graedel's (1996) description of industrial ecology. Sometimes it might help to bring more parts on the table, thus increasing the number of possible solutions to a problem, than to take away the ones that seem unnecessary at first. As Porter & Kramer (2011, p. 4) state it: "*Our field of vision has simply been too narrow*".

Bansal (2002) has studied the challenges related to sustainable development in the USA. She argues that sustainable development should be institutionalized. She found out that only few managers adopt corporate sustainable development agenda as they feel that the costs are too high in comparison to possible gains. Nidumolu et al. (2009) think in the same way, stating that many executives feel that sustainability is a burden for their companies. This is also noticed by Hart & Milstein (2003). Furthermore, also Lovins et al. (1999) have introduced similar views as they state that the common practices of public and private sectors encourage companies to waste resources rather than to improve resource productivity.

Thus, the public interest in sustainable development has so far been greater than the interest of firms. Firms mostly act because of economic reasons but institutional pressure also plays a role (Bansal 2002). There are exceptions though (e.g. White 2009), but they are rare. On the other hand, a study conducted in 2014 shows signs of sustainability gaining a central role in the business actions of companies (Tervonen et al. 2014). It is probably not only coincidence, as it has been argued that adopting sustainable operations and trying to build sustainable business models is a tremendous source of innovation and competitive advantage (Nidumolu et al. 2009).

Clearly, there is an upward trend in the discussion on sustainability in relation to different industrial topics. Therefore, the topic of this thesis is sensible for producing more insight about sustainability as a part of industrial processes. The aim is to create more information about sustainability and about sustainable value in industrial environment.

This thesis is written as a part of the StraSus –project (Strategic business models and governance for sustainable solutions) which was started in late 2013. The project is a joint project of VTT (Technical Research Centre of Finland), Aalto University, Lappeenranta University of Technology and Tampere University of Technology. StraSus is funded by TEKES and it aims at finding new ways for companies to improve their businesses through sustainability-based decisions in product and service development. It also seeks to find out how sustainable business creation affects radical improvements.

Every research partner (listed above) is in charge of one partner company in industry. Tampere University of Technology is in charge of a service provider that supports its customers to be more sustainable by offering energy and material efficiency solutions. Thus, this thesis also seeks to find ways for the service provider to better serve its customers and in that way, enhance sustainable development.

1.2 Research Questions and Objective

There has been a lot of research on different topics of sustainability in industrial environment. First, different forms of sustainability frameworks have been introduced. Some scholars have built sustainability models based on value stream mapping (Faulkner & Templeton 2012; Torres & Gati 2009; Paju et al. 2010; Vinodh et al. 2011). The shortcoming of most of these tools is that they are specified to a certain process and as such, lack general applicability. More general framework is introduced by Figge et al. (2002b): the Sustainability Balanced Scorecard (SBSC) which can be used, or constructed, basically for any entity from a small firm to strategic business unit of a larger company. What is lacking, however, is a model or study trying to explain, how sustainable value is formed in industrial processes. What are the small tasks or actions through which sustainable value is generated?

Second, different sets of indicators have been studied by Feng & Joung (2009) and Singh et al. (2009). The sets of indicators studied include the ones introduced by Global Reporting Initiative (GRI), the United Nations Committee on Sustainable Development Indicators and the one introduced in the 2005 Environmental Sustainability Index report. They are all general sets of metrics that can be used by different entities but companies have to modify them and make them suitable for their own operations. For example, a mining company might be interested in water and energy consumption, whereas a software house might be keen to know the societal acceptance of its sourcing activities. If the problem above was that the models introduced are too specific, here the challenge is to choose the right indicators as building blocks of sustainable development.

It seems that so far no one has really observed and studied industrial processes as a source of sustainable value or explained what sustainable value consists of. Therefore, the main research question of this thesis is:

How is sustainable value formed in industrial processes?

The study aims at creating more knowledge on sustainable value and its creation in industrial processes. The main question is broken down into three sub-questions to help to identify the phenomena and building blocks of sustainable value formation. In order to be able to take advantage of sustainable value in industrial processes, it must be somehow identified and assessed. The first sub-question is:

1. How is sustainable value identified and assessed in industrial processes?

In order to make decisions that foster sustainable development and also benefit from them, organizations must identify and assess sustainable value in their operations. The first sub-question aims at finding the tools and techniques that companies use in the evaluation process.

As stated in the first section, it is very important to be aware of the different issues affecting sustainability and the value it creates. Tervonen et al. (2014) argue that the task of evaluating the total sustainable value is difficult and complex. They continue by saying that the problems in determining the value elements of sustainability explains the reluctant attitudes towards sustainability in the private sector reported, for example, by Nidumolu et al. (2009), Bansal (2002) and Lovins et al. (1999). Thus, the second sub-question is stated as follows:

2. What are the building blocks of sustainable value in industrial processes?

It would be interesting to know which factors are considered as parts and components of sustainability in industrial environment. Elkington (1997) has introduced the three sub-elements of sustainability: economic, environmental and societal dimensions. But what is meant here, are the smaller parts, factors or building blocks: what creates economical, socially acceptable and environmentally sound processes? Knowing this, firms might be able to direct their offerings more precisely and better justify the usefulness and value of their solutions.

In addition to knowing the building blocks of sustainable value, it would be interesting to find out how a service provider would be able to help the industrial process owners to identify, assess and enhance the formation of sustainable value. Is it necessary that the process owners assess their processes at all? Could it be done by an external service provider? The last sub-question is:

3. How can an external service provider support the formation of sustainable value?

An external service provider might have a broader understanding about the needed actions in order to achieve the best possible amount of sustainable value as a whole. Thus, external service provider might be able to bring in solutions that serve all the related stakeholders and actually benefit the process owner more. But how to take the service provider into account in the big picture? That is one of the sub-themes in this thesis.

1.3 Structure of the Thesis

This thesis is divided into six chapters. After the introduction, a literature review is presented. It consists of possible tools and methods to identify and assess sustainable value, indicators and actions in different functions of a company to foster sustainable development and the role of external service providers in sustainability work. The literature review is used as a basis for this study and for the forming of the interview outline used to gather data for this research.

Third chapter represents the methodology of this thesis. Research design, case companies, data collection and data analysis are discussed. In the fourth chapter the results of this study are presented. The results are not analyzed as a cross-case comparison, but according to the different functions of a company and themes of the study.

Fifth chapter is discussion, providing the evaluation of the results of the study. Discussion chapter compares the results to prior research and to the literature represented in the second chapter. Most important results are highlighted in accordance to the sub-questions of this research.

The last chapter of this thesis is a conclusion of the results. It begins with an examination about meeting the objectives that were set for the study. Next, academic contribution and managerial implications are presented. Last two chapters explain the limitations of the study and propose ideas for future research.

2. THEORETICAL BACKGROUND

In this section a literature review on the related topics of this thesis is carried out. First, the concept of sustainable value is examined and defined. Second, different methods, tools and frameworks for identifying and assessing sustainable value are examined. Next, the building blocks of sustainable value are being discussed. Building blocks include different sustainability indicators and sustainability actions in different functions and at the strategic level of a firm. Fourth, the effect and role of an external service provider on sustainable value creation of a company is analyzed.

2.1 Towards Sustainable Value Creation

In addition to sustainability and sustainable development discussed in the introduction, the concept of sustainable value and how it is interpreted is a critical term definition in this thesis. Sustainable value is a multidimensional concept and it seems that so far there is no consensus about the definition. The earlier definitions are scarce and no satisfactory definition is to be found.

Filho (2000) has made the conclusion that even though the value of sustainability is widely acknowledged in the academic community there is still confusion about the concept. Figge & Hahn (2004) have created an approach called Sustainable Value Added (SVA). The approach is based on opportunity costs and making a comparison between the sustainability between two companies. Thus, being more sustainable than competitors a firm can create sustainable value. This approach is problematic as it considers sustainable value to be a relative measure: a firm is not necessarily producing sustainable value per se, even if it might be the most sustainable in the industry.

Henriques & Catarino (2014) define value as correlation: Satisfaction of needs divided by the Consumption of resources. Their idea is to take also environmental and social aspects into account in their equation and the process is called the Sustainability Value Methodology (SVM). However, quantifying environmental and social aspects is almost impossible: how to quantify, for example, the value of not using child labor. The SVM is also developed to be used on a specific “study subject” (i.e. product or process). More general definition on sustainable value is needed.

Ueda et al. (2009, p. 698) argue, based on their extensive review on the history and different aspects of value, that “*sustainable value should be co-created through the dynamic interaction among social, natural and artificial systems*”. They describe (2009) sustainable value to be an important concept that, in addition to ecological sustainabil-

ity, targets social and economic values as well. In the context of this thesis sustainable value is defined as economic value that is - or has been - created preserving or even improving the state of natural and social environment. Thus, wealth created while, for example, reducing waste and promoting human rights is interpreted as added sustainable value. Sustainable value cannot be measured only quantitatively, but also qualitative analysis is needed.

Taking a market value perspective on sustainability, it has been argued that bad environmental performance has a significant effect on the market value of a company (Konar & Cohen 2001). Similar findings have been reported largely in literature (e.g. Klassen & McLaughlin 1996; Hamilton 1995; Konar & Cohen 1997) but also some opposite observations have been made (Mahapatra 1984; Jaggi & Freedman 1992). Khanna et al. (1998) argue that while the loss of market value had an impact on toxic releases of the site in question, it did not affect the amount of toxic wastes of the company as a whole.

It seems that bad environmental performance has a negative effect on the value of firms. Thus, it would make sense that “good environmental” behavior is then rewarded. However, Guidry & Patten (2010) state that it is not. They found out that markets did not react significantly when companies issued their first sustainability reports. Yet, it is remarkable that the market did not react negatively. Also the quality of the report issued correlated with positive market response. (Guidry & Patten 2010) Based on the findings of Khanna et al. (1998) and Guidry & Patten (2010), it can be argued that sustainability is not yet a relevant factor influencing market value and decision making of a company, bad reputation is, but sustainability is getting more and more important.

2.2 Identifying and Assessing Sustainable Value

In this sub-section of the literature review some interesting ways to analyze sustainable value found in earlier research are presented. First, a lean manufacturing tool Value Stream Mapping (VSM) and its derivatives are introduced. Then another model, Balanced Scorecard (BSC) and its derivatives are examined. In the last section a summary of different models is made.

2.2.1 Value Stream Mapping

Value Stream Mapping (VSM) is an improvement tool to visualize the production process of a company (Singh et al. 2011). It considers material and information flow (Singh et al. 2011). According the literature review made by Forno et al. (2014, p. 779) “*VSM is described as a technique used for the diagnosis, implementation, and maintenance of lean approach*”. VSM can also be seen as a communication tool, a business planning tool, and as a tool to manage an extended enterprise (Lovelley 2001), that is, the supply chain. In addition, VSM has also been named as a benchmarking tool (Hines et al.

1999). The focus is more on internal benchmarking and VSM aims to find the gaps between processes today and the desired processes (Hines et al. 1999).

VSM is based on developing a map of the current state and a map of the future state (Khaswala & Irani 2001) and then comparing the two and removing the waste identified to reach the desired flow of the future state map (Lovelley 2001). The rationale behind value stream mapping is to identify and find a way to reduce or even remove waste in value streams (Hines & Rich 1997). Waste is understood here, for example, as waiting time, overproduction, inappropriate processing and mistakes. Hines & Rich do not consider unexploited material flows or wasted energy as waste.

Hines & Rich (1997, p. 46) define value stream as *“the specific parts of the firms that actually add value to the specific product or service under consideration”*. As such, it is not to be mixed with supply chain which also includes the non-value-adding parts and processes of companies involved in producing a product or service. (Hines & Rich 1997, p. 46) However, they later state that the process optimization and waste removal actions should involve the complete supply chain (Hines & Rich 1997, p. 49).

Lovelley (2001) sees VSM as a map illustrating the current and possible future states of a production system, showing the users where they are and what kind of waste could be eliminated from the production system. Singh et al. (2011) state that an important part of VSM process is the documentation of relationships between the production process and the controls in use to manage them, for example production scheduling and production information. Lovelley mentions a visual blueprint identifying value and waste in the system as a result from VSM process. The blueprint encourages eliminating waste in a systematic manner. Ultimate goal of VSM is to design and implement a value stream in which the flow of entire system is optimized all the way from information to material to end product arriving to the customer. (Lovelley 2001)

VSM has been praised to be a simple-to-use and useful big-picture technique to analyze processes in order to eliminate waste (Lovelley 2001). Forno et al. (2014, pp. 779–780) have made an extensive literature review on VSM and list the following issues as benefits of VSM:

- *“Allows a broad view of the entire flow*
- *Helps to identify wastes*
- *Shows the relationship between material and information flow*
- *Provides a simple and standardized way to treat procedures*
- *Makes decisions more “visible” allowing previous discussion of possible changes and improvements*
- *Forms the basis of an action plan”*.

Implementing VSM tool to analyze the processes of a firm is not a guarantee of successful operations. In fact, if not applied correctly, VSM can even make things harder, not

easier, for the company using the tool (Forno et al. 2014). Possible harms caused by an unsuccessful use of VSM listed by Forno et al. (2014) are more complicated identification of waste, misinterpretations and undermined implementation of future improvements.

Khaswala & Irani (2001, pp. 3–4) have introduced disadvantages of VSM which include for example:

- VSM is not able to map multiple products with different material flow
- VSM lacks a clear economic measure for “value” (e.g. profit, operating costs)
- VSM is based on concepts that are mainly suitable only for high volume and low variety manufacturing systems
- VSM does not take the factory floor space into account as a resource
- VSM does not enable, due to the manual nature of the tool, rapid and multiple “what-if” analyses

In addition, not all manufacturing entities are suitable to be mapped using VSM. For example in a multiproduct factory it is hard to decide which product to map as VSM always takes a product-based view of the process and different products may have different production paths (Forno et al. 2014). Thus, changes eliminating waste identified on a single product path can cause an increase in amount of waste on other paths. (Forno et al. 2014) This problem can be partly removed by using techniques such as grouping products into product families (e.g. Alves et al. 2005; Chitturi et al. 2007; Khaswala & Irani 2001).

As a reply to the need of grouping products to families a Value Network Mapping (VNM) tool has been introduced (Khaswala & Irani 2001). Khaswala & Irani state that with the help of different software tools VNM is able to map various different value streams simultaneously, and helps to recognize possible streams that could be merged. They recommend VNM, rather than VSM, to be used in make-to-order jobshops as the numerous different product flows might be difficult to map with a VSM tool. Also other improvements have been suggested. For example, Solding & Gullander (2009) argue that simulation should be used with VSM in order to make it more dynamic.

2.2.2 Mapping of Sustainable Value Stream

As incorporated in the triple bottom line approach, there have been some efforts to build a value stream mapping (VSM) tool especially focusing on environmental and societal aspects. In their case-study Faulkner & Templeton (2012) applied their sustainable value stream mapping (Sus-VSM) tool to a manufacturing process of satellite television dishes. In contrast to traditional VSM tools their approach focused not only on economic aspects, but on environmental and societal aspects as well. Their Sus-VSM tool considered process water, raw material usage and energy consumption as environmental

metrics, and physical work and work environment as societal metrics. The concept is specified for the purposes of the manufacturing process in question and other approaches might be needed for a totally different process. (Faulkner & Templeton 2012) The societal aspect of this tool seems somewhat limited, as it includes workers as the only stakeholder group.

Similar thoughts have been introduced by Torres & Gati (2009). They explored implementation of an environmental value stream mapping (EVSM) tool in an alcohol and sugar manufacturing plant. However, as the name reveals, their EVSM does not include social aspects as a relevant factor. Thus, there is a clear blind spot in relation to this thesis, as societal view is not covered. Furthermore, the tool only considers water losses and economical value lost as metrics. (Torres & Gati 2009) While the tool might be able to help significantly reduce water usage, it is really narrow in scope. It can be even argued that the tool should not be called EVSM at all, as water usage is the only environmental factor considered. Given the analysis above, the EVSM totally fails to deliver the scope of evaluation that would be desired in this study.

The Sustainable Manufacturing Mapping (SMM) developed by Paju et al. (2010) is only partly based on VSM. It is also based on Life Cycle Assessment (LCA) and Discrete Event Simulation (DES). LCA is defined in two standards by the International Standardization Organization (ISO): ISO 14040 and ISO 14044. According to Graedel (1996), LCA is a method or technique for environmental impact evaluation. LCA has three (3) stages and it begins with defining the scope of LCA. This includes making an inventory analysis, through which the quantities of materials and energy used or released at each stage of life cycle are measured. Second, the impacts of the measured quantities of materials and energy are analyzed. The final step of LCA is analyzing possible improvements. LCA tends to be quite time-consuming and expensive which decreases the usability of the method. (Graedel 1996)

Combining the desired features from VSM, LCA and DES, Paju et al. (2010) have come up with a methodology that would be easy to use, have high visualization and provide framework not only for environmental assessment, but for other sustainability indicators' assessment as well. The SMM tool uses the goal and scope definition of the LCA and also the idea of using readily gathered environmental data in estimating the environmental impact of products and operations. From VSM the SMM borrows the idea of using symbolic process mapping as a platform for the assessment. The role of DES is to make SMM dynamic, as it is used to model sequence of operations. (Paju et al. 2010)

Using SMM one has to set a goal to begin with and choose desired sustainability indicators (Paju et al. 2010). The indicators are case and goal-specific and thus, the SMM tool is highly flexible. It is also important to set a reference unit which can be yearly production or a single product and according to which, all the data presented on the map must be adjusted. The indicators used may include metrics from energy, materials, produc-

tion, emissions, logistics, costs and social aspects. The assessment begins with identifying material and energy flows and making the energy and material balances. Also the operations that contribute to the chosen metrics have to be recognized. After mapping the chosen metrics (heat and electricity energy, and energy costs for example) they are converted to environmental indicator (for example Global Warming Potential). Due to the amount of data and the high number of metrics used, LCA software might be needed. Computer modelling is done by converting the essential manufacturing and auxiliary processes to a process map using a VSM software tool. (Paju et al. 2010) The tool presented by Paju et al. (2010) is of high interest regarding the scope of this work. Something like this is probably needed to conduct a holistic sustainability check for a manufacturing plant.

Also Vinodh et al. (2011) have introduced their own version of VSM that includes features that take environmental aspects better into account. They have modified VSM in a way that incorporates environmental waste into the evaluation of processes. The incorporated waste categories include energy use, materials use, toxic/hazardous chemicals use, water use, air emissions, water pollution, solid waste etc. After drawing the current state map that also considers the environmental waste, an Eco-function matrix is to be used. It is a version of Quality Function Deployment (QFD) with fuzzy framework and focus on identified waste types and proposed strategies to reduce them, which are a result of a brainstorming session. (Vinodh et al. 2011)

Originally QFD was a systematic way to incorporate the will of customers into the product and service development processes of a firm (Stevenson 2010, p. 156). It is used to translate customer requirements into specific technical terms related to the product at hand and to possibly also apply importance weightings and competitive evaluations (Stevenson 2010, p. 157). Similarly, when the Eco-function matrix by Vinodh et al. (2011) is properly filled, it will show the most important waste types and the strategies to deal with them. These will then help in constructing the future state map.

2.2.3 Balanced Scorecard

The Balanced Scorecard (BSC) is a set of measures used to evaluate the performance of a company and it was first introduced by Kaplan & Norton (1992). It was developed to take also other factors into account than just financial indicators and it can be used to transform vision and strategy into action (Stevenson 2010, p. 52). The BSC includes four points of interest: financial performance, customer satisfaction, internal processes as well as innovation and learning activities (Kaplan & Norton 1992). Nikolaou & Tsalis (2013) suggest using stakeholder perspective rather than customer satisfaction as one of the four points of interest. This makes sense at least in the sustainability version of the BSC as the customers are not the only remarkable stakeholder group of a firm. Same modification has been proposed by Hsu et al. (2011) in their study on sustainability scorecard. Use of the BSC is based on developing objectives, metrics and targets and

also initiatives to achieve the objects for each of the four aspects of the tool (Stevenson 2010, p. 52).

The BSC links long-term goals to short-term actions (Kaplan & Norton 1996b) and connects the top-management with operational workforce by converting the mission and vision to day-to-day actions (Kaplan & Norton 1996b). This can be done by evaluating the cause-and-effect relationships of different things in the four above-mentioned points of interest in a cascading order, starting from the financial measures (Kaplan & Norton 1996a, p. 30). For example (Kaplan & Norton 1996a, p. 30), return-on-capital-employed (ROCE) might be one financial scorecard measure. The driver of this could be high customer loyalty, and a prerequisite for that might turn out to be on-time delivery. Thus, a company should find out the processes and actions that must be in order to be able to meet the on-time-delivery requirement. Some evidence on different measures affecting each other is presented for example in the study of Hsu & Liu (2010) as they stated that a considerable correlation can be found between some of the measures they used as a part of their BSC. A properly constructed BSC depicts the strategy of a company and points out the critical links between goals and actions. (Kaplan & Norton 1996a, pp. 30–31) The figure 1 represents the Balanced Scorecard.

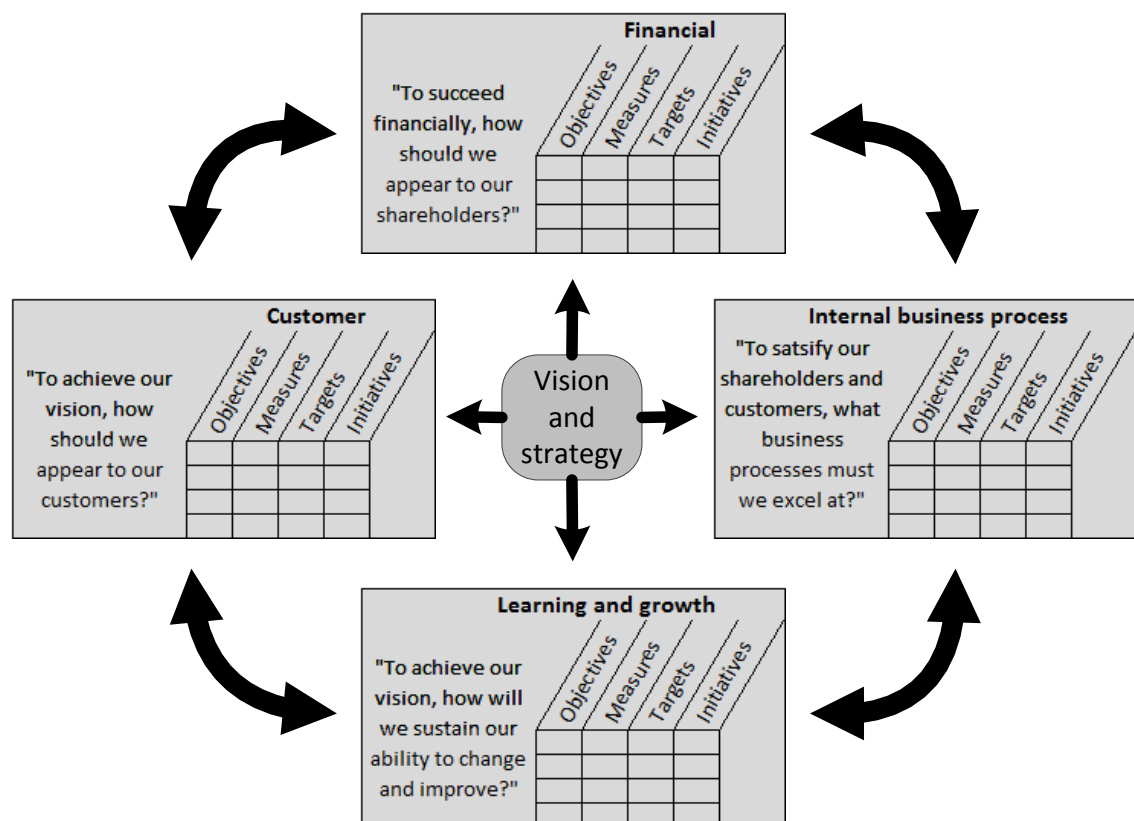


Figure 1. Balanced Scorecard (BSC). Modified from Kaplan & Norton 1996a, p. 9 and Kaplan & Norton 1996b.

Kaplan & Norton (1996a, p. 149) separate the so called lagging (outcome measures) indicators and leading (performance drivers) indicators. For example, market share, profitability, customer satisfaction and employee skills are all lagging indicators, as they reflect the outcomes of the strategy. On the other hand, leading indicators such as financial drivers of profitability, cycle times or part-per-million defect rates tend to be more unique and firm/business unit specific and they show how the lagging indicators, that is the outcomes, should be achieved. An appropriate mix of lagging and leading indicators should be incorporated into a good BSC. Without performance drivers (leading indicators) the outcome measures (lagging indicators) fail to communicate how the outcomes are to be achieved. Conversely, leading indicators (performance drivers) without lagging indicators (outcome measures) bring only short-term improvements but will not tell anything about the effects of these actions in the long-run. (Kaplan & Norton 1996a, pp. 149–150)

The BSC has been said to have the following strengths (Kaplan & Norton 1992):

- it minimizes information overload by limiting the numbers and measures used
- it shows many elements of the company's competitive agenda at a single glance
- it guards against sub-optimization

On the other hand also some criticism has been presented. For example Stevenson (2010, p. 53) has pointed out that the framework lacks environmental, community and sustainability issues as well as supplier and governmental issues. Although BSC is mostly used to evaluate and measure the performance of a company, this study is equally interested about the process of building a BSC that also takes sustainability issues into consideration. The process of building the BSC forces the target organization to identify and assess different sustainability issues affecting the performance of the entity at hand. Thus, it serves the first sub-question of this research.

2.2.4 Sustainability Balanced Scorecard

The sustainability issues have later been presented to be added to the BSC for example by Figge et al.(2002b), Hubbard (2009), Chalmeta & Palomero (2010) and Nikolaou & Tsalis (2013). Nikolaou & Tsalis (2013) have modified the Sustainability Balanced Scorecard (SBSC) model introduced below creating a sustainability evaluation model to be used by an external party or in the benchmarking process of a firm. Using their SBSC approach and drawing data, for example, from sustainability reports of the companies being evaluated, one can compare the sustainability performance of different firms. However, in this thesis the point of interest is more on the models and tools that firms use to assess their own sustainability issues. This is why the study of Nikolaou & Tsalis (2013), although combining GRI (Global Reporting Initiative) and SBSC in an interesting way, has only limited validity in relation to this study.

Figge et al. (2002b) argue that BSC combined with the three pillars of sustainability helps to overcome the problems associated with conventional sustainability management. Hubbard (2009) also sees the potential in BSC to be the framework to incorporate the sustainability metrics in. He justifies his opinion by arguing that BSC takes both short-term and long-term planning into account and that BSC is already an accepted tool in use. Figge et al. (2002b) continue by stating that BSC fulfills the prerequisites of a sustainability management system and that it also considers “soft values” which cannot be expressed in monetary value. Especially, if a company is already using BSC, adding sustainability objectives to the same framework appears promising (Lämsiluoto & Järvenpää 2008).

Figge et al. (2002b) offer three different ways to combine sustainability with BSC to construct a Sustainability Balanced Scorecard (SBSC) and the way chosen by each company depends on the challenges they are facing and other circumstances (Epstein & Wisner 2001; Dias-sardinha et al. 2002). Also Searcy (2012) has noticed that the sustainability performance measurement systems (including SBSC) must be developed, implemented, utilized and updated case-by-case for the target company. First (Figge et al. 2002b), the sustainability view can simply be incorporated to the existing strategy and turned into objectives in the four aspects of the traditional BSC. This was done in the case company of Lämsiluoto & Järvenpää’s study (2010). Also Hsu & Liu (2010) incorporated sustainability indicators (based on, for example, the ISO 14000-standard and literature) to the traditional BSC structure.

Second, sustainability can be taken into account as its own perspectives which would lead to having five or more aspects on the scorecard (Figge et al. 2002b). This way is chosen when sustainability is seen as a source of competitive advantage or it is otherwise considered important (Epstein & Wisner 2001). This approach is used in the SBSC introduced by Fulop et al. (2014). They added two more aspects, “natural environment” and “society” to the traditional BSC, resulting in six aspects on the scorecard. Fulop et al. (2014) remind, however, that merely adding two more aspects is not enough. First, the added aspects should not be thought as separate set of metrics, but should instead be seen as criteria for the operation of a company. Second, the issues explaining the gained end results should not be forgotten, which often is the case. Third, in line with Figge et al. (2002b), Fulop et al. highlight the importance of the cause-and-effect relationships. (Fulop et al. 2014)

Third (Figge et al. 2002b), sustainability can be examined as its own specific scorecard. There can even be own cards for environmental and social aspects. Figge et al. argue that this third option can only be realized after either or both of the previous two steps are accomplished. This is due to the fact that a specific scorecard for environmental and/or social aspects is derived from BSC and in order to have cause-and-effect links in action, the BSC must already contain the seeds of the derived scorecard or cards. It must

also been noticed that the first two alternatives presented above are not mutually exclusive. (Figge et al. 2002b)

Figge et al. (2002b) differentiate between strategically important environmental and social aspects that are somehow integrated to the market system (for example environmental costs) and those that influence the target entity outside the market forces. The former can easily be integrated to the BSC simply as suitable lagging or leading indicators. This is the first of the three ways mentioned above. On the other hand, environmental and social aspects that do not influence the entity at hand through market mechanisms (e.g. complaints of neighbor groups or child labor) must be considered as an additional aspect of the BSC. This is the second way described above. Here one should be careful in order not to include the same matter in both of the ways. Also, if an additional non-market aspect is to be inserted, two conditions must be met. First, environmental and social issues in the added aspect must be strategically core issues or performance drivers. Second, it is not possible to include them to the existing four aspects of the conventional BSC. (Figge et al. 2002b)

The decision of how to include the environmental and social aspects to BSC and thus, how to construct an SBSC is formed during the process of formulating the SBSC rather than at the beginning of the process (Figge et al. 2002b). The process of formulating an SBSC aims to meet three criteria: the integration of environmental and social management into business management, the resulting SBSC must not be generic but business unit specific, and lastly, environmental and social aspects of a business unit must be included in accordance of the strategic relevance. The last criterion leads to the decision of whether an additional non-market aspect is necessary to be added or not. These three criteria lead to three steps in formulating an SBSC. First, the target business unit must be selected. For small or medium sized companies business unit might be equal to company level. Second, the environmental and social issues affecting the business must be identified. Third, the strategic relevance of the issues identified during the second step must be analyzed. (Figge et al. 2002b) Figure 2 shows the three steps of formulating an SBSC.

The formation of an SBSC begins with choosing the target strategic business unit. This can also be the whole company in the case of small and medium sized enterprises. If business unit with independent profit targets and own customers can be identified, the SBSC should be formed independently for each of these entities. After the target has been chosen, the strategy of the entity in question should be recognized. It should be remembered that BSC or SBSC are not tools for formulating a strategy, but rather a framework to transform an existing strategy into different actions. (Figge et al. 2002b)

sardinha et al. (2002; 2005; 2007) adapt SBSC according to every case individually which may explain the contradiction mentioned above. The latter is more of a performance evaluation type of approach, and not implemented to link the strategic issues to performance measures. This is why the perspective of Figge et al. is given more attention in this literature review.

Once the target entity and its strategy are clear, the environmental and social issues affecting the target entity must be identified. This the step two (figure 2) and can be done separately to environmental and social aspects using the frameworks offered by Figge et al. (2001, p. 36 and 38). The frameworks are shown in the figure 2 as parts of the second step. As for environmental aspects, the framework guides the process of systematically screening all the possible effects that the target entity's actions and products have on the environment. As for social aspects, the process is somewhat harder because of the high variability and diversity of possible issues.

Figge et al. (2002b) recommend classifying the social aspects not according to the content of the issues but in relation to the possible actors involved in the operation of the target entity. Thus, they have built their framework (as shown in the figure 2) according to the stakeholder perspective. The possible relevant stakeholders can be recognized and divided into internal stakeholders, stakeholders in the value chain, stakeholders in local community or societal stakeholders. In addition Figge et al. suggest the separation of direct and indirect stakeholders; direct stakeholder being one that has material exchange relationship with the target entity and indirect stakeholder being one that does not have such a relationship. After all the possibly relevant stakeholders have been recognized, the social claims and issues related to them are to be identified and assessed. The step two leads to business-unit-specific profiles of environmental and social exposure. (Figge et al. 2002b)

The third step (figure 2) is to determine the strategic relevance (and integration accordingly) of the aspects identified in the second phase. The process begins with cross-checking the identified environmental and social aspects with the financial perspective of the BSC. It aims at dividing the environmental and social aspects into three categories: strategic core issues, performance drivers and hygienic factors. The first two groups are relevant for BSC (or SBSC), but hygienic factors are not considered as a part of the framework. The reason is "*that hygienic factors represent necessary but not sufficient conditions for a successful execution of a firm's strategy*". (Figge et al. 2002b, p. 279)

The cross-checking can be done with the help of matrix introduced by Figge et al. (2001). The same matrix (figure 3) is used for all the following perspectives as illustrated in the figure 2, and the different aspects of SBSC are covered in a cascading order to establish and maintain the linkages from strategic core issues to performance drivers. In the matrix appropriate lagging indicators (strategic core issues) and leading indicators

(performance drivers) are listed on the left-hand side of the matrix. Then environmental and social aspects are checked against the listed core issues and performance drivers. The following questions might be useful in the process (Figge et al. 2002b, pp. 279–280):

- “Does the environmental or social aspect represent a strategic core issue for the business strategy of our business unit (→ environmental or social lagging indicator)?
- Does the environmental or social aspect contribute significantly to a strategic core issue and therefore represent a performance driver for the business strategy of our business unit (→ environmental or social leading indicator)?
- What is the substantial contribution of the performance driver to the achievement of a strategic core issue?
- Is the environmental or social aspect simply a hygienic factor, which necessarily has to be well managed but leads to no particular strategic or competitive advantage?”.

Figure 3 illustrates an example cross-checking matrix done for the internal process perspective.

		Process perspective													
		Environmental exposure							Social exposure						
		Emissions	Waste	Material input/intensity	Energy intensity	Noise and waste heat	Radiation	Land use	Direct			Indirect			
Internal	In the value chain								Local community Societal	Internal	In the value chain	Local community Societal			
Strategic core issues	Innovation process														
	Production Process														
	Toxic residues in the products			▪ Residues of heavy metal based dyeing salts											
	Production cost														
Performance drivers	Service process														
	Quality control of purchasing activities			▪ Pollution level of pre-products											
	Use of harmful substances in production			▪ Use of heavy metal based dyeing salts ▪ Use of chlorine based dyeing agents											
	Energy-, water- and material-efficiency			▪ Water consumption of washing and dyeing processes	▪ Energy consumption of drying and steaming processes										

Figure 3. Example matrix to be used in cross-checking for different aspects of SBSC. Modified from Figge et al. 2002a.

Following the cascade-like order of going through the four (or more) aspects of BSC, makes use of information gained earlier during the process in the figure 3. As shown in figure 3, two strategic core issues have been derived from higher-level targets during the cross-checking of financial and customer perspectives: ‘toxic residues in the products’ and ‘production cost’. These are thus lagging indicators for internal processes. It can be

seen from the figure 3 that ‘production cost’ has no environmental or social dimension and is thus handled as a conventional financial ratio indicator. ‘Toxic residues in the products’, on the other hand, is related to ‘residues of heavy metal based dyeing salts’ which thus has strategic importance to the company at hand (because it is in the same cause-effect-chain with a lagging indicator). This means that ‘residues of heavy metal based dyeing salts’ should be included to the SBSC through appropriate environmental lagging indicators. (Figge et al. 2002a)

Three performance drivers (leading indicators) are identified and derived from lagging indicators for internal processes as shown in figure 3: ‘quality control of purchasing activities’, ‘use of harmful substances in production’ and ‘energy-, water- and material-efficiency’. The first two influence the strategic core issue ‘residues of heavy metal based dyeing salts’ and all three affect the core issue ‘production cost’. As can be seen from the figure 3 the ‘quality control of purchasing activities’ does not have as strong environmental stance as the other two leading indicators. (Figge et al. 2002a)

Table 1 gives an example of the lagging and leading indicators that can be used in the cross-checking process. It should be remembered, however that the SBSC should not be generic (Figge et al. 2002b) and also some other case-specific indicators than just the ones presented here might be needed.

Table 1. Example of lagging and leading indicators. Compiled from Figge et al. 2002a, Figge et al. 2001 and Kaplan & Norton 1996a.

	Financial perspective	Customer perspective	Process perspective	Learning and growth perspective	Non-market perspective
Lagging indicators	Revenue growth	Market share	Innovation process	Employee retention	Freedom of action
	Productivity growth	Customer acquisition	Operations process	Employee productivity	Legitimacy
	Asset utilization	Customer retention	Postsale service process	Employee satisfaction	Legality
		Customer satisfaction			
Leading indicators	–	Product attributes	Cost indicators	Employee potentials	Child labour
		Customer relationship	Quality indicators	Technical infrastructure	etc.
		Image and reputation	Time indicators	Climate for action	

According to Figge et al. (2002b) the process of forming the SBSC continues by going through all the four perspectives of the conventional BSC in cascade-like order until all the perspectives have been compared to the issues identified. This is done starting from the financial aspect in order to maintain the cause-and-effect links in action and to recognize and make the relationship of strategic objectives and operational actions visible. This way of working ensures that the strategically important aspects, the core issues, will be linked to the performance drivers and thus, translated into operational actions. This is criticized by Hubbard (2009) who argues that the real-life organizations do not know their operations well enough to form the described cause-and-effect links. However, it seems that so far no empirical study (e.g. Dias-sardinha et al. 2002; Chalmeta & Palomero 2010) has supported this view.

Dias-sardinha et al. (2002) take a slightly different perspective than Hubbard as they introduce a version of SBSC that is built by cascading the objectives beginning at the corporate level. Also Epstein & Wisner (2001) emphasized the importance of linkages between different levels of the target organization, whereas Figge et al. (2002b) present the SBSC as a tool for specific business unit or for a small firm.

Once all the four perspectives have been handled, it should be evaluated if the fifth, non-market aspect should be added. This is the case if some environmental or social issues influence the target entity via mechanisms outside the market system. (Figge et al. 2002b) A case study conducted by Chalmers & Palomero (2010) suggests that additional aspects are used quite often. In their study all the companies taking part in the study added two new aspects, environmental and social/labor, to the process.

Hubbard (2009) suggests that adding the non-market, environmental and social elements would be the first thing to do in forming an SBSC. In the model of Figge et al. (2002b) the non-market aspect would only be added if there was a need after going through the other aspects. In this sense Hubbard's approach differs from the one presented by Figge et al. (2002b) as he does not demand the deriving of the measures used in a cascade-like order from strategic core issues. Hubbard (2009) also calls for simplicity in reporting and thus offers a lighter version of the SBSC without the linkages between strategic core issues and performance measures.

Unlike Figge et al. (2002b), Nikolaou & Tsalis (2013) suggest that no non-market aspects should be added, but the environmental and social measures could be included in the existing four aspects of BSC by using the indicators of GRI (Global Reporting Initiative, see the section 2.3.1 for more detailed information on GRI). This is reasonable as they seek to build a model that would generate comparable results from different organizations.

As a result from the cascade-like cross-checking process the environmental and social aspects can be divided to strategic core issues, performance drivers and hygienic factors. The aspects in the first two groups are integrated in the SBSC formed and are thus part of a large cause-and-effect network that visualizes the strategy of the examined entity. Now appropriate indicators, measures, objectives and targets have to be developed to be able to control and guide the actions of the business unit or company to the desired direction. (Figge et al. 2002b)

As a visualization or as a deliverable from the process of forming an SBSC a strategy map can be drawn (Figge et al. 2002b; Dias-sardinha et al. 2007). It illustrates the linkages between identified strategic core issues (Figge et al. 2002b) under the different aspects of the SBSC (Dias-sardinha et al. 2007). The SBSC in its different forms has been implemented in a wide range of set-ups. Dias-sardinha & Reijnders (2005) made use of SBSC as a part of a larger performance framework and studied large (>400 em-

ployees) Portuguese companies and Dias-sardinha et al. (2007) developed an SBSC to three large Portuguese companies in different sectors: electricity production and distribution, tourism, and shopping and leisure center management.

Hsu & Liu (2010) identified environmental issues and built a map of environment strategy in the Taiwanese automobile industry using a BSC approach. Hsu et al. (2011) have proposed an SBSC framework for evaluating the sustainability performance of the semiconductor industry and tested it in Taiwanese environment. Lämsiluoto & Järvenpää (2012) created an SBSC and assessed the environmental performance of a firm in the food processing industry. Fulop et al. (2014), in turn, built an SBSC and implemented it at a company in the chemical industry. From the last study it must be said that it seems that they have done nothing conceptually new (as they claim) but instead tested one form of the SBSC presented already before by Figge et al. (2002b).

It is clear that SBSC is applicable to different industries and environments but it should also be tailored to the specific needs of the firm at hand. On the one hand this is good, as the model can be used in any firm. On the other hand, the model is never similar and thus lacks the possibility of making comparisons between different firms.

Hsu et al. (2011) develop the use of SBSC further by using it together with fuzzy Delphi method (FDM) and analytic network process (ANP). Delphi method is used to extract the most reliable consensus of opinion from a group of experts (Dalkey & Helmer 1963). Fuzzy Delphi method is a modification to the Delphi method, in which the opinion formation is eased by asking the experts to give a three-point (pessimistic, moderate and optimistic) estimate and from them a triangular fuzzy numbers are formed and their means computed (Hsu et al. 2011). This way the consensus building can be alleviated (for more information see Hsu et al. 2011). Using ANP Hsu et al. say to be able to set relative weights for the indicators used in SBSC. ANP is a tool used to build ratio scale priorities for indicators (for more detailed description see Saaty 2001).

In their massive literature review Hansen & Schaltegger (2014) propose that the scholarly debate about SBSC can be divided into two issues. First, they identify different opinions on whether sustainability issues should be handled as a part of the existing four aspects of BSC or should there be separate, additional aspects for them (e.g. Figge et al. 2002b; Epstein & Wisner 2001; Lämsiluoto & Järvenpää 2010; Dias-sardinha et al. 2002). Second, Hansen & Schaltegger (2014) mention the debate on whether the strategic core issues should be tightly linked to performance measures or whether they are impossible and unnecessary to identify (Figge et al. 2002b; Hubbard 2009). As can be seen from the literature review above, also other small debates are on-going, and slightly different versions of the SBSC are proposed and used. As this study is not about the BSC or SBSC itself it is not meaningful to limit the evaluation on one specific version but to acknowledge that different versions exist.

2.2.5 Synthesis of the Frameworks

There is a good reason to assume that models like sustainable VSM and SBSC are used in the industry as they are being researched quite extensively. The two frameworks and their derivatives introduced above were chosen to be examined in this thesis as they offered a vast amount of literature to be evaluated. Table 2 consists of information gathered about the different models discussed in section 2.2.

As can be seen in the table 2 a wide range of different derivatives and views exist on VSM and BSC. It is impossible to say which one is the most popular or most useful. The models offered are quite scattered and no connecting thread seems to be found, other than that they are all based either on VSM or BSC. This makes it rather difficult for companies to find and implement one that fits their needs.

Table 2. VSM, BSC and their derivatives in literature.

Framework	Purpose/Motivation	References	Key findings
Value Stream Mapping (VSM)	Identify and eliminate waste from manufacturing process.	Hines et al. 1997; Hines et al. 1999; Singh et al. 2011; Forno et al. 2014; Lovelle 2001; Khaswala & Irani 2001	Good tool to identify waste and to get broad view of the entire material flow. Challenges include not being able to map multiple product paths, lack of clear measure for value and being mainly suitable for high volume and low variety processes.
Value Network Mapping (VNM)	Remove the weakness of not being able to measure multiple product paths.	Khaswala & Irani 2001	Combining VSM and software tools allows mapping of multiple value streams.
Sustainable VSM (Sus-VSM)	Focus on sustainability issues in VSM.	Faulkner & Templeton 2012	The tool worked as expected for the case company. Raw water usage is monitored confusingly and the tool cannot, as such, be used to a totally different case and new metrics should be considered.
Environmental VSM (EVSM)	Focus on environmental issues in VSM.	Torres & Gati 2009	The tool is able to identify excess raw water usage but there is a misalignment in financial and environmental goals in the tool.
Sustainable Manufacturing Mapping (SMM)	Ease of use, high visualization and focus on sustainability. Simulation to make SMM dynamic.	Paju et al. 2010	SMM might be able to utilize publicly available data to compare different value streams. Comparison between different systems might be problematic as the indicators vary.
Eco-Function matrix-integrated VSM	Incorporating sustainability to lean tools.	Vinodh et al. 2011	Using the tool, priority order for wastes identified and improvement proposals can be defined.

Framework	Purpose/Motivation	References	Key findings
Balanced Scorecard (BSC)	Link the strategy of an organization to day-to-day actions. Measure and evaluate the performance of an organization.	Kaplan & Norton 1992; Kaplan & Norton 1996; Stevenson 2010;	BSC minimizes the information overload and shows many different aspects of the firm at a single glance. BSC guards against sub-optimization but it lacks sustainability issues.
Sustainability BSC (SBSC)	Combine BSC with the three pillars of sustainability.	Figge et al. 2002b	Method to incorporate sustainability to the decision making process.
SBSC for external evaluation	Tool for benchmarking to be used by an external party.	Nikolaou & Tsalis 2013	Tool can be used to compare the sustainability performance of different firms for example based on the GRI reports of the firms.
SBSC with traditional four aspects	Easy to implement. Especially if the company already uses BSC.	Lämsiluoto & Järvenpää 2008; Hsu & Liu 2010	SBSC helps in forming the environmental strategy.
SBSC with added aspects	Used when sustainability is considered as competitive advantage or otherwise important.	Fulop et al. 2014	SBSC is useful in pursuing sustainability strategies and business excellence.
SBSC with an own sustainability scorecard	Coordinated control of all strategically relevant sustainability aspects.	Dias-sardinha et al. 2002; Dias-sardinha et al. 2007	SBSC is found to be useful in stating the current and intended practices.
SBSC with fuzzy Delphi method (FDM) and analytic process network (ANP).	Alleviate consensus building through FDM and set the relative weights for indicators of BSC with ANP.	Hsu et al. 2011	The version of SBSC was proved functional.

On the other hand, it can be said that there probably is a method to suit the needs of most organizations if the organizations only have the motivation to consider sustainability issues. What is also worth mentioning is that not all methods discussed include social aspects. Environment still seems to be dominating the sustainability discussion. It must also be said that sustainability methods based on VSM and sustainability tools deriving from BSC are not mutually exclusive. BSC is about linking strategy to everyday operations and objectives, while VSM is more concerned about the value stream of a product or a product family and removing possible waste in it.

2.3 Building Blocks of Sustainable Value

In the previous sub-chapter of the literature review methods to identify and assess sustainable value were introduced. In order to fully extract the potential of these tools, companies must understand what is sustainable value made of and find the right actions to implement. Building blocks of sustainable value are understood as the indicators used to measure and follow sustainability, and as the actions taken to enhance the sustainabil-

ity of a given company. First, the indicators in use are examined. In the next sections the actions fostering sustainability are reviewed in accordance to the three functions that are the focus in this thesis: R&D, manufacturing operations and marketing. Last, actions enhancing sustainability at the strategic level are discussed.

2.3.1 Overview of the Indicators in Use

Feng & Joung (2009, p. 2) have made an overview of different indicators used to assess sustainability. Modified version of that overview is presented in the table 3. The modified table includes the Global Reporting Initiative (GRI) indicators chosen to be discussed in this study, plus the indicators introduced by the United Nations (UN) Commission on Sustainable Development (CSD) and the ones presented in the 2005 Environmental Sustainability Index (ESI) Report. The CSD and ESI indicators are presented only for comparison, as the CSD indicators are intended to be used at national rather than at company level (Commission on Sustainable Development 2007) and the ESI indicators include only environmental indicators (Esty et al. 2005), which does not sufficiently cover the topic of this thesis.

Table 3. Sources of sustainability indicators. Modified from Feng & Joung 2009.

Indicator Set	Components	Reference
Global Reporting initiative (GRI)	91 indicators *, **	https://www.globalreporting.org/resourcelibrary/GRIG4-Part1-Reporting-Principles-and-Standard-Disclosures.pdf *
2005 Environmental Sustainability Indicators	76 building blocks	http://www.yale.edu/esi/ESI2005.pdf
United Nations Committee on Sustainable Development Indicators	50 main indicators *	http://www.un.org/esa/sustdev/natlinfo/indicators/guidelines.pdf

* = total number of indicators or reference has changed in comparison to the original source (Feng&Joung 2009)

** = only the Specific Standard Disclosures are included

Feng & Joung (2009) introduce many different sets of metrics and point out that all of them aim at reporting to stakeholders. That is to say that none of them is necessarily effective in supporting internal decision making or tracking sustainable performance internally (Feng & Joung 2009). Even though the focus of Feng & Joung's study is on measuring sustainable performance, the sets of metrics used in the measurement process probably also indicate the valuable factors affecting the three dimensions of sustainability. Also Searcy (2012) has made an extensive review about the research on different sustainability indicators.

In addition to Feng & Joung and Searcy, also Singh et al. (2009) have done an overview on the different sets of indicators in use. Also they mention the Global Reporting Initiative (GRI) and the set of indicators introduced by the United Nations Commission on Sustainable Development (older version). Relating to indicators in general, Singh et al. (2009) remind that no metrics used helps the actual work towards sustainable develop-

ment, but can only offer feedback and measurement data for the evaluation of actions taken.

Next, the GRI reporting framework and its indicators are presented. The GRI framework chosen is well-known and roughly estimated (Feng & Joung 2009; Searcy 2012; Singh et al. 2009) one of the most extensive ones. The choice of examining GRI more in depth can be justified with the nature of this study. This study is not about the quality of the sets of metrics themselves but about the factors behind the three aspects of sustainability. Thus, from a larger set of indicators it is more likely for an interesting factor explaining one (or more) of the aspects of sustainable value to be found.

“The GRI is an independent nongovernmental organization” (Dingwerth & Eichinger 2010, p. 76) and its reporting framework for non-financial reporting *“is the best-known framework for voluntary reporting of environmental and social performance by business worldwide”* (Brown et al. 2009, p. 571). GRI provides a base for sustainability reporting in form of reporting instructions that manufacturers can use as a reference when reporting and evaluating their own processes (Feng & Joung 2009). Rough representation of the structure of the reporting guidelines of GRI is given in the table 4.

The guidelines provided by GRI are reviewed from time to time and the newest version is the G4 guidelines published in 2013. The disclosures presented in the guidelines are divided into Core and Comprehensive options. Core option includes only the essential aspects and indicators, whereas the Comprehensive option builds on the Core version and is more extensive. Not all aspects and disclosures are required to be reported when applying the guidelines. (Global Reporting Initiative 2013)

As can be seen from the table 4, the guidelines contain two kinds of standard disclosures: general and specific. The general ones provide information on the organization and the reporting process. The specific standard disclosures enlighten the organization’s management and performance in accordance to the significant aspects of the company at hand. Specific disclosures are broken down to three categories (economic, environmental, social) as proposed by the triple bottom line thinking. All the aspects listed in the table 4 contain 1-22 more accurate points or indicators. As an example, “Stakeholder Engagement” includes “List of stakeholder groups engaged” and “Basis for identification and selection of the engaged stakeholders” amongst others (General standard disclosures). As a further example, the aspect “Emissions” involves the indicators “Direct greenhouse gas emissions” and “Reduction of greenhouse gas emissions” amongst others (Specific standard disclosures). In total, there are 150 different disclosures and indicators, of which 91 are indicators in the Economic, Environmental and Social aspects. (Global Reporting Initiative 2013)

Table 4. *GRI guidelines, categories and aspects for sustainability reporting. Modified from Global Reporting Initiative 2013: Table 1 and p. 21.*

General Standard Disclosures	<ul style="list-style-type: none"> • Strategy and Analysis • Organizational Profile • Identified Material Aspects and Boundaries • Stakeholder Management 		<ul style="list-style-type: none"> • Report Profile • Governance • Ethics and Integrity 		
	Specific Standard Disclosures	Category	Economic	Environmental	
Aspects		<ul style="list-style-type: none"> • Economic Performance • Market Presence • Indirect Economic Impacts • Procurement Practices 	<ul style="list-style-type: none"> • Materials • Energy • Water • Biodiversity • Emissions • Effluents and Waste • Products and Services • Compliance • Transport • Overall • Supplier Environmental Assessment • Environmental Grievance Mechanisms 		
Category		Social			
	Sub-Categories	Labor Practices and Decent Work	Human Rights	Society	Product Responsibility
	Aspects	<ul style="list-style-type: none"> • Employment • Labor/Management Relations • Occupational Health and Safety • Training and Education • Diversity and Equal Opportunity • Equal Remuneration for Women and Men • Supplier Assessment for Labor Practices • Labor Practices Grievance Mechanisms 	<ul style="list-style-type: none"> • Investment • Non-discrimination • Freedom of Association and Collective Bargaining • Child Labor • Forced or Compulsory Labor • Security Practices • Indigenous Rights • Assessment • Supplier Human Rights Assessment • Human Rights Grievance Mechanisms 	<ul style="list-style-type: none"> • Local Communities • Anti-corruption • Public Policy • Anti-competitive behaviour • Compliance • Supplier Assessment for Impacts on Society • Grievance Mechanisms for Impacts on Society 	<ul style="list-style-type: none"> • Customer Health and Safety • Product and Service Labeling • Marketing Communications • Customer Privacy • Compliance

GRI has also received some criticism (e.g. Atkinson 2000; Brown et al. 2009; Dingwerth & Eichinger 2010). Just to mention few examples, it can be argued that high environmental expenditure (Specific standard disclosure G4-EN31) itself does not necessarily indicate sustainable operation (Atkinson 2000). Brown et al. (2009) argue that GRI has failed to mobilize civil society groups which was originally one of its goals. They add that its impact on private regulation through market mechanisms seems to be lower than expected.

In addition, Dingwerth & Eichinger (2010) state that GRI reports from automotive industry are, in contrast to what is claimed, not comparable and offer only little value to different audiences. This is partly due to the fact that companies can choose themselves which level of reporting they want to accomplish (Hedberg & von Malmborg 2003). For example, Hussey et al. (2001) found out in their study on environmental reports of three major oil companies that the reports did not cover a number of issues related to long-term sustainability. GRI has been found to be insufficient also in the cement industry, as a report done according to the guidelines does not give the information whether a company is sustainable or not (Isaksson & Steimle 2009). All in all, “*GRI has been by several measures a successful institutionalization project*” (Brown et al. 2009, p. 571) and “*the transparency the guidelines provide is perhaps more important than having identical reports to compare*” (Hedberg & von Malmborg 2003, p. 163).

2.3.2 Issues Enhancing Sustainability in R&D

Already in the early 90’s Wheeler (1992) recognized the importance of recyclability of a product. He also introduced a list of questions to challenge the traditional product development by covering issues like recycling, setting the benchmark instead of compliance, modular design (allowing for upgradability) and reducing the use of solvents, toxics and oils. He also raised the issue about product’s death: what then? How will it be disposed of when it can no longer be used? (Wheeler 1992)

Karjalainen (2014) has made an extensive literature review on end-of-life (EoL) strategies and listed a number of different methods and models to be used in the R&D phase to help the designers to keep also sustainability in mind (2014, pp. 10–11). Different methods concentrate most heavily on life cycle considerations and EoL strategies, but Karjalainen (2014) reminds that even though many models and methods have been introduced, only a few of them are actively in-use in the industry. This is why none of the models is described more in depth, but instead only some examples are given. The methods and models include, for example:

- using life cycle scenarios in comparing different life cycle strategies (Fukushige et al. 2012),
- end-of-life design advisor (ELDA) (Rose & Ishii 1999; Rose et al. 2002),
- mathematical model to compare EoL options (Ziout et al. 2014).

The EoL methods are implemented according to a hierarchy of different alternatives of EoL solutions (Karjalainen 2014, p. 11). One of the hierarchies is the so called Lansink’s ladder stating that the EoL solutions should be implemented - when possible - in the following order (Duflou et al. 2008, p. 585):

- Prevention of waste
- Reuse of products

- Reuse of components
- Material recycling
- Incineration with energy recovery
- Incineration without energy recovery
- Landfill.

Chapas et al. (2010) have recognized components that are closely linked to sustainability in the R&D function. They mention green certification, raw material analysis and LCA as possible enablers of sustainable R&D. Bhandar et al. (2003) argue that R&D has gained more importance as the focus of environmental friendly industry has moved from filtering the manufacturing process to the entire lifespan of a product. They continue that LCA has been recognized as a possible way to incorporate this wider thinking to R&D but it has been far from a perfect solution. They see LCA as too time-consuming and argue that it needs too much detailed information that the designer does not have at the early phase of product development process. Yet, they feel that LCA and methods alike are important tools, even with their defects, for the early phases of product design where the most effective decisions affecting sustainability are made. (Bhandar et al. 2003)

Bereketli & Genevois (2013) offer an approach that does not require detailed information about a product and is thus suitable for the early R&D phases. They propose a Quality Function Deployment for Environment (QFDE) with Fuzzy Analytic Hierarchy Process Extent Analysis. Combining these two they are able to consider the end users' requirements as well as the ones from all the other stakeholders and define priorities. Although considering only one specific product: a hand blender, they found out that materials are the best possibility to reduce environmental impact. Results might not be completely applicable to all contexts, but the study gives designers in general something to think about: use recyclable materials, select non-hazardous materials, and use reusable parts and components. (Bereketli & Erol Genevois 2013)

Pujari et al. (2003) state that designing for environment, the environmental new product development (ENPD) is not that different from "traditional" NPD. It rather only adds little more complexity to the process addressing the physical product life cycles and designing also for post-use applications. Pujari (2006) states that higher degree of cross-functional (NPD professionals, environmental specialists) coordination, higher degree of supplier involvement, higher degree of market focus and LCA activities are key issues to better market performance of ENPD based greener products.

Rather surprisingly social aspects, like safety for user, have not received as much attention as environmental aspects. As an example, Hauschild et al. (1999) mention safety as one priority in the product development process.

Hsu & Liu (2010) mention R&D in the area of green technologies and products as an environmental effort. Being quite a large issue, it still reminds about the importance of designing products that are sustainable as default. Meaning that if a company can choose between designing an improved coal power plant or new environmentally friendly energy source, choosing the latter is more sustainable.

Summarizing the issues found out in this section it can be said that designers should pay attention to the following:

- EoL strategies
- Life cycle considerations
- Material choices (reduce toxicity and harmfulness, increase recycling)
- Different methods (e.g. QFDE) might help
- Fuzzy logic might help
- Cross functional coordination (NPD professionals, environmental specialists)
- Supplier involvement
- Product safety
- Promote R&D aiming at green products and technologies.

2.3.3 Issues Enhancing Sustainability in Production

Sustainable production includes issues like waste reduction, cleanliness and safety (Hsu & Liu 2010). Halldórsson et al. (2009) have listed other issues in sustainable production. They used two sources, from which only the literature review by Srivastava (2007) is available. Table 5 summarizes the key findings of Halldórsson et al. and Srivastava.

Table 5. Issues in sustainable production. Adapted from Halldórsson et al. 2009 and Srivastava 2007.

Environment	People	Economy
Elimination of overuse of resources	Automation of physical heavy work	Increased productivity due to improved working conditions
Reduction of waste and energy usage	Job rotation and enrichment	Savings through decreasing energy and material costs
Environmentally friendly packaging	Training and education of employees	Costs of certification, documentation and reporting
Closed loop manufacturing; waste from one company is input to another	Prevention of accidents	
Replacing hazardous materials		
Using recycled raw material		
Remanufacturing and repair		

According to Veleva et al. (2001, p. 448) The Lowell Center for Sustainable Production defines Sustainable Production as “*the creation of goods and services using processes and systems that are: non-polluting; conserving of energy and natural resources; eco-*

nomically viable; safe and healthful for workers, communities, and consumers; and, socially and creatively rewarding for all working people”.

Deriving from the definition Veleva et al. (2001, p. 451) have interpreted some key issues related to sustainable production:

- production should be done using as little resources and energy as possible and without toxic materials
- wastes and byproducts are recycled, eliminated or reduced
- hazards to workers' health are continuously eliminated
- products produced are ecologically sound and durable, repairable, easily recyclable and possibly biodegradable.

These are in line with the issues in the table 5. Veleva & Ellenbecker (2001) have developed these thoughts further and have introduced six main aspects of sustainable production:

- resources (energy and material use)
- natural environment
- social justice and community development
- economic performance
- workers
- products.

Ball et al. (2009) have introduced the idea of zero carbon manufacturing facility and developed the idea of integrated material, energy and waste process flows. They handle the same issues as described previously in this section but the idea of integrated, holistic view on different process flows gives more insight about closed loop manufacturing. Additionally, they examine things such as energy source of the production stating that solar cells and wind turbines are offering options for conventional power production but this falls, although interesting, outside the scope of this thesis. (Ball et al. 2009)

In summary it can be said that health and safety issues are far more on display than in the R&D function. In addition, also the surrounding community has been acknowledged as a sustainability issue. Energy and material efficiency and waste elimination or recycling bring economic savings as well as simultaneously help to reduce the load on environment. Furthermore, all toxic substances should be excluded from the manufacturing process. This all is not always free of charge and costs for certification, replacement of materials and documentation should be kept in mind.

2.3.4 Issues Enhancing Sustainability in Marketing

Davis (1991) saw the early days of green marketing as a mere bluff and states that green marketing was full of misleading half-truths and deception. He demanded for more

transparent marketing and self-control among marketers. However, creating sustainable marketing strategies has proved to be very difficult for companies (Peattie 1999). Peattie (1999) offers identifying and challenging the key assumptions of “traditional” marketing strategies as a solution. He argues that sustainable marketing has to appreciate the triple bottom line thinking.

Peattie (1999) states that sustainable marketing needs more than companies making just greener marketing strategies in order to seek competitive advantage. He calls for:

- extending the marketing time frame (considering also the needs of future generations)
- widening the concept of value; considering also the value of a product to others affected by it and not only the value to the customer or user
- other alternatives (e.g. leasing) for ownership than just outright purchases
- cooperation between suppliers and customers to reduce waste
- changing the core of marketing and not just the cover.

Polonsky & Rosenberger (2001) remind that companies have to realize that true long-term benefits might not be available if the greening of marketing is not supported by the organization as a whole. Thus, they support the view of Peattie (1999). Polonsky & Rosenberger (2001) continue and state that green marketing cannot be defined as individual tactical activities. Instead, it should be understood as multi-disciplinary cooperation and true organizational philosophy integrated in the actions and strategy of a company.

The holistic approach to green marketing can be realized through the following issues as stated by Polonsky & Rosenberger (2001). First, a company must ensure that its green positioning is in line with its values and behavior. Although negative media presence affects all organizations and their sales (Oates et al. 2008), customers will judge companies stating to be green more critically and thus companies will get caught on “greenwashing” more easily. Second, companies should start marketing waste. Meaning that companies could try to find applications for their byproducts and waste as they might offer an opportunity for “extra” value-added. (Polonsky & Rosenberger 2001)

Third, while using green promotion, companies must avoid greenwashing as it is no longer accepted by regulators and customers. Instead, companies should carefully consider what information to communicate and how. When revealing worthwhile environmental information it must be communicated in a way that customers understand it and feel that they are not being deceived. This must be in line with the first point discussed earlier. Fourth, green alliances might provide a way to implement green activities as companies might not have all the required knowledge and know-how. However, using partners requires a lot of work and time to be able to grasp the possible benefits from such a partnership. (Polonsky & Rosenberger 2001)

As already stated above, the process is not easy and no clear improvement can be seen between the studies of Davis (1991) and Peattie & Crane (2005). The latter call for mainly the same issues as their colleagues Polonsky & Rosenberger (2001) some 4 years before and Peattie (1999) some 6 years before. Being reworded and reshaped, the message of Peattie & Crane (2005) is more or less the same demanding more focus on benefits from product use, informative communication, redefinition of the product, thinking beyond current consumer needs, emphasizing the life cycle costs instead of price and taking more responsibility. (Polonsky & Rosenberger 2001)

Sometimes customers have to be educated about the environmental or social benefits or drawbacks of certain materials and products, and about life cycle costs (Wheeler 1992). Failure to do so might force a company to use more harmful materials (Peattie 1999) as customers do not know enough about available alternatives and their benefits (Wheeler 1992). More active communication and information sharing with educational and enlightening objective might be necessary as also noted by later researchers (Polonsky & Rosenberger 2001; Peattie & Crane 2005). This was also the case in a study conducted in Greece about forest certification (Papadopoulos et al. 2010). Papadopoulos et al. (2010) found out that timber companies want to improve the awareness of customers about forest certification systems and enhance the sustainable use of Greek forests.

In summary, sustainable marketing underlines marketing green products and raising awareness among customers, while trying to find new ways to handle the traditional marketing views with the aim of promoting more sustainable marketing system (Gordon et al. 2011). Furthermore, it must be kept in mind that when marketing greener products, marketing must be in line with other functions and the strategy of a company. Greenwashing is not accepted anymore and companies stating to be green are critically examined by customers and societies. Also the time horizon of marketing has to be long enough to include the needs of future customers as well as the needs of today's customers. In addition, new ways to market byproducts and waste and new ideas to replace, for example, product ownership should be developed. One key factor might be focusing on marketing life cycle costs instead of product costs.

2.3.5 Issues Enhancing Sustainability at Strategic Level

While doing research on sustainability issues as a part of Balanced Scorecard, Hsu & Liu (2010, p. 603) ended up listing sustainability actions implemented by Taiwanese automobile industry. They found issues like:

- Environmental performance evaluation
- Corporate Environmental Report
- Waste reduction
- Pollution prevention
- Safety and health.

Obviously, these are too broad concepts and offer no clear guidance on the path to sustainability. However, they set the starting point for the values and critical evaluation of the operations of a firm: a company must be willing to examine its environmental and safety issues in order to be able to improve its operations. One way to begin with might be to start publishing environmental reports or evaluating sustainability performance and thus, get an idea of where the organization stands and where can it improve its sustainability performance. There must be an urge in the organization to be sustainable.

Vachon & Klassen (2006) state that technological integration with most important suppliers and primary customers offers a possibility to improve environmental monitoring and performance. They found out that strategic level cooperation in, for example, R&D, common technical training and premises visits usually meant also higher level environmental collaboration. These kinds of things are related to Supply Chain Management (SCM) and through sustainable SCM companies seek to achieve sustainable flow of products, services, information and capital (Wolf 2011). Wolf (2011) has studied the factors enabling or hindering sustainable SCM and some ideas from her study are presented in the table 6.

Table 6. *Enablers and inhibitors of integrating sustainability into the SCM.*
Adopted from Wolf (2011).

Enablers	Inhibitors
Stakeholder integration capability	Knowledge and limited availability of information
Sustainability strategy and appropriate performance measures	Lack of needed human resources
Investment in human resources and development of know-how	Limited communication internally
Close supplier relationships	
Goal alignment	
Interaction with non-governmental organizations	
Leadership commitment	
Supplier selection	

As seen in the table 6, collaboration inside and outside the company is an important issue. Sustainability strategy should be formulated and then followed with appropriate measures. Needed human resources and know-how should be ensured. Management must be motivated and show it to the employees also. Good relations to NGOs might reduce the pressure from them and thus, reduce the resources needed to manage these relations. Wolf's (2011) findings support the ones from Vachon & Klassen (2006). Bansal & McKnight (2009) argue that combining SCM efforts with the ideas of industrial symbiosis, companies might be able to realize even more benefits. Industrial symbiosis is a sub-concept of industrial ecology (IE).

Industrial ecology (IE) is a concept that aims at matching the inputs and outputs of an industrial system to the local and planetary carrying capacity (Lowe & Evans 1995).

According to Lowe & Evans (1995) one key enabler of this objective is to move from linear to closed loop systems regionally. Korhonen (2004) and Desrochers (2001) question this approach and argue that IE systems always have to be a part of a larger system and limiting them by requiring them to be sustainable regionally or “on their own”, might actually hinder sustainable development. In the table 7 there are issues gathered from literature that might offer guidance to reach sustainability at the strategic level of a company.

Table 7. *Issues affecting sustainability at the strategic level.*

Issue	Researchers
Environmental performance evaluation	Hsu & Liu 2010; Wolf 2011
Corporate environmental report	Hsu & Liu 2010
Replacing non-renewables with renewables	Korhonen 2004
Reducing the material intensity of products and services	Korhonen 2004
Integration with key suppliers and major customers	Vachon & Klassen 2006; Wolf 2011; Bansal & McKnight 2009
Stakeholder integration	Wolf 2011; Korhonen 2004
Interaction with non-governmental organizations	Wolf 2011
Management of supplies	Lowe & Evans 1995
Designing products that last long and are easy to repair or upgrade	Lowe & Evans 1995
Sufficient human resources	Wolf 2011
Flexibility of authorities	Desrochers 2001
Leadership commitment	Wolf 2011
Reducing pollution and waste	Lovins et al. 1999; Hsu & Liu 2010
Closed loop production	Lovins et al. 1999; Lowe & Evans 1995; Korhonen 2004
Being proactive instead of only complying with the rules	Nidumolu et al. 2009
Industrial Ecology / Industrial Symbiosis	Lowe & Evans 1995; Desrochers 2001; Korhonen 2004; Bansal & McKnight 2009; Chertow 2007

As the table 7 shows, there is no clear managerial advice on how to be sustainable or how to reach sustainability at strategic level. The concepts are quite wide and no exact guidance can be found. Instead, there are numerous concepts that ought to help reaching sustainability. Next, some of the issues are explained more in detail.

Nidumolu et al. (2009) argue that to be sustainable and profit from it, companies must change their mindset and start to think how to be ahead of law and regulations instead of simply complying with them. Secondly, according to Nidumolu et al. (2009), the whole value chain should be made sustainable which is in line with Wolf’s (2011) suggestions about supplier selection, stakeholder integration (also Vachon & Klassen 2006) and close supplier relationships. Third area of focus is to develop new sustainable prod-

ucts and services and business models (Nidumolu et al. 2009). This might be easier said than done.

Lovins et al. (1999) stress the urgency to shift to biologically inspired production models and to solutions-based business models reducing product-centric thinking. Being good advice they are still too wide concepts to offer any clear instructions to push forward. Lovins et al. (1999) continue deepening their thoughts and come across to some of the same things that were introduced before (Hsu & Liu 2010; Wolf 2011) like reducing waste and pollution and considering the industrial systems as a whole (integration). In addition, they mention closed loop production. Lowe & Evans (1995) see that closed loop systems could be realized through redesigning the industrial systems to resemble biological ecosystems where the waste or residuals of one company become raw material or feedstock of another. Thus, they support the views of Lovins et al. (1999).

Industrial ecology (IE) has been researched a lot (see table 7) and it is tightly linked to industrial symbiosis. It is nothing new, just good common sense, but during the industrialization and era of specialization the common sense was forgotten (Lowe & Evans 1995). Lowe & Evans (1995) name Kalundborg (city in Denmark) as a case in point example of industrial symbiosis. In Kalundborg five partners (4 companies and a utility) and number of smaller companies have created a network of materials and energy exchange with the original idea of seeking profitable uses for the wastes from the companies in the area. They did not do only that but ended up substantially reducing environmental impact as well.

However, Desrochers (2001) reminds that Kalundborg, although an excellent example of collaboration between companies in different industries, is not a local network nor self-sufficient. Material has to be exported and imported but that is not necessarily a bad thing as also interregional trade is needed (Desrochers 2001). Korhonen (2004) too, reminds that IE systems are and will always also be a part of a larger system, that is, our planet. Desrochers (2001) does not criticize Kalundborg itself but the obsessive idea of some researchers that IE systems should somehow be regional and self-sufficient.

Key issues associated with industrial symbiosis are management of supplies, design of procurement standards and specifications, holistic analysis of materials and energy flows, process design and total cost accounting (Lowe & Evans 1995). Another issue is to begin to design products to last as long as possible and in addition, to be able to extend their life cycles with repairs and upgrades. This would entail new service economy possibilities of durable products.

Desrochers (2001) argues that in addition to the involved companies' willingness and attitude, also the regulatory framework plays a role. He states that IE systems cannot be designed entirely in a top-down manner, but instead the regulatory atmosphere can be altered in such a way that it supports the development of IE systems. He mentions the

flexibility of Danish authorities in the case of Kalundborg as an enabler of the IE system. Chertow (2007) agrees and states that the industrial symbiosis cannot be forced but its formation can be eased.

Korhonen (2004) calls for more discussion on the societal aspect of IE as people also need to satisfy their social needs and the social system is also a part of larger IE systems. The issues in societal aspect include stakeholder cooperation, transparency, dialogue and community (Korhonen 2004).

As stated in this section, the managerial advice on guiding a company towards sustainable operations at the strategic level is somewhat scarce. Most of the issues offered as guidance seem too wide to be implemented and leave managers with too many open questions about how to proceed. However, at least a broad and holistic view, and analyzing the operations as a system can be seen as starting points on the road to sustainability. Holistic view and bringing more parts on the table to solve a problem were also discussed already in the introduction (Graedel 1996; Porter & Kramer 2011).

2.4 External Service Provider as Enabler of Sustainability

This last chapter of literature review deals with the role of an external service provider as an enabler of sustainable operations of the customer organization. First, sustainability services and their customers and providers are discussed. Then, in the second subchapter, the role of external service provider is examined.

2.4.1 Sustainability Services

Bartolomeo et al. (2003, p. 830) have studied eco-efficient producer services (EEPS) which they define as “*services which improve the eco-efficiency of business customer activities*”. They argue that eco-efficiency can be reached by directly influencing the operations of a company, for example by replacing a conventional product-service mix. In addition, also indirect influence is important in reaching eco-efficiency and it includes influencing customer activities to make them more eco-efficient. (Bartolomeo et al. 2003) The latter, services aiming at helping companies to be more sustainable, is the point of interest in this thesis.

Bartolomeo et al. (2003) divide eco-efficiency enhancing services to different categories, from which the “*product result services*” and “*information-based services*” are best suited for the external service providers discussed in this thesis. Product result services are complete solution deliveries to meet a specific need of a customer. They are usually long-term contracts, in which the supplier has a certain responsibility to reach a specified performance. Often a detailed understanding of the customers’ business is needed and also some involvement in customers’ internal management processes might be part of the delivery. (Bartolomeo et al. 2003)

Anttonen (2010) names chemical and resource management as an example of such services. These are, according to Anttonen's view, one of the few examples where service provider has been able to realize the expectations of services leading to more eco-efficient and sustainable society. Other examples of product result services include end-of-life (EoL) management services and energy management services (Bartolomeo et al. 2003).

Information-based services include advice and consultancy services, and information services. Advice and consultancy services have the sole purpose of giving advice to customers in different situations. Bartolomeo et al. also identify services that do not include any kind of advice or interpretation on specific information but solely the delivery of the information itself. These services are especially considered to have a great potential. (Bartolomeo et al. 2003)

Hertog (2000) has studied the knowledge-intensive business services (KIBS) as a part of innovation. KIBS also include environmental services (Hertog 2000) which are, for example the eco-efficiency enhancing services described above (Bartolomeo et al. 2003). Hertog (2000) argues that KIBS can foster innovation in number of ways. Providers of KIBS might be facilitators, carriers or sources of innovation (Hertog 2000). Derived from that, it can be argued that an external service provider offering sustainability-oriented KIBS might foster sustainable innovation and sustainability of its customer.

Anttonen (2010) has researched chemical and resource management services, and in the light of his study service providers should align their and their customers' business goals and activities in order to reach sustainable value. Reducing waste and saving costs has to be a common goal. Long-term contracts are needed in order for the service provider to be able to know its customer's processes and develop the needed customer and industry specific competence. This highly specific competence is needed for more integrated cooperation where service provider is an explicit part of its customer's processes. (Anttonen 2010)

Anttonen et al. (2013) found out in their study on demand for sustainability services that customers acknowledge the time and commitment needed to build shared competence. Customers call for trust between them and their service provider. There is a clear will for having only one turnkey service provider that would manage the whole set of material efficiency services from traditional waste hauling to implementing new solutions to avoid waste. In addition, if the service provider would be able to offer solutions also in energy efficiency, it would further make the service provider a desired partner. (Anttonen et al. 2013)

Thitz (2013) analyzes the value chain of waste management industry and reveals many spots in the chain where external service provider is probably used. External service

provider might be used for actions like collection of waste, transport of waste, utilization of material and utilization of energy (Thitz 2013). These types of services are product result services in the typology of Bartolomeo et al. (2003). They are also normally non-core business of the customer companies, and thus more easily outsourced (Anttonen et al. 2013).

By outsourcing the waste management and possibly some other sustainability related issues as well, a company is able to concentrate on its own core business activities (Fitzsimmons et al. 1998). Fitzsimmons et al. (1998) find this relieving as the company does not have to develop or maintain expertise in the outsourced function. There is also the possibility to reach cost reductions and further develop operations by forming a partnership with an external service provider (Thitz 2013). It was also found out by Anttonen et al. (2013) that customers are more willing to pay for shared savings contracts than for a certain unit of hauled waste.

Service provider's lack of knowledge of customer's processes and business was seen as a clear barrier for using material efficiency services by the manufacturing industry (Anttonen et al. 2013). Another reason for not using material efficiency services is the incapability of service providers to create a metrics that would clearly show the benefits of using their services. Also lack of proper marketing was seen as a barrier for using services. Service providers tend to contact the wrong person, for example the Environmental Manager, in the customer's organization who is not able to make the decision on purchasing services. Purchasing Manager or Director might be the one to contact for marketing services. (Anttonen et al. 2013)

2.4.2 The Role of External Service Provider

Entering a partnership with external service provider might lead to the formation of industrial symbiosis which was discussed in the chapter 2.3.5. As already mentioned, forming an industrial symbiosis might prove to be very beneficial for the companies engaging in such a partnership. What was missing from the discussion, however, is the need for possible external catalyst. An external service provider might be able to help the parties forming an industrial symbiosis. It was earlier argued in chapter 2.3.5 that an industrial symbiosis cannot be forced (e.g. Desrochers 2001; Chertow 2007) but on the other hand, companies might be so engaged and occupied by their day-to-day operations and core business activities (Fitzsimmons et al. 1998) that they simply do not have time or resources to make the most out of the industrial symbiosis formed.

Another reason for not forming an industrial symbiosis or not trying to build sustainable supply chain might be the lack of knowledge about the advantages of sustainable supply chain management (SCM) (Seuring & Müller 2008). The same reason was argued to hinder the use of material efficiency services in the previous sub-chapter (Anttonen et al. 2013). Seuring & Müller (2008) applied Delphi-method to their SCM study and in

addition to the lack of knowledge discussed above, two issues in their findings imply that there might be a need for more research on the role of external service provider: extending sustainability efforts beyond immediate interfaces of supply chain and supply chain-wide cooperation and communication.

First, derived from the findings of Seuring & Müller (2008), not knowing the benefits of sustainable SCM firms might be reluctant to engage in improvement activities. This could possibly be solved by an external service provider who brings needed knowledge to the supply chain. This would mean offering KIBS (Hertog 2000) or information-based services (Bartolomeo et al. 2003). Second, extending sustainability efforts beyond immediate interfaces is a clear statement for the need of other operators in addition to the traditional supply chain. Anttonen et al. (2013) found out in their study on big Finnish companies that there is a need, for example, for material efficiency services among the manufacturing firms. Third, it might be that supply chain-wide cooperation should also include someone from the outside to help in the sustainability efforts; for example an external service provider offering more innovation capability which was seen as one of the key factors in building a sustainable supply chain (Pagell & Wu 2009). In addition, Pagell & Wu (2009) argue that sustainable supply chain are able to exploit the potential in non-traditional supply chain members.

Paulraj (2011) employs a resource based view on companies while studying SCM and argues that companies should try to find strategic partners matching their capabilities and resources in order to be able to be sustainable and meet the future goals and requirements. Zhu et al. (2012) also emphasize the importance of cooperation along the supply chain in order to reach the benefits of green SCM. However, neither Paulraj nor Zhu et al. mention an external service provider as an additional enabling factor. A catalyst, an external service provider might be what is missing from the SCM research. It might be that so far SCM researchers have not taken external service providers into account, as they are outside the “traditional supply chain” which is aimed at delivering products to customers. While not being directly part of that chain, external service providers might still be able to contribute substantially to the performance of companies.

Summing up the section 2.4, it seems that although sustainability services have been discussed in literature for about ten years, the service providers as part of their customers’ sustainable operations have not been given the same attention. Some examples were to be found (e.g. KIBS by Hertog 2000) but more coherent discussion is needed. SCM and industrial symbiosis literature have their own agenda, to which the role of external service providers only partly fits. By this observation, there is a need to clarify and study the role of external service providers as possible promoters of sustainable operations. Anttonen (2010) and Anttonen et al. (2013) offer examples of the topics possibly leading to better understanding on external service providers fostering sustainability.

3. RESEARCH METHODOLOGY

In this chapter the methodology of this thesis is explained. In the first section the design of this study will be presented. In the second section the case companies are briefly introduced. In the third and fourth section the methods of data collection and analysis are introduced accordingly.

3.1 Research Design

The purpose of this study is to find out how sustainable value is formed in industrial environment. For this aim the study employs the case study method. The research questions of this thesis are more how or why kind of questions by their nature than what, where or who questions. Yin (2009, pp. 8–9) argues that in this kind of a situation a case study is justified. The nature of the research is explorative which Saunders et al. (2009, p. 146) find to be compatible with case study method.

The research was conducted as holistic multiple case study with two case companies. With a multiple case study a broader view on the subject can be obtained. Saunders et al. (2009, pp. 146–147) argue that using multiple case study the results of the research can also be generalized better. Yin (2009, p. 46) further divides multiple case study methods to holistic or embedded studies. This research is holistic as the focus of the study is on the case companies' operation as a whole and no attention is given to subunits (Yin 2009, p. 50).

The nature of the study is qualitative instead of quantitative. This was decided based on the objective of the research which was introduced above. The aim of the study is to generate new knowledge about the research theme. In the beginning of the research not enough knowledge was available about the themes and interesting issues of the study subject to form a precise view. Saunders et al. (2009, pp. 139–140) recommend using exploratory study if the researcher does not have a clear understanding of the research problem. Thus the research design of this study is found to be valid and legitimate.

3.2 Case Companies

As often in case studies (Saunders et al. 2009, p. 237), also the sampling method used for this study was purposive sampling. Saunders et al. (2009, p. 237) state that using purposive sample judgment is used to select the cases that suit the study best. Two companies that were thought to be the most interesting were chosen in collaboration with a partner company of the StraSus research project. The selected case companies are

customers of the partner company. The partner company was also part of the study through workshop events held after the results were available. The StraSus partner company is an external service provider for its customers. It will be referred to as “service provider” in this methodology chapter from now on.

The two case companies chosen for the study are not presented in detail because of the wish of the service provider. They want to protect the anonymity of their customers and that wish is respected. Some background information is given in the following paragraphs but no detailed information will be provided. Also the results were analyzed keeping the wish of the service provider in mind. This means that no cross-case analysis was made. Instead, the results were analyzed according to the different functions of the companies. However, there were issues that are strongly affected by the nature of the two different cases and when necessary, this was expressed during the analysis of the results.

Case 1 is a family-owned company employing roughly 1 100 people in the process industry. The segment of industry they operate in has started to appreciate sustainability more and more in the recent years. This allows the companies in the industry to charge a “sustainability premium” if they have taken sustainability issues into account in their operations. Case company 1 has a long history of cooperating with the service provider.

Case 2 is a single manufacturing unit of a global publicly listed corporation. The unit employs around 400 people also in the process industry. The industry segment the company 2 operates in is different from the industry segment of case 1. Here sustainability issues are more given and no “sustainability premium” can be charged. Case company 2 is more recent customer to the service provider than case company 1.

3.3 Data Collection

Saunders et al. (2009, p. 146) state that in a case study the data collection methods might vary and different methods are probably combined. This was also the case in this study, as the data collection was made through observation periods, interviews and workshops. Yin (2009, p. 106) points out that interviews are one of the most important sources of information in a case study. Interviews are hence a valid data collection method for this study.

The type of interviews was chosen to be semi-structured as the nature of the study is qualitative. Semi-structured interviews suit well an explorative and qualitative study (Saunders et al. 2009, pp. 321–322). Using semi-structured interviews, the researcher has a set of questions to be covered in the interviews but they are not as strictly followed as in structured interviews (Saunders et al. 2009, p. 320). The order of the questions may change if required by the flow of conversation and sometimes new questions outside original ones are needed during the interviews (Saunders et al. 2009, p. 320).

The interview outline was built according to the literature review and own assumptions of what could be interesting. The outline was discussed with more experienced researcher and some mistakes were fixed and other minor improvements made. After internal scan and corrective actions, the outline was sent to the service provider which also gave feedback and one more set of corrections were made. During the interviews some minor issues were fixed and the finished interview is presented in Appendix.

Altogether 12 interviews were made in the two case companies with 14 interviewees. One of the interviews was done through Microsoft Lync as the schedule for the interview was rather tight and the interviewee was located far away from any of the researchers of StraSus. The interviewees were given rough idea about the themes to be discussed in the interviews but not the exact outline. This was done in order to avoid the interviewees coming up with answers beforehand. Table 8 summarizes the interviews of this study and shows the number of interviewees in different groups.

Table 8. *Summary on the interviews conducted.*

Interviews	Interviewees	Management	Environmental Specialists	R&D	Production	Marketing	Average duration
12	14	3	2	4	2	3	83 min

The interviews were done in December 2014 – early April 2015. As can be seen from the table 8, the average duration of the interviews was 83 minutes. There were interviewees from 5 different groups: Management, Environmental Specialists, R&D, Production and Marketing. All interviews were recorded and also transcribed afterwards to make the analysis easier.

It must be kept in mind, that interviews as a data collection method have some drawbacks. To name a few, Yin (2009, p. 102) mentions bias due to poor questions, response bias, bias due to poor recall and reflexivity as possible problems. Poor recall problems were eliminated through audio recording all the interviews whenever possible, and in addition notes were made during the interviews. None of the interviewees prohibited recording of the interviews so all of them were recorded. In some interviews there were two interviewers. This ensured the quality of the notes made, as one person could do the interview, while the other one was able to concentrate on making notes. The quality of questions was ensured through pre-testing of the questions. The other possible problems can be avoided, for example, by using multiple sources of evidence (Yin 2009, p. 114). In this study interviews, observations and workshops were implemented to get as truthful as possible view on the case companies.

As for observation, Yin (2009, p. 110) finds it useful in offering additional information about the phenomenon being studied. This supports the use of observation alongside interviews in this study. Saunders et al. (2009, p. 195) remind that the line between what is being observed and what is not, must be drawn clearly. For example they state that

private phone calls, or other private life related action, of participant's should not be observed. In this study only work related issues happening on the shop floor of the manufacturing facilities of the chosen companies was observed.

Workshops with the service provider were held after each round of interviews was accomplished and results from the two individual cases were available. Workshops were structured as presentations with an open discussion section in the end. In the workshops the service provider and the involved researchers compared notes on the results, their meaning and possible improvements for future work.

3.4 Data Analysis

In this thesis the data analysis was made inductively. This means that there was no prior theory to be tested, but instead the data was analyzed without prior assumptions (Saunders et al. 2009, p. 124). Saunders et al. (2009, p. 127) state that inductive approach is well suited for collecting qualitative data.

The analysis was done using ATLAS.ti computer program for the analysis of qualitative data. The coding was done according to the different themes in this thesis and the functions of the firm. This means that, for example, the actions enhancing sustainable operation in R&D and production were coded differently. As no cross-case analysis is provided, the separate functions of the firms are the point of interest. Actions enhancing sustainability are examined separately at the strategic level, in R&D, production and marketing. The coded transcriptions of the interviews were then analyzed.

Quotations are used in the following chapters to enrich the analysis and provide supportive examples. Quotations are written in the following way:

“This is a quotation.” – Research assistant

If something was removed from a quotation, it was marked with three lines: ---. Some words like “it” or “that” might have needed more explanation to understand them in the right context. These additions were [marked with brackets]. Also some expressions, that might have been too sensitive to be presented as expressed by the interviewees, were substituted with [more general expression] in brackets. To avoid confusion between quotations from interviews and citations from literature sources, the latter will be presented *“with italics but without indentation”*.

As the interviews were conducted in Finnish the quotations were inevitably modified in the translation process. In addition, the quotations were formatted to make them better understandable. However, modifications and the translation process were done very carefully in order not to change the key message of the quotations.

4. RESULTS

The results are not presented as a cross-case analysis, but instead the analysis is based on the different functions in a company and on the methods and views discussed in the literature review. First, interpretation of sustainability, why it is being fostered and its value are examined. Also the possible harms of sustainable operation and future threats are considered. In the next section tools and methods in use to assist the sustainability work are being discussed. In the third section of the results chapter the building blocks of sustainable value are assessed. Fourth and the last section of the results chapter cover the role of an external service provider as a part of sustainability efforts.

4.1 Sustainability: What, Why and What Is the Value?

In the first section of the results chapter the case companies' interpretation of sustainability is presented. In addition, reasons behind sustainable actions and the benefits - the value of sustainability - are considered.

4.1.1 What is Sustainability?

The respondents generally answered very differently when they were asked what sustainability is. Table 9 presents the most common answers that were given by at least one person from both case companies. The number in the cells under each theme represents the number of respondents that gave more or less the same answer.

Table 9. What is sustainability?

	Maintaining social and natural environment	Being profitable	No contradiction with financial goals	Sustainable products	Continuous improvement
Comprehensive	9	7	4	4	3

The most frequent view was that sustainability is many different things and not just environmental issues or not just about being profitable.

“Sustainable development can be seen just as a small trend and as things you have to do [by law and regulations]. But if you truly emphasize sustainable development you try to improve your business and find course of actions that support the triple bottom line.” – CEO

"We have made the strategic choice of being sustainable. We want to do something good and we want to be a part of the society but after all, it is not possible if we are not profitable." – R&D Director

Comprehensive view on sustainability is said to help finding also business enhancing issues out of ever tightening laws and regulations. Sustainability includes protecting the environment, reducing emissions and supporting the surrounding community but it also includes the business aspect as well. On the other hand, only thinking about profits might lead to a too narrow scope on business and thus weaken the ability of a company to make profit in the long-run.

Maintaining natural and social environment was also seen as a key element of sustainability and sustainable operations. Many respondents felt that they should leave the living environment (natural and social) in a better shape for their children or at least not make it any worse. There has to be a balance in the social and natural environment.

"I see it as biological and social issue. You cannot take more than the nature has to give and on the other hand, a community like [name of a city] here, that people are equal and the well-being is distributed in a reasonable manner." – Development Manager

Many respondents also emphasized the importance of being profitable while doing good for the environment and society. Only profitable company can be sustainable and sustainable company is profitable. Being profitable makes it possible for the company to support the local community by hiring employees and the society by, for example, paying taxes. Profitable company can invest in new technology and can bear some extra costs that might stem from sustainable operations in the short run.

"It must be kept in mind that if you do not have money and resources it is very difficult to act sustainably." – Factory Director

Every third respondent thought that sustainability does not conflict with financial goals. It was argued that not wasting resources and energy also brings cost savings and thus helps to reach the financial targets. This was especially emphasized in production but it was also said to improve the internal processes of a company.

"In production it [sustainability] is so neatly related to euro that no one is going to prohibit you from doing improvements related to material or energy efficiency." – Production Manager

"It is not only about being more sustainable, but we also save in costs and improve the efficiency of our own processes. Almost always these things lean to the same direction." –R&D Director

In both case companies respondents felt that delivering sustainable products is also part of being sustainable. Sustainable products are easy to recycle or otherwise easy to dispose of after usage. They also enable the customer to be sustainable. While own products might not always be sustainable through and through, they will at least be safe to use and make the operations of the customer more sustainable. A company cannot claim to be sustainable if the products of that company may endanger the health of a customer or otherwise conflict with the principles of sustainability.

“Our product is sustainable as it improves the working conditions of customers.” – CEO

“As long as we manufacture sustainable products we are on the right path.” – Development Manager

Last issue that clearly came up in the interviews is continuous improvement. While sustainability can be fostered by making big changes and radical improvements, it is also about making little upgrades here and there. This was most clearly present in production.

“It [acting sustainably] is part of our culture of continuous improvement, continuous development.” – Production Director

“Walk the path [of being sustainable] and improve every year. If a giant leap can be found, we will take it, but otherwise we will at least take small steps.” – Production Manager

Taking big steps is of course great but sometimes they might be quite hard to come by. Doing small things enables the companies to stay active and keep on searching better ways to run their businesses.

4.1.2 Why Do Companies Operate Sustainably?

When the interviewees were asked about the reasons for sustainable operations and sustainable development, a wide range of views emerged. Customers, law and regulations and competition were among the most frequent answers. Table 10 summarizes the findings. Here again the number in the cell below each theme represents the number of respondents giving approximately the same answer.

Table 10. Why sustainability?

Customers demand it	Law and regulations	Competition	Own will	Selling point	Corporation	Community
10	8	5	5	3	3	2

In both case companies the message was clear: customers demand more and more sustainable operations from product manufacturers and suppliers. Customers were found to be interested in the sustainability or unsustainability of the operations of the case companies. The answers of the other case company clearly point out that in certain product segments customers are more conscious of sustainability issues than on some other segments. However, all customers were found to be interested in sustainability at least at some level.

“They [customers] have strong sustainable programs and they greatly appreciate if their suppliers speak the same language.” – R&D Director

Sometimes the pressure from customers was considered even more powerful than the pressure from law.

“The customers are pretty demanding --- and their demands are even more stringent than our own goals.” – Expert on Department of Environment

The nature of the industries that the two case companies operate on differs slightly from each other which can be observed from the “Selling point” related answers. One of the companies operates in an industry where no “sustainability premium” can be charged, whereas the other operates in an industry where the customers reward sustainable operations and manufacturing. The former argues that they still feel the pressure from customers as there is a certain level of sustainability that has to be met in order to be able to sell anything.

“It is hard to use it [sustainability] as a selling point but the customers practically demand that a certain level is met.” – Factory Director

On the contrary, the other case company is able to charge “sustainability premium” on its products, and thus sees sustainability as a selling point.

“It is [a selling point] and we strongly believe that it [sustainability] gives us competitive advantage. Customers reckon us as responsible and innovative company which is in line with our brand and basic values.” – CEO

What is interesting, however, is that both companies’ interviewees in the marketing function were more cautious when considering sustainability as a selling point. There seems to be a disagreement of some sort between the marketing people and the rest of the staff in both companies.

It is obvious that if one is able to grasp business benefits from being sustainable, there is also inner urge to be sustainable. It is hard to say how it started but at least the other case company claims to have begun with the sustainability work well before it became a worldwide hype and is now simply enjoying the results of their long-lasting work.

"We have been thinking these issues [sustainability] for long time now. Then we decided that we should write everything down as it is so natural behavior to us. It has been our philosophy for many years."

– Business Development Manager

For the company at hand it is also a strategic choice that they do not compete on price but on quality, innovation and sustainability.

"It is a key question to us. We do not seek cheap labor from China but we want to lead with innovation and quality." – CEO

These kinds of answers were given by almost all of the interviewees in the case company that is able to charge a "sustainability premium". Also one respondent from the other company that is not able to charge "sustainability premium" stated that they try to differentiate with dealing with sustainability issues in a sensible manner but that they still base their operations on law and regulations.

"Of course it [law and regulations] affects. It is kind of a minimum requirement level for us. If I have understood correctly we are not happy with fulfilling that level but we try to extract some additional value by doing these things smartly." – Development Manager

However, this view was not supported by the respondent's colleagues. Most of the respondents from the same company were not so sure about doing more than required.

"The pressure comes from legislation as you have to do certain things."
– Quality and Environment Manager

"If we can reach the limit given by authorities we are satisfied with that."
– Development Manager (different one than the one above)

There seems to be some difference of opinion about how laws and regulations affect the operation of a company. One respondent stated that laws and regulations are not the driving force, as customers and own corporation demand more.

"We do a lot more than required by the law --- I would say that the most stringent demands come from customers, then from our own corporation and only then from authorities." – Expert on Department of Environment

There is some ambiguity about laws and regulations affecting sustainability operations but it is a fact that it does affect. For example, higher landfill taxes are a way to affect the operation of companies and make it more sustainable by reducing the amount of material that goes to landfill.

“Of course law and regulations affect too. I mean if we suddenly have to pay a higher tax on our own landfill it is a challenge.” – R&D Director

This was an issue that both companies were struggling with. One clear example, in addition to higher tax on landfill, is the total ban of organic waste going to landfill starting in 2016. This means that companies have to come up with recycling solutions or other means for dealing with organic waste.

Also competition was seen to affect the sustainability work of companies. Almost every second respondent saw competition as an underlying reason for sustainability. Sustainability and related work is important because everyone is talking about that now and companies cannot afford to fall behind in this matter.

“First of all, it is a trend in the world. If we want to stay in the game we have to talk about these things because everyone is talking about them.

Yes, we are not able to compete in the future without sustainability.”
– *Business Development Manager and Marketing Director*

The two case companies had the same idea that sustainability is important for competition. It might be a way to differentiate for the other company but for both of them it is about surviving.

“Sustainability is about staying alive.”
– *Quality and Environment Manager*

Corporation was a clear source of sustainability requirements for the other company. Due to the fact that only other one of the two case companies is part of a larger global corporation, the following reasoning is based on only one case company. Corporation was seen as a guiding and demanding supervisor. The company at hand is reporting certain issues and indicators to the corporation level on a weekly, monthly or yearly basis depending on the specific indicator. Corporation was found to be more demanding than laws and regulations.

“At corporate level there are some guidelines and big goals which usually are far stringent than the ones from legislation.” – Factory Director

Community was another thing that is more heavily only related to one of the companies. Locating close to local people and community is something that naturally affects the operations of a company. For example, any kind of emissions will be spotted right away and people have the opportunity to examine the operation at close range. On the other hand, it is also an interest for the company to keep the local community alive and interact with it in a suitable manner. That way the side by side life is easier for both, the

company and the local community. The legitimacy for the operation has to be gained from the community also.

“Our location as a part of the local community has brought its own challenges to our operation. We cannot let out whatever emissions we want.”
– *Quality and Environment Manager*

It could be said that there is a substantial difference in the attitude towards sustainability between the two case companies. Some of it can be explained by the fact that the other is a business unit in a globally operating corporation and the other is a family owned middle-sized company. The former gets a lot of things given from above while the latter can more freely choose its strategy. Another thing is that the conditions and history differs remarkably in the industries these two companies operate on. It obviously affects the behavior of the case companies.

4.1.3 What is the Value of Sustainability?

So far the case companies' interpretation of sustainability and their reasons for sustainable operations have been presented. Next, some insight on the value of sustainability is given. The interviewees were asked to name benefits and value of sustainability for the firm itself, for environment, for the working community, for customers and possibly for other stakeholders. Also possible harms and threats of sustainability work for any of these were asked to be revealed. Figure 4 depicts the key findings.

As can be seen from the figure 4, sustainability has brought about many different benefits. Starting with the company itself, sustainable operation has enabled the case companies to improve their image. It is important as customers of both companies are interested in the sustainability issues. In the other case company sustainable products have been a gate opener to some customers. Although the specific sustainable product in question might not have been the one that customer bought in the end, it was the one that lead to the sales negotiations in the first place. Thus the sustainable product has also increased the sales of other products as it was the reason that the customer got interested at all.

“They [sustainable products] have been a gate opener in many cases. We have been able to get in with those, even if they were not the ones the customer decided to buy after the demonstration.” – *Production Director*

Through sustainability the companies have also been able to avoid some costs like land-fill tax. In addition, through material and energy efficiency the companies have been able to decrease the operational cost and also procurement costs as less material is needed. Sustainability has also provided the legitimacy to operate and has acted as a corner stone for all operation.

“I have to say that it is a basis [for our operation]. You simply cannot run the business if the sustainability issues are not in order.” – Factory Director

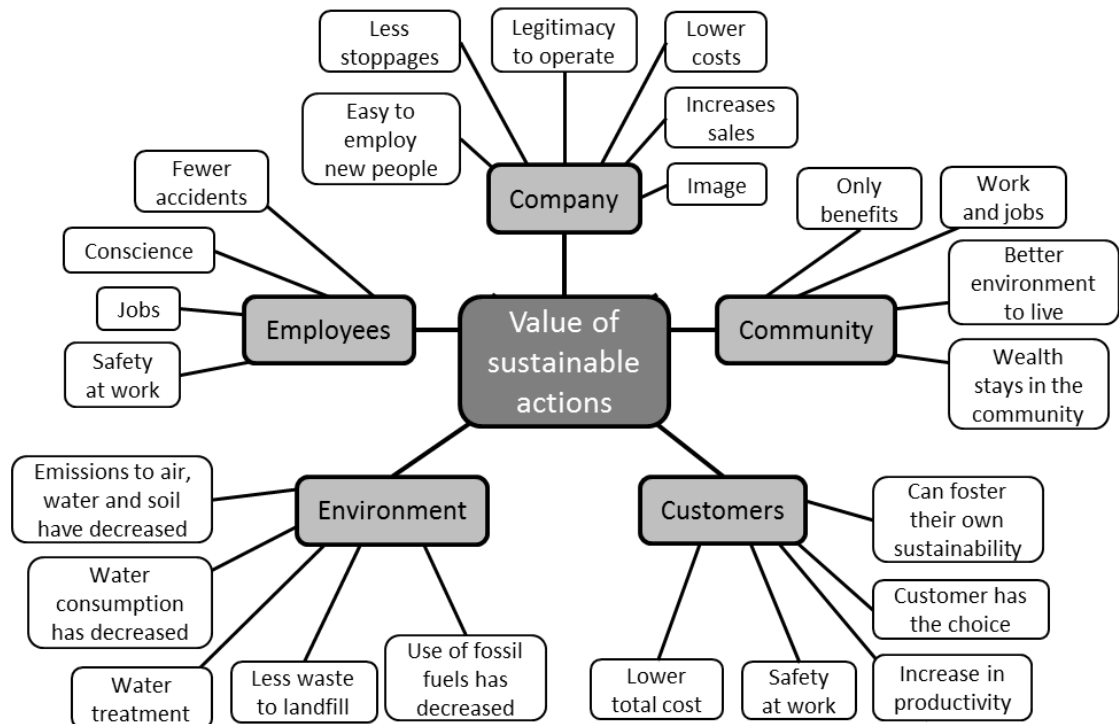


Figure 4. Value of sustainable actions to different stakeholders.

Through safety issues there are less stoppages and absences in the production which also brings savings. As sustainability issues have been taken care of, it has also been quite easy for the other company to find and hire new people.

Next entity is employees of the companies. Employees have benefited from sustainability in many ways. Most important is the safety at work which directly leads to fewer accidents.

“We used to operate with so many [harmful substances] that there were clear safety and health problems in the production.” – Production Director

The case companies take safety seriously and the other company starts its days in production with a morning meeting that deals with safety, quality and environmental issues. The other company on the other hand has implemented a “0-accidents” campaign that integrates the production workers to the safety improvement mission.

Sustainability has generated some new jobs for the other company. Many respondents also stated that it is easier to work for a company that operates in a sustainable manner. It might even lead to taking pride in the employees’ work and employer.

“People are proud of working for a company that also thinks about the future and the next generation.” – Marketing Director

The benefits for environment include fewer emissions to air, water and soil. This was a clear message from both companies. Both found that they have been improving their operations substantially during the last decades. Maintaining nature was also mentioned.

“It [benefit for environment] is better quality of water, cleaner air and maintaining the nature which is so precious to human beings.”

– Quality and Environment Manager

Lower emissions are due to less water usage and decrease in the use of fossil fuels. In addition, both companies are treating their waste waters carefully before letting them out of the production site. Through some significant investments both companies have been able to reduce the usage of oil as an energy source. This, in turn, has led to smaller carbon footprint, better profitability (high oil price) and lower CO₂ and nitrous oxide emissions. The other company has been able to shut down its former landfill as it found a way to exploit its biggest flow of production waste. It can even exploit the old waste from stationed at the old landfill if needed.

“Well, for example, we do not take production waste to our landfill any more but it is [exploited] instead.” – Business Development Manager

Customers of the two case companies can foster their own sustainability by doing business with sustainable suppliers. The customers have the freedom of choice and an alternative to use products that are produced sustainably the two case companies.

“They have the alternative to choose a product that has been produced responsibly. It also makes them more sustainable.” – CEO

The product of the other case company enables the customers to alter their processes in a way that makes it possible for them to substantially reduce the space needed for the production and also reduce the lead-time. This way the product, while fostering safe and healthy working environment, increases the efficiency of work done by the customer.

“By using our products the customers can [do two stages] in the same working area. The production efficiency increases.” – R&D Engineer

Using the products of the other case company, end users (sometimes same thing as customers) have been able to improve their working conditions in the sense of health and safety. Less protective equipment is needed and workers are able to work longer using the product. This all leads to lower total costs and improved profitability.

“I mean, it is the total cost that is lower when our products are used.”
– Production Director

Sustainable operation has led to many advantages to the local community. According to several respondents, sustainability brings only benefits to the surrounding community.

“Well, there is no harm for the society. There are only benefits there to be gained.” – Quality and Environment Manager

The benefits include new jobs and work for the current workforce. Both companies have, like stated earlier above, been able to significantly reduce their influence to the environment around them which directly makes the surrounding areas better places to live than before. By choosing more local energy sources the companies have managed to divide wealth to the local community instead of the gigantic companies of conventional energy sources.

“Through the new project money stays here, in the community, instead of flowing to Arabic countries.” – R&D Director

Some interviewees also brought up the benefits to owners and shareholders. However, the nature of the benefits remained a little unclear and that is why the issue is not discussed in depth.

Negative value is also something that has to be kept in mind when talking about sustainability. Sustainability is not only about good things and increased profitability. The interviewees agreed on one thing: sustainability also needs capital. When legislation changes, for example, it might be that companies are forced to make investments that probably will not pay back in the long-run. On the other hand, these costs can be partially avoided by being ahead of legislation and actively trying to develop new solutions. Doing changes before they are forced still brings problems but interviewees felt that it is change that is the problem, not sustainability as such. Change is always challenging and sustainability is no exception.

*“Well, we had some problems in the beginning whenever we changed the process [to be more sustainable]. And of course it costs to invest in safety and better machinery. But it gives a good image of us.”
– Production Director*

“It [sustainability] might cost a lot time to time and it also affects our processes, for example, if we have to re-design something. But that is what change always does.” – CEO

Like the first quotation already says, many interviewees stated that even though sustainable operation might cost a little more, it is worthwhile in the end. Even if operation is a little more expensive, it is okay because people are treated in a sensible manner and the image of the company is clean.

“If you only think about money, well, the world is full of terrifying examples: kids manufacturing sneakers, people literally standing in the chemical pools while producing and dyeing raw material for our jeans... World can be a terrifying place sometimes. It is surely a good thing that people have started to think about sustainability, even if it has a price tag.”

– Production Manager

There were also respondents that did not come up with any problems or negative effects of sustainability. According to them the effects on every stakeholder are only positive.

“It is hard to come up with any harmful effects on any of the stakeholders or us. No, I cannot think of any.” – Factory Director

Sustainability was generally treated as a really positive phenomenon but also some worries were raised. Sometimes the legislative authorities might not be completely on the ball. One example includes the other case company recycling a certain type of waste. In the process most of the material could be recovered and some part of the material burned. Legislation might require them to make costly investments to the already working process as law and regulation does not recognize the process as such. This way legislation might also hinder sustainable development and new innovations! The case was still open at the time of the interview but it still acts as an example of how regulation made to foster sustainability might in extreme cases actually backfire radically.

“Now we might have to make costly changes as the law does not approve our process as such. We might end up burning oil instead.”

– Quality and Environment Manager

Another example is the legislation about the transmission of electricity in Finland. One of the case companies has looked into exploiting wind power. Problem is that even if a power plant owned but not operated by them is not on their site, they have to pay for the transmission to a local monopoly company. The local transmission company would not even have to do any investments for the project and the wind power plant would not be connected to local grid but still the case company would have to pay for the transmission which makes the project unprofitable.

One more thing related to legislation and a concern named by many interviewees is too tight and local regulation. It was clearly the most common threat named. Many interviewees named the “sulfur-directive” affecting the ship traffic in the Baltic Sea as a case in point example. What does it help to reduce the sulfuric emissions in the area of such a small sea when at the same time many more ships sailing in the other seas of the world are free to do whatever they want? Or why the Europeans have to reduce their emissions in Europe while the huge economies of China and India, for example, are allowed to continue polluting. Sustainability was found to be a good thing but interviewees saw that Finland and the European Union should not suffocate their industry

with too tight regulation. Being first is a good thing but it has to be done in cooperation and agreement with companies. This way the benefits can be ensured and unnecessary losses avoided.

“Nice idea but why it [sulfur directive] only affects a small area in Europe and some can continue to do whatever they want? --- Someone just said that it does not matter what we do here if the Chinese can continue to pollute. I agree with that.” – Production Manager

“Of course an ever-present threat is that the authorities might constrict the industry in Europe too much. We need pioneers but it [being first] must not be an absolute value. I mean we have to have the means and tools ready to fulfill the forthcoming legislation.” – Factory Director

Some problem might also arise from the behavior of customers. Some customers might refuse to use any recycled material because of purity requirements placed on their products. This in turn decreases the willingness of the case companies to invest in recycled material use. This might also be a threat in the future.

4.2 Tools and Methods Assisting in the Sustainability Work

In the case companies assessing sustainable value was experienced to be somewhat challenging:

*“It is not that assessing is unimportant but that it is really challenging.”
– Factory Director*

It was also found out that there is a lack of tools to do the assessment work. One respondent stated that quite often there is measurement data available but it is not analyzed further for some reason. However, some simple measurements are being done: for example, the cost savings from energy saving improvements is rather straightforward to calculate. In addition, some traditional metrics in production can be harnessed for sustainability assessment, for example the above-mentioned energy savings and material efficiency. While the assessment work is almost non-existing, there is a will to build-up more systematical methods to assess the value of sustainability.

“We are trying to move into the direction that it [assessment] would be more target-oriented including more clear indicators.” – CEO

Both of the case companies report their sustainability performance according to the GRI guidelines. Thus, it can be seen as some kind of identification and assessment work but it is not done to foster sustainable development or quantify the value of sustainability in the companies. Rather, it is a way to communicate the sustainability performance to stakeholders. Only in few cases the data is also used for internal improvements and as-

assessment. One of the companies also deploys Key Performance Indicator (KPI) system and they follow the metrics on a daily, weekly, monthly or yearly level depending on the individual indicator. The KPI system is used to report certain things at corporation level and other ones for authorities. However, what is worth noting is that KPI is not used to assess the value of sustainability or sustainability related actions:

“KPI system is not used for assessing the value brought by sustainable actions.” – Quality and Environment Manager

In the table 11 a comparison of the respondents’ answers is made. The number in each cell indicates the number of respondents stating that identification or assessment methods are or are not in use. The answers are further divided according to the three different functions in a company that are the focus in this study.

Table 11. *Identifying and assessing sustainable value: Are there specific methods and tools to identify or assess the value of sustainability?*

	Yes	No
Identification or Assessment	2	10
R&D	1	2
Production	1	1
Marketing	0	2

As revealed by the table 11, only 2 respondents answered that there are methods in use to identify or assess the value of sustainability. However, one of them felt that GRI was a tool for the job, a view that no other respondent supported. The other respondent answering “yes” was sure that there are some tools and methods but could not name any and stated that in the company someone would surely know of such tools. However, as can be seen from the table 11, no other person named any.

When evaluating the answers in accordance to different functions the “yes” views got a higher weight. However, GRI was not thought as a tool for this purpose by any other respondent and the other could not name any such tools. In addition, GRI reporting was not directly used in R&D or production to guide internal processes as it is a reporting method. Thus it can be argued that there are no real tools and methods in use for assessment and identification of sustainable value. Furthermore, one respondent stated that all the company does for evaluating sustainability work is following the indicators which authorities are following to regulate the industry.

As a summary it can be said that data is available, and sometimes even some measurements are made that could support the assessment and identification of the value of sustainability. However, there are no proper tools (or at least they are not used) and know-how to do the assessment and identification work. The assessment and identification is experienced to be really challenging but there is an urge to improve the internal evalua-

tion of sustainability work to be more systematical and target-oriented. So far the assessment and identification is more heavily based on common sense than numbers.

4.3 Building Blocks of Sustainable Value

In this section the building blocks of sustainable value identified and discussed in the case companies are presented. Building blocks are understood as the indicators in use and as the actions implemented by the case companies. The examination is divided to four sub-sections: strategic level, R&D, production and marketing.

4.3.1 Strategic Level

The two case companies had difficulties to express the indicators that are used to guide the sustainable development and sustainability work in the company. Only two clear concepts came up during the interviews. First, both of the companies are reporting their sustainability performance according to the GRI guidelines. It gives the companies a clear base to build on, as through GRI reporting they see what are they doing right and where they might have something work on.

“When we did the first GRI report we got a bunch of ideas on what we could measure and how to follow our performance.” – Production Director

However, as the aim of GRI is to report performance to external stakeholders it has not guided the sustainability work that much. It offers a great amount of data but for some reason it is not exploited further when steering the internal development. The role of GRI remained somewhat unclear and good example is that in the other case company only few interviewees mentioned it as a source for indicators.

Second, key performance indicators (KPI) were used by one of the case companies. Their KPI includes metrics from different areas and sustainability is one of them. The KPI system they use is multilevel and some indicators are followed at corporate level, some at the factory level; some of them are followed daily or weekly and some monthly or even yearly. The followed indicators include metrics like waste going to landfill, electricity and energy used per products manufactured, all sorts of emissions and emission limit overruns. According to Quality and Environment Manager KPI system steers the operation:

“We get input from many directions but in the end when we build the KPI system we try to figure out what is important in the future. So it can be said that the KPI steers our operation after all.”
– Quality and Environment Manager

Only one interviewee saw the KPI system steering the operation as explicitly as the Quality and Environment Manager. However, also other respondents mentioned single indicators falling into the KPI system. Thus it can be argued that in the other case company the KPI system is a part of sustainability work.

In addition to indicators, also some actions affecting sustainability work at the strategic level can be recognized. There is no clear structure or pattern to be found in the actions but they relate to all kinds of issues ranging from GRI reporting to overseeing own suppliers. Figure 5 summarizes the findings.

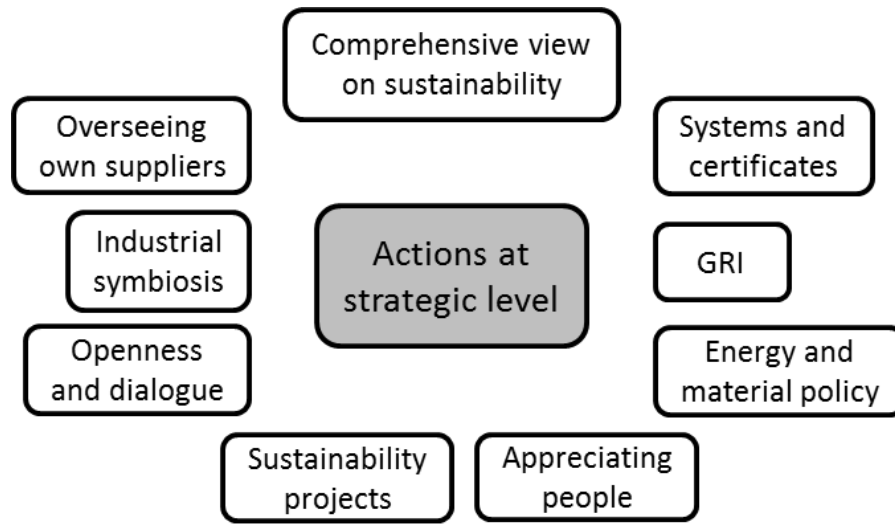


Figure 5. *Actions fostering sustainability at strategic level.*

One of the case companies highlighted the importance of comprehensive view on sustainability. This means that if sustainability is only seen as an unwanted necessary evil, something valuable might be missed. In addition, focusing only on one of the aspects of triple bottom line (social, environmental, financial) at the expense of the other two was mentioned to be undesirable.

“If you take a broad enough view on sustainability, suddenly everything can be interpreted to be part of it.” – CEO

Comprehensive view on sustainability includes performance evaluation, anticipating the future and planning future improvements. Evaluating own performance might be the follow-up for sustainability report or forming an operation steering KPI system. Both of the companies stated that they are trying to find substitutes for materials and additives that might someday be prohibited.

“We are starting a project to find a biomaterial-based substitute to [a substance].

Yeah, because we know it might be banned in the next 15-20 years.”
– R&D Director and R&D Engineer

One of the companies had clear vision about future work on sustainability regarding the manufacturing process.

“We have a plan to get rid of [a certain stage in production that uses a lot of energy] and to build shorter and more efficient production lines.”
– R&D Director

If they succeed, their future process will produce less waste, use less energy, take up less space and speed up the production process. Also in the other company improvements and upgrades were sought but they did not have as clear a vision as the other case company. Both of the companies were, or had been trying out new processes to make their operations more sustainable. At strategic level there must be an urge to move towards sustainable operations in order for the companies to improve their processes in a sustainable way. One of the companies also had a “zero-vision” that someday their influence to air, water and soil would be zero.

Next in the figure 5 are different systems and certificates. The range of different certificates and management systems is quite broad and it is not important per se which certificates or systems a company chooses. Rather, using them or applying for them at all shows interest in the sustainability related issues and serves as a base to build on. The same applies for GRI. Although the report can be modified to only suit the needs of an individual company, preparing the report in the first place tells something about the company.

Next issue that came up is energy and material policy. What is meant by this is that a company wanting to improve its sustainability performance has to have a plan and will to reduce its energy and material usage. Concrete actions or objectives include stopping the use fossil fuels, favoring sustainable energy sources and improving the energy efficiency of the company. For example, one of the case companies has completed a project that allows them to use biogas instead of liquefied petroleum gas and another project that allowed them to stop burning oil. The other case company has found a way to replace oil in a certain stage of their manufacturing process through a renewable energy source. Stop burning fossil fuels has a symbolic value in addition to possible financial gains. A company with sustainable energy policy sometimes does improvements, even if it might not always bring savings. Reducing fossil fuel usage has a value of its own.

“Switching to biogas is a break-even result but it allows us to get rid of fossil fuels.” – R&D Director

Regarding material policy, reducing waste going to landfill, cutting emissions, fostering recycling and improving material efficiency are important. Also using sustainable raw materials is relevant. Good example of material policy is to find application to all process waste and try to find ways to use recycled materials.

“We have a process to take in used products and separate useful raw material, [certain material] and material suitable for energy production.”

– Quality and Environment Manager

Moving to more concrete actions, the two quotations above are case in point examples of projects fostering sustainable development which can be seen in figure 5 at bottom left. Both of the case companies are researching different ways to be sustainable in form of different projects. Some had been successful, some had not. Important is to try out different things because that is how something new and interesting will be found.

“Even though the bigger part of the project did not work out, we were able to introduce a small part of it to our process and that is why we do not need oil anymore.” – Quality and Environment Manager

At the bottom right in figure 5 there is appreciating people. There are many ways that the two case companies try to ensure that people are respected and treated equally. First example is the foreman education that was largely implemented in one of the companies. Both of the companies swear by respecting the human rights and one of the companies heavily encourages its employees to exercise physically.

“We support exercising and try to make sure that everyone is in good condition to work.” – Business Development Manager

Continuing with more concrete actions, one of the case companies cooperates closely with authorities and openly communicates with them. This builds up trust between the parties and gives some working space for the company. It also makes it easier for the company to work with authorities when they have good relations, as authorities do not make a fuss out of every tiny little thing.

“We have a very open cooperation with the authorities. We call them regularly and not just to tell that something is wrong. We might just ask for opinion or advice, even if we had no problems at the particular moment. We have been able to build trust with them and it is much easier to work with them nowadays.” – Quality and Environment Manager

Industrial symbiosis is a concept that was earlier introduced in section 2.3.5. One of the case companies has been able to reach major cost savings, waste and emission reductions and local community benefits by forming an industrial symbiosis with an external service provider. Also the other case company has tried different set-ups but the cooper-

ation has mainly remained at reverse logistics level where a customer returned used products and the case company used them again in its production. Furthermore, the cooperation has been more individual cases by nature than a systematic approach.

“We used to cooperate with a customer and share the benefits from recycling some used products but these issues are always really case-specific.”
– Production Manager

Last strategic level action that came up in the interviews is the supervising and overseeing of own suppliers. Both of the case companies supervise their suppliers and are ready to take measures if violation of human rights or such is to be revealed.

“We have switched suppliers that did not comply with our rules or obey the law. After all, what kind of suppliers we use is also on our responsibility.”
– CEO

By supervising suppliers companies can be sure that no negative publicity gets out all of a sudden. A company cannot be sustainable if it uses unsustainable suppliers. Implementing a set of rules clarifies the cooperation and makes it explicit what is expected from the suppliers.

“We require our suppliers to accept our rules and we demand our own people to follow the same rules as well. We are really demanding; to our suppliers but to ourselves as well.” – Sales Director

4.3.2 Research and Development

As no indicators guiding the R&D work came up during the interviews, this section directly begins with the actions fostering sustainability in R&D. The actions in R&D are somewhat general by nature. It seems that so far sustainability is not so systematically considered in the R&D function. Figure 6 summarizes the actions emphasizing sustainability in R&D.

Starting with most concrete actions, the first issue in figure 6 is Life Cycle Assessment (LCA). One of the case companies stated that it has tried to make LCA for its products but it has turned out to be quite difficult. The problem is that the product itself might not be the most sustainable one but it makes the operation of customers more sustainable. LCA is thus rather difficult to make.

“We have at times tried to make LCA, as so far we have only been doing a cradle-to-gate analysis, but what is interesting is the completeness because our customers are more sustainable by using our products. But it is also very difficult to measure.” – R&D Director

The problem has been the availability of data. Customers are not willing to give information for LCA. It is not known how much they save, for example, in raw material costs when they use the product of the case company in question.

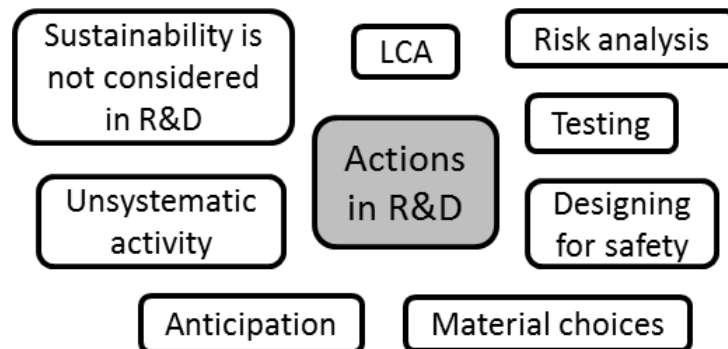


Figure 6. Actions fostering sustainability in R&D.

Another concrete action is risk analysis. When making changes to products or processes one case company makes risk analysis as a part of the change management process. This way it is ensured that no harmful, environment or health endangering changes are made. It goes for development actions as a whole and not just for new product development (NPD).

“It is an integral part of our development work - process or new product - that we go through the changes and make a risk analysis. It is kind of a check list that ensures that we are not making things worse.”

– Production Manager

One of the case companies also has extensive facilities to test its products in as truthful as possible conditions. This way the proper functioning of a product can be carefully tested. In addition, after passing the tests at their own facilities, the company also performs large field tests at customers’ facilities.

Next issue is designing for safety. One of the case companies clearly stated that it designs its products in a way that they do not expose end users to health hazards. For example, they have a list of harmful chemicals that they never use in their products. Product safety has been an important feature in their products.

“We do not use harmful substances. For example, we have a public list of chemicals that we never use.” – R&D Director

Material choices were visible as a part of risk analysis, designing for safety and anticipation, as can be seen from the quotations. The case companies try to avoid harmful substances and anticipate the forthcoming changes in legislation. Both case companies stated that they try to minimize the challenges brought by new legislation by trying to

find substitutes for substances that might be prohibited in the future, as stated earlier in section 4.3.1.

“Talking about new product development, if we have a hunch that a certain chemical might be banned in, let us say, 10 years it might be a good idea to start developing a product without that chemical.” – CEO

Problem is that the old products with harmful substances usually are rather good and it is difficult to find substitutes for the substances used before. On one hand, if developing the new product might take anything between one and ten years it makes sense to start right away. On the other hand, it is always a question of balance: if no good solutions are available or possible yet, there is no benefit to be gain from anticipation.

Against preliminary assumptions, the case companies named only a few concrete sustainability oriented actions affecting R&D. It seems that R&D is mostly a series of un-systematic actions based on common sense.

“For example, we have no procedures like project gates. It is more about using common sense during the project.” – R&D Director

Minimization of the use of chemicals and environmental burden are examples of the individual things that came up in the interviews. However, there was no tool or systematic way to ensure that the goal is accomplished.

“Of course we try to minimize the use of material and chemicals. We also try to find ways to ease the environmental burden by switching the harmful substances.” – Expert on Department of Environment

There was also one quite critical opinion in the interviews that one of the case companies would not consider sustainability at all in product development. The critical voice claimed that product development is based on lowering the production costs of a product and on nothing else. It was also seen as a weakness.

“Talking about product development, I’d argue that sustainability is not one of the starting points but lowering the production costs is. --- And I think it is a weakness.” – Quality and Environment Manager

One thing that both of the case companies mentioned in the interviews, was the need to design products for recycling in the future. For example, one of the case companies had an on-going project to increase the use of recycled products in its manufacturing process. This also adds pressure to R&D to alter the processes and products in a way that, on the one hand, processes are able to make use of recycled material and on the other hand, products are as easy to recycle as possible.

“If we get good results from this development project of ours, it is going to add pressure to product development to develop our products to be as easy as possible to recycle.” – R&D Director

4.3.3 Production

In production the indicators enhancing sustainable development are, according to the interviewees, related to the traditional metrics in production. Basic indicators like wasted material, energy consumption, emissions etc. are the ones followed.

“We know how much a certain order needs material and we measure the actual usage and compare it with the theoretical value. It reveals bad planning.” – Production Director

*“We follow energy consumption constantly. We have clear goals for energy consumption that should be met at a monthly level.”
– Expert on Department of Environment*

As discussed in the section 4.1.1, saved energy and material also bring cost savings in production, and thus it makes sense to be sustainable in sense of material and energy efficiency. Also the absence percent of workers and the accidents leading to absences are being followed. Also in production, however, there is no “sustainability metrics”, and the individual indicators seem to be somewhat separate as no systematical set of indicators for sustainability work can be identified.

“There is no “check list” or set of indicators but we follow the energy consumption.” – Production Manager

In production actions fostering sustainable development are quite straightforward. Employee commitment, their safety and well-being, and material and energy efficiency widely understood are the principles that came up in the interviews. Figure 7 presents the findings related to sustainability actions in production.

First issue in figure 7 is committing the employees. One of the case companies has done this by giving the employees a certain amount of time, during which they can freely brainstorm and try to find improvements to the current production arrangements. The amount of proposals is being followed and measured per unit and it is a part of a bonus system.

“The employees can use a certain amount of their working hours to come up with proposals for improvements. The proposals are followed and they are part of our bonus system.” – Production Director

The ideas are gathered bottom-up and the commitment of employees most probably increases as they are the source of change. The improvements can relate to quality, environment or safety issues. Also educating games and “0-accidents” program were discussed and they were seen as important parts of getting the employees involved. As a result, the employees have been very active submitting proposals for improvements and near miss reports for accidents that almost occurred.

“The staff has been really active and I think over 700 self-made improvements were realized during 2014. Also 77 % of our employees had written a near miss report, so they are quite nicely involved in the improvement work.” – Production Director

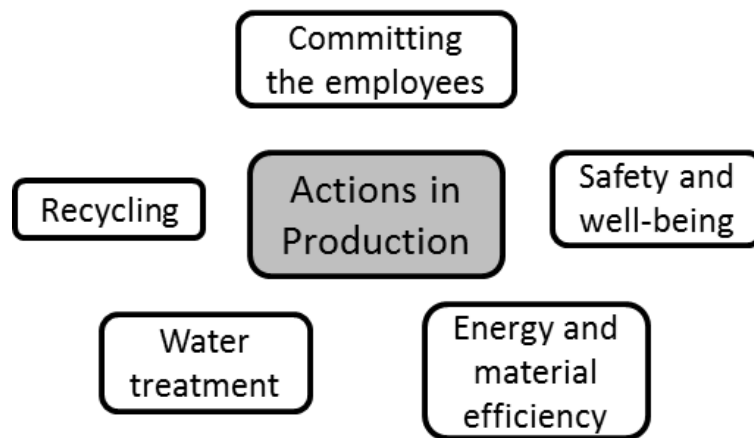


Figure 7. Actions fostering sustainability in production.

Another issue related to employees is safety and well-being at the workplace. As discussed above, one of the companies implements a “0-accidents” campaign to improve safety in production. It is not only a matter of unwanted accidents leading to absence and at worst to injuries. It is also a matter of stoppages and lost time in production. So here again, safety and financial goals are not conflicting objectives.

“If we could manage to make even one of our machines totally risk free, it would mean less accidents and injuries but also less stoppages.” – CEO

Also the materials and chemicals used in production were said to be totally safe to employees by the two case companies. Safety is also, for example, chemical safety. Through observation at one of the case companies’ production site, morning meetings can be said to be an important part of sustainability work. In the morning meetings quality, environment and especially safety issues are discussed and solutions are decided upon when necessary. Thanks to this practice, all the workers are informed of possible problems and are prepared for issues needing extra attention.

Next issue in figure 7 is energy and material efficiency. Continuous improvement discussed earlier, and small steps if giant leaps are not in sight, are important. This can be

noticed, for example, in the answers relating to new investments. Interviewees from both case companies mentioned that when making new investment decisions about, for example, new machinery or machine upgrades, material, energy and water usage are being evaluated. As mentioned in the section 4.1.1, sustainability is closely related to cost savings in production and it makes sense to try to decrease the usage of material and energy.

“There is no contradiction there. If we decrease our energy consumption we use fewer euros as well and we benefit from that.” – Production Manager

One of the case companies also had visions of future technologies that could be implemented into the production process in order to use less energy and decrease waste. This new technology is easier to calibrate between production batches (leading to less waste), uses less energy and is more efficient in material and additive use. Furthermore, they are also researching a possibility to manufacture one key component used in their products from local raw materials. This would lead to major sustainability improvements as it would lead to more jobs, less logistics and less euros spent in procurement.

In addition to material and energy efficiency, also things like internal logistics matter. Through observation it can be said that in the manufacturing facility of the other case company there is no intermediate or finished products inventory which decreases the need for inner logistics, and thus helps to eliminate wasteful actions and unnecessary movement of goods. Every single product being made is already ordered by a customer. This is not the case at the production site of the other case company and there is a need for quite massive inner logistic system.

One of the interviewees stated that in production the most important thing related to sustainability is decreasing emissions. It is part of energy efficiency and also partly related to the strategy of the firm. Actively trying to substitute fossil fuels with renewables - or at least less polluting energy sources - leads to fewer emissions in the long-run. Yet, energy efficiency in production also matters.

“In production sustainability can be seen as decreasing emissions. It is the most important thing.” – Quality and Environment Manager

Next and lower left in the figure 7 is water treatment. Both case companies treat their waste waters before letting them out. Both of the companies also use the water they take in more than once. This means that they do not take fresh water in for every stage in production but only for those stages that really need pure water.

“We need to wash the machines between batches and we recycle that washing water. Then at some point [when it cannot be used anymore] the water used for washing the machines goes to water treatment.” – CEO

Water treatment is so efficient that one of the interviewees claims their effect on water system to be smaller than the effect of nonpoint source pollution. Nonpoint source relates to individuals' pollution from their everyday life: traffic, sewage system etc.

“It is clear that our operation has an effect but when the waters are treated properly the effect is a lot smaller than, for example, the effect of nonpoint source pollution.” – Development Manager

Last issue that came up in the interviews is recycling. One of the case companies already makes products from recycled raw material. The other case company is also investigating how it could include recycling to its processes but it might be a little challenging as the product is not necessarily consumed in Finland. Reverse logistics might prove to be more harmful in the sense of sustainability than the possible benefits gained through recycling.

“We are investigating if it would be sensible to take back the products that customers have already used in Europe for example.” – R&D Engineer

4.3.4 Marketing

Related to marketing, no clear indicators that would be followed came up during the interviews. Yet, there are some things that could be measured and followed: for example travelling days, driven kilometers of the sales force, how many video meetings are held etc. However, at the moment they are not measured and followed.

“We could measure how much people are travelling, how many kilometers are being driven or how many video meetings we have held... But at the moment we are not doing that.” – Marketing Director

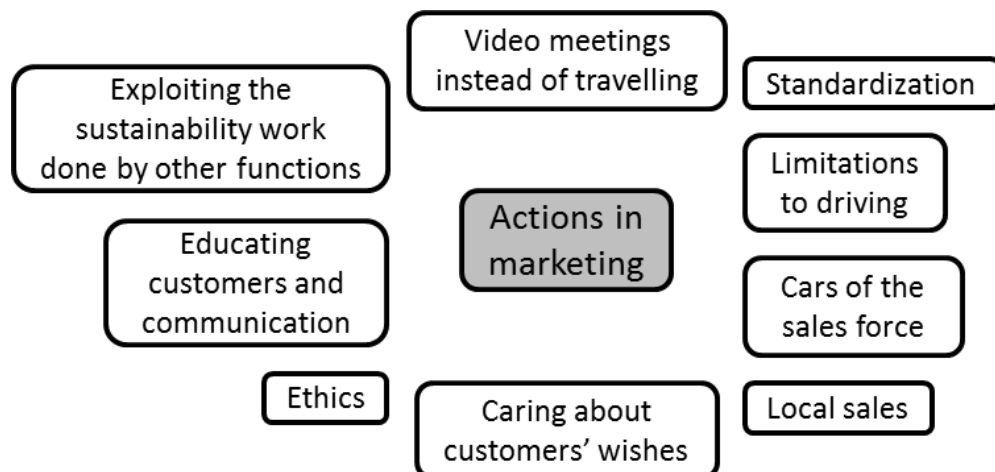


Figure 8. Actions enhancing sustainability in marketing.

Quite many concrete actions enhancing sustainability in marketing were found in the interviews. Of course, there are some really abstract principles like “Caring about customers’ wishes“, but also really precise things like “Limitations to driving” were discovered. Figure 8 represents the actions related to sustainability in marketing function.

Starting from more concrete actions and top-middle in figure 8, video meetings were seen as a worthy alternative for travelling. Video meetings might not replace the need for face-to-face meetings but it will substantially reduce travelling and the disadvantages related to it.

“We have the opportunity to have video meeting instead [of travelling]. Sometimes we of course have to travel.

We save time and money and decrease emissions [by having a video meeting] but we also save our energy. It is quite exhausting to travel all the time.” – Sales Director and Business Development Manager

Next action improving sustainability is the standardization of marketing operations. One of the case companies was going through a standardization process where the operation of all its subsidiaries abroad is being unified. This allows them to change the operation of marketing to digital format. No paper is needed anymore and efficiency increases when everyone is working along the same principles.

“We are in the process of standardizing the operation of all our sales offices abroad. Through digitalization we can get rid of paper archives and improve our efficiency.” – CEO

Continuing with concrete actions, next in the figure 8 are limitations to driving and cars of the sales force. One of the companies relies on mobile sales force and the company has implemented kilometer limits to the driving distances of their salesmen and women. This is done to ensure careful planning of sales trips and to avoid unnecessary driving. With more efficient sales work, money is saved, emissions decreased and cars conserved.

“We have a limit for driven kilometers in order to encourage people to plan their trips carefully. It saves environment and gasoline and preserves the car.” – Marketing Director

Another thing related to cars is the type of the fleet of vehicles companies are utilizing. One of the case companies was about to change all the cars it has to less fuel consuming and polluting ones. In addition to environmental impact it is also a financial issue.

“We are about to change all the cars of the company to more fuel efficient ones. It means less used fuel, fewer emissions and saved euros.” – CEO

To minimize logistic costs and emissions alike, one of the case companies always tries to sell its products as close as possible to the site they are produced at. This relates to recycling issues discussed earlier. It makes sense to use recycled material where it is available and when products are sold to local area, also retrieving the products is worthwhile.

One of the case companies has received really good feedback about being a trustworthy partner. They concentrate on finding solutions to the problems of their customers and not just selling products. This caring about customers' wishes not only brings sales benefits but also helps the customers to be more sustainable.

“We have heard that we are a valued partner of doing business with. We do not only sell products, we also care about the customer and their benefits.”
– Marketing Director

Moving to more abstract actions, in figure 8 the next issue is ethics. Both of the case companies stated that they are really strict about following the competition legislation. Both of the companies have their own code of conduct that not only all employees but all suppliers also have to comply with. Single issues that were brought up in the interviews are, for example, anti-corruption actions and preventing cartels.

“Our Code of Conduct clearly states what is allowed and what is not. There are instructions on responsible sales operations and it is a part of our sustainable operation.” – Sales Director

One of the case companies was also rather strict to whom they sell their products. It was said that sometimes a customer might have something to hide from the public. In such a case, this customer would not be sold any products.

“We have decided that we do not want to have anything to do with that kind of shady business. We rather refrain from selling entirely.”
– Marketing Director

Second last action in figure 8 is educating the customers and communication also otherwise. One of the companies had the problem that even though they had developed more sustainable products that would support the sustainability efforts of the customer as well, their own sales force would not actively sell these particular products. To counter this phenomenon, the company is educating its customers regularly so that they would be able to demand the products really helping them if the sales person does not advertise them at all.

“We are selling products too aggressively compared to solutions. If our sales force does not sell the solutions, maybe customers are able to demand them as we have been educating our customers constantly.”

– R&D Director

Right way of communication is also otherwise important. One of the case companies had been struggling with some image weakening issues in the past and was now more open and dialogic in its communication. It is better to tell things oneself than to wait for someone else to tell the same things, probably even incorrectly. All in all, both of the companies felt that they have a good story to tell their customers and the public.

“We have a good story to tell.” – Marketing Director

However, they also felt that they should improve their communication further. One example is the sustainability features of the products in comparison to all competitors, direct and indirect. The companies stated that by affecting the end customer and making the public more aware of the benefits of their products, they can make a big impact as it has to be the end customer who demands sustainable products and solutions.

The last issue in figure 8 relates to marketing being the one that takes the benefits from all the other functions' sustainability work and exploits them in marketing efforts. One of the interviewees even felt that marketing itself cannot do much for sustainability.

“Marketing enhancing sustainability? I see it the other way around: marketing should be the one exploiting all the good sustainability efforts of other functions.” – Expert on Department of Environment

However, as we have seen earlier, marketing can also do a lot to contribute to sustainability work. Still, majority of the interviewees were concerned about marketing and communication. There were concerns that a lot of good things are being done but they are not utilized in marketing efforts.

“We might be quite bad at that [communicating sustainability work] actually. I mean, we do many good things but we do not bring it up well enough.”

– R&D Director

It has to be remembered, however, that if one advertises oneself to be really sustainable, it might encourage some people and organizations to start investigating the operations of a company more carefully. And if something is to be found, it is a big thing.

4.4 External Service Providers as a Part of Sustainability Work

This section presents the role of external service provider in sustainability work. First, it is discussed whether an external service provider is needed at all. Second, the type of cooperation with external service providers is examined. Third, the reasons for using an external service provider are outlined. Fourth, the satisfaction with external service providers of the case companies is evaluated. Fifth, the possible gained benefits are examined and sixth, future development ideas on cooperation are presented. Figure 9 illustrates the structure of this section.

Almost all interviewees thought that external service providers are needed in the sustainability work. They are needed to challenge the current ideas of an organization and to provide a benchmark. External service providers quite often also do the planning work for manufacturing machines, and thus define many issues that will affect the operation of manufacturing company. External service providers are also used for bigger development projects when many different type of know-how is needed, for example when trying to find new applications for production waste or solutions for water usage.

“We have used external service providers to come up with new solutions for production waste. They have also been investigating our water circulation.”
– *Quality and Environment Manager*

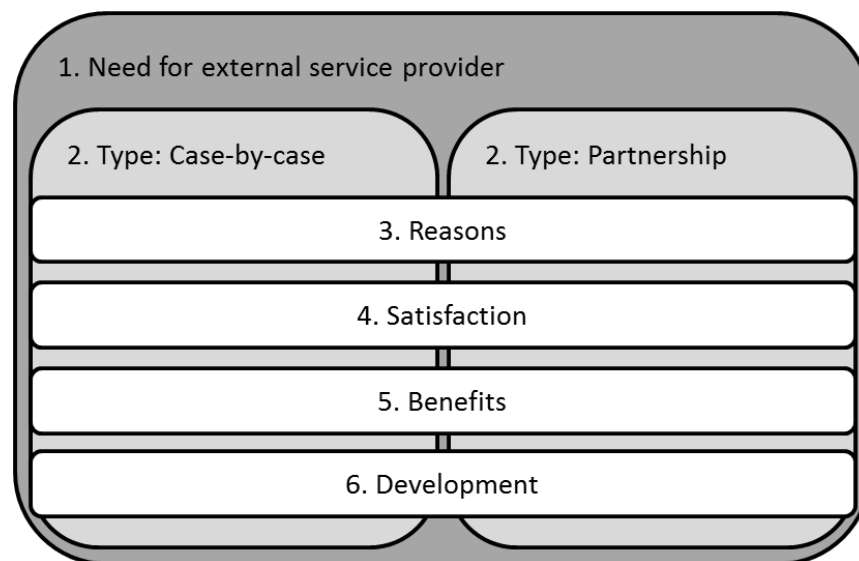


Figure 9. Structure and flow of examination through the section 4.4.

External service providers are used for waste management services and they might help with putting together a sustainability performance report or measuring customer value. What is also needed is basic analytic service, such as laboratory and emission level measurements. It was highlighted that no single actor can claim to be sustainable alone. Instead, the whole ecosystem or supply chain has to be sustainable.

“No one can be sustainable all by oneself. It has to be looked in a wider perspective.” – Development Manager

“We cannot declare ourselves as a sustainable island among suppliers that are not sustainable.” – Development Manager (different than above)

Also some views came up in the interviews, according to which not so many external service providers are used for sustainability issues. However, these comments were a clear minority. One interviewee also felt that some knowledge-based service providers are offering things that could also be made by the company themselves.

“We know that this substance A is more toxic than this substance B and it would be better if we did not have to use substance A. We do not need a consult for that.” – R&D Director

However, as a summary it can be said that external service providers are used in sustainability work quite extensively. The type of cooperation depends on the nature of the used service. Some services need a lot of cooperation and the relation between service provider and the manufacturing company can be said to be a partnership. On the other hand, also case-by-case transactions are used.

*“We have both. We need and we have long-term partnerships but we also seek service providers to do a single case.”
– Expert on Department of Environment*

Quite many interviewees felt that there is a movement towards more partnership-like cooperation. Price of the service was not seen as an eliminating factor if companies can also expect good results.

*“It can be seen so that we are finding more and more partners that we cooperate with. --- Price is not an issue if we know that we are going to get increased value and better quality for that money.”
– Quality and Environment Manager*

What is tried to achieve with long-term cooperation, is better development. When both parties know each other well it is much easier to develop something new.

“We try to have more long-term partnerships and we would like to see it develop and bring benefits over time.” – Factory Director

Also services that are traditionally case-by-case by nature could be given and promised to one single actor taking care of the one specific need. Even if one cannot talk about partnership in this sort of cooperation, there might still be some benefits to be gain from not having to invite service providers to bid on every single little thing. Annual sub-

scription could be in force and then whenever needed, the service provider could be invited to do their job.

“It would be much easier if I had a long-term contract with a single company. Just a phone call would be needed and no trouble of doing the competitive bidding again and separately every time would incur.”

– Expert on Department of Environment

Two main reasons were mentioned when the interviewees were asked about the reasons for using external service providers: know-how and resources. First, it was argued that while the world is constantly becoming more and more complicated, it is impossible to have all the know-how in-house.

“We need know-how from outside as we do not have all needed understanding and know-how. It might be production equipment supplier, academies or other service providers so that we can utilize all knowledge in our network.” – Factory Director

Know-how might also include just getting a second opinion about something. One can turn quite blind to own thoughts when working with something for too long. Fresh view from outside the company often helps.

“It is a good idea to get an external view on things as one quite rapidly becomes blind to one’s own work.” – Production Director

Second, companies are facing ever tightening cost pressure and competition which does not leave room for any extra resources. It might be that a company has a lot of improvement ideas but too few hands to make them happen.

“We might have a lot of ideas but not that many doers so it is a matter of resources.” – Production Director

Same issues were mentioned when interviewees were asked how they saw the role of external service providers in the future. Interviewees saw that while the world becomes more complicated, focusing on core competencies will increase in future.

“It [the need for external service providers] will definitely not decrease in the future. I assume we are going to focus even more to our core competencies and we need many services from outside.” – Development Manager

Also pressure from authorities and customers is probably going to increase and more investments on development are needed. As the competition is not going to disappear, and thus people will be stuck in running the everyday business, there are most likely no resources in-house to do all the needed work.

“I do not think that it [the need for external service providers] is going to decrease. I suppose demands will increase and our resources are definitely not going to increase so the need for external resources is most likely to increase.” – Expert on Department of Environment

One of the case companies has been able to realize substantial benefits from the industrial symbiosis with its service provider. The benefits include fewer emissions, decreased use of fossil fuels, less waste to landfill, more local jobs, better image and, of course, better profitability. They are also looking into new interesting things together.

“We have been considering new possibilities and we want to continue and develop our collaboration further. We have been really successful in concentrating on our needs and coming up with new proposals.” – CEO

One of the interviewees also felt that a well-functioning collaboration has made it possible to do things that the company could never have accomplished alone. They would not have had the required know-how and resources to do the needed work to reach the current level of sustainability alone. The company wants to focus on its core competencies and be good at those things.

“We cannot forget what the products are that we do and what is our core competency and capabilities. We live from what we do well and not from anything else.” – R&D Director

One of the case companies is really satisfied with its current service providers but the other not so explicitly. The former has been working for a long time with a certain service provider and they have formed an industrial symbiosis. They have on-going development projects together and are also planning future cooperation. The latter has not formed industrial symbiosis with any service provider and has been facing some problems regarding the progress of certain projects. The latter company sees that some problems are due to own lack of resources.

“The gained benefit is closely related to our own capability to allocate resources for the cooperative work. Outsider does not always have enough knowledge about the facility and if we have not had the time to instruct them the result is somewhat fuzzy.” – Quality and Environment Manager

They also have an idea of how the external service providers they have had could improve their operation. They hope that external service providers could take more leading role in common undertakings and make proposals on their own.

“We also hope for the service providers to be bold and bring new ideas to the table.” – Factory Director

It might be a bit demanding for service providers that do not know the operation of the firm. Especially if the parent organization does not have enough time to properly prepare the service provider for the project at hand. Another thing that could be taken into consideration is taking care of one thing at a time. Progressing logically piece by piece is better than trying to do everything at once.

“Advancing a bit by bit would be better. There has been too much of trying to do it all at once.” – Expert on Department of Environment

Relating to the above mentioned step-by-step progressing, quick and honest replies and answers about the capability to do a certain project were seen important. Even if it might be hard for a service provider to admit that something cannot be done, a quick answer is better than not communicating the incapability. This way the first project can be abandoned rapidly and the resources redirected to somewhere else.

“I understand that it might be a bit difficult for someone to come and say that we cannot do it after all. However, it would be very beneficial if we could get a clear answer. That way we could move on to next challenge with the service provider.” – Expert on Department of Environment

Both case companies see networking and openness to be important in the future. Not everything can be managed by the company itself so more cooperation and network management is needed.

“We are looking into more ecosystem-type of thinking. We cannot do everything by ourselves.” – CEO

Openness also in the sense of open innovation was mentioned in the interviews. In order to avoid doing everything like it was done in the past, many actors from different background could be gathered to solve an individual issue. Solutions might stem from surprising directions when people with totally different views gather to chat about a problem at hand.

“We are already implementing open innovation-type of cooperation. We believe that it is needed to get fresh ideas and avoid doing things like they were done in the past.” – Factory Director

5. DISCUSSION

The research question of this thesis was divided to three sub-questions. The results of this study are examined here in accordance to these three sub-questions. The results are also compared to the literature of this thesis and other researches about the same themes.

First, the attitudes and views on sustainability as a whole are discussed, together with possible ways to identify and assess sustainability. Second, the indicators and actions helping the sustainability work are examined. Last, the external service providers and their role in aiding sustainability work are discussed.

5.1 Sustainability and Ways to Identify and Assess It

In this section the first sub-question is covered. The first sub-question was: “*How is sustainable value identified and assessed in industrial processes?*” In addition, also the interviewees’ perceptions on sustainability, why it is fostered and the value of sustainability are being evaluated. Starting with the latter, most common answers relating to what is sustainability, were that it is comprehensive, about maintaining social and natural environment, about being profitable and that there are no contradiction between the financial goals and the objectives of sustainability, as was seen in the table 9. This is more or less in line with the definition of triple bottom line introduced by Elkington (1997).

As was shown in the table 10, customers, laws and regulations and competition were among the three most common answers on why companies act sustainably. Own will and selling point were mentioned more seldom. This seems to be in line with Tervonen et al. (2014) who claim that environmental actions are mostly driven by pressure from the authorities in the form of reports, regulations or indexes. The other case company is a case in point example of this kind of thinking but the other one has sustainability integrated to nearly all what the company was doing. This does not mean that everything is already done or that they do not produce any pollution and so forth, but that they seem to consider decisions with a wide scope and take a lot of different perspectives into account. It can be said that sustainable development based on common sense is a built-in part of the culture of the company. In addition, many sustainability actions were made because of possible cost savings and other business benefits, such as increased sales.

Quite many interviewees saw sustainable development as a must in order to keep up with the changing world and ever tightening competition. This supports the view of

Nidumolu et al. (2009) about sustainability being a source of competitive advantage. However, only few interviewees clearly stated that sustainable development is a selling point and a way to differentiate. This is not completely in line with Tervonen et al. (2014) as they stated that sustainability is seen as an important way to seek competitive advantage and business growth. It has to be remembered though, that the two case companies were very different in nature and in the sense of attitude towards sustainability. Thus no generalization based on this study can be made. Arguments for and against the views of Nidumolu et al. (2009) and Tervonen et al. (2014) can be found from the results of this study.

Nidumolu et al. (2009) and Bansal (2002) have stated that sustainability is mostly seen as a burden in the industry. This view is not supported by the results and interviews of this study. Sustainability might have some costs but they are not seen as major burden in comparison to the possible benefits. In fact, one of the case companies has been able to significantly reduce its cost, while improving its environmental performance, having fewer accidents and supporting the local community at the same time.

Furthermore, Nidumolu et al. (2009) have stated that companies trying to be sustainable might find it easier to get the workforce they need than before. This was also the case in one of the companies in this study, although they are located quite far away from any bigger city. Thus, the results support the view of Nidumolu et al. about sustainability being a way to achieve benefits in the future.

The case companies were keen on taking care about their image. One part of the value of sustainability was said to be improved image or good image in the eyes of customers and community. One of the companies had even faced some pressure from shareholders when struggling with sustainability issues. This is in line with the literature presented in the section 2.1, where it was stated, based on Guidry & Patten (2010) and Khanna et al. (1998), that bad environmental reputation influences the market value of a firm. The results indicate that image is also important because of the customers.

The interviewees also mentioned many benefits to customers, environment, employees and community. It was a little surprising that interviewees had no trouble naming multiple positive effects of sustainability work to stakeholders also. It can be argued, based on the results that at least the companies know the benefits of sustainable operations, even if it they might not always act sustainably.

As of threats of sustainability, some of the interviewees saw the different legislation and rules in different countries as a problem. They feel that companies acting according to and fostering sustainable development (voluntarily or not) might lose competitive advantage to companies that are allowed to stay outside sustainable development. Tervonen et al. (2014) have also noticed the same challenge with the globally differing legis-

lation. The results seem to show a little frustration against the legislative decision making and a concern that sustainability fostering legislation is not globally just.

Moving to the discussion on the first sub-question, the results of this study state that there is no means, or at least no systematically employed tools and methods in use to identify and assess sustainability. Neither of the case companies reported any such tools as can be seen in the table 11. This is really surprising given all the models that literature is offering to be used in sustainability work. Examples include the LCA (e.g. Chapas et al. 2010; Epstein & Roy 2001), the VSM and its sustainability variations (e.g. Faulkner & Templeton 2012; Torres & Gati 2009; Paju et al. 2010) and the SBSC (e.g. Figge et al. 2002b; Fulop et al. 2014; Hsu et al. 2011).

One of the case companies had tried LCA but it has proved to be too complicated, at least for the time being. VSM and BSC were not mentioned during the interviews, apart from one time where one interviewee said that “scorecards” have been used in strategy work with no or only little linkage to sustainability. Also the KPI system and GRI sustainability reports were mentioned by individual interviewees but they were more following and reporting tools than identification and assessment methods. It seems that academics are offering concepts that are not really seen useful by the case firms. It has to be remembered, however, that this study only involved two companies. Still, it seems odd that so much has been written about sustainability assessment and identification methods and then they were not mentioned during the interviews.

Epstein & Roy (2001) argue that every sustainability initiative undertaken should be measured, followed and compared against the goals expressed as specific performance indicators. That was not the case in neither of the companies of this study. The interviewees said that they are doing a lot of sustainability actions but they do not know exactly how the effects should be measured and what indicators to follow. There was no systematical follow-up of sustainability efforts. One quotation captures the situation at the moment:

*“It is not that assessing is unimportant but that it is really challenging.” –
Factory Director*

What is worth noting, however, is that there is willingness to move towards more systematical assessment and clear indicators to help in sustainability work.

5.2 Indicators and Actions Supporting Sustainability

This section covers the second sub-question which was stated as follows: “*What are the building blocks of sustainable value in industrial processes?*” The question is aimed at finding out the indicators and actions fostering sustainable development in different functions of companies. Four examined functions were strategic level, R&D, production

and marketing. This section is divided into two sub-sections: first indicators and then the actions at different functions of a company are discussed.

5.2.1 Indicators in the Sustainability Work

Starting with indicators, there were only few that were actually involved in sustainability work. GRI and KPI were issues that were most strongly brought up in the interviews. Both of the case companies are reporting their sustainability efforts and performance according to the GRI guidelines. However, GRI indicators were mostly used for reporting and not for internal development work, as is also stated by Feng & Joung (2009) who reminded that all sets of metrics they introduced are aimed at reporting to stakeholders.

Although not being directly part of sustainability work, GRI might still provide the basis and desired feedback for the sustainability work. This was also the opinion of Singh et al. (2009) in their overview on different indicators in use in industry. GRI guidelines offer a vast range of indicators but the problem is that every company can choose the indicators they like. Thus, the comparability of sustainability performance is rather limited, as was stated in the literature review by, for example, Dingwerth & Eichinger (2010).

A KPI system steered, at least to a certain extent, the sustainability work of one of the case companies. The KPI system was used for deciding what to measure in the future which means that it is used to define what is seen as important to follow in the long-term. At least Adams & Frost (2008) have reported about similar cases where sustainability indicators as part of KPI are guiding the decision making to some extent. Building a KPI system including sustainability indicators can thus be argued to be a way to enhance sustainability work.

Especially in R&D activities it is difficult to identify systematic following of sustainability. In manufacturing the history of measuring different indicators is much longer, and thus also at least some sustainability factors are being measured. Interesting result from interviews is that manufacturing indicators are seen to serve both: the financial goals as well as sustainability efforts. This linkage was explained with energy and material efficiency, which both also lead to cost savings. Still, there is no one clear set of indicators that could be claimed to be the standard. Related to marketing, interviewees from one of the case companies mentioned many things that could be measured, but at the moment no following and measurements were done. One exception was the limitation for driven kilometers that was employed in one of the case companies to reduce the unnecessary driving of their sales force.

As a summary, it can be said that there is an urge to make the follow-up of sustainability much more systematic and part of every-day actions, as also stated by Tervonen et

al. (2014), but so far no one set of standardized indicators has emerged. Despite many different sets of sustainability indicators, they are so far less exploited in sustainability work than it could be thought based on the literature in section 2.3.1.

5.2.2 Actions Fostering Sustainable Value Creation

Starting with actions at the strategic level, companies need a broad enough view to be able to benefit from sustainability and turn it to an advantage. Like Porter & Kramer (2011) argued, the field of vision should be broad enough to allow the companies to find solutions that have cross-functional effects. This was quite well expressed by one of the respondents:

“If you take a broad enough view on sustainability, suddenly everything can be interpreted to be part of it.” – CEO

Both of the case companies were reporting their sustainability performance which was mentioned to be used at least by automobile industry in Taiwan (Hsu & Liu 2010). Other issues mentioned by Hsu & Liu (2010) and the interviewees include waste reduction and safety issues.

Both of the case companies were really strict about their suppliers complying with their rules on sustainability. This was also mentioned in the table 6 where the enablers and inhibitors of sustainable supply chain management (SCM) according to Wolf (2011) were introduced. Significant similarities between the table 6 and the results of this study can be drawn. One of the case companies has a clear sustainability strategy, has close supplier relationships and clear goal alignment, all of which are enablers (table 6) of sustainable SCM. In addition, they do not suffer from any of the inhibitors mentioned by Wolf (2011). They have also been able to reach substantial benefits from their sustainability work.

Furthermore, while the other case company might also possess some of the enablers, like exemplary interaction with non-governmental organizations, it also faces lack of needed human resources and at least some of their service providers have been said to have too little knowledge on the processes of the company. The company also finds it hard to grasp benefits from their sustainability work. This indicates that the enablers and inhibitors of Wolf (2011) provide a way to evaluate the sustainability work of companies, even though it was meant for SCM evaluation.

Also the table 7 provides interesting topics and issues to compare with the results of this study. For example closed loop production mentioned by many scholars (Lovins et al. 1999; Lowe & Evans 1995; Korhonen 2004) was not mentioned at all during the interviews of this study. On the other hand, being proactive instead of only complying with rules (Nidumolu et al. 2009), replacing non-renewables with renewable energy sources

(Korhonen 2004) and integration with key suppliers and customers (e.g. Vachon & Klassen 2006) were mentioned by the respondents of this research.

Two issues in the table 7 are really important to take a closer look at: flexibility of authorities (Desrochers 2001) and industrial symbiosis (e.g. Lowe & Evans 1995; Bansal & Mcknight 2009). The inflexibility of authorities was mentioned to be a clear threat to sustainable operations by one of the case companies, as they might have to change a totally working recycling concept because the law does not recognize it as it is at the moment. This supports the importance of authorities being able to make rapid decisions and updates when needed, as mentioned by Desrochers (2001).

In this study industrial symbiosis was seen as an important way of reducing environmental impact, reducing costs and supporting the local community, for example in the form of new jobs. These issues are also realized in the industrial symbiosis of Kalundborg, Denmark (Lowe & Evans 1995). It can be argued then that industrial symbiosis is a way to enhance sustainability in all of its forms and is worth pursuing for. However, as Chertow (2007) argues, an industrial symbiosis cannot be forced, and also the industrial symbiosis of one of the case company was formed without external pressure, purely because the partners saw a business case in tight collaboration.

Moving on to **R&D**, already Wheeler (1992) came up with the importance of recyclability and reducing the use of harmful substances in product designs and production. Also in this study some of the interviewees mentioned that recyclability is going to play a bigger role in new product development and product upgrades in the future.

Quite surprisingly, none of the methods and tools mentioned in the literature review were discussed during the interviews. Instead of clear routines, the R&D seems to rely more on common sense. Another difference is that even though safety for end users was not a dominant issue in the literature review, it was considered quite extensively in one of the case companies and also mentioned by the interviewees from other one.

The most extreme opinion was that R&D is not at all affected by sustainability. This is in clear contradiction with all that is written in the literature review. It can be said that considering R&D, there seems to be a gap between the academic discussion and the reality on the shop floor of the companies. However, it has to be remembered that the industries or the products of the two case companies might offer the explanation to this gap.

For sustainable **production**, a quite all-inclusive definition was given in the section 2.3.3 by Veleva et al. (2001). Although the case companies are not quite there yet to claim their production facilities to fall under that definition, some elements were discussed in the interviews of this study. The respondents were talking about decreasing emissions, material and energy efficiency, being profitable and safety for the workers. All of these issues were also mentioned in the definition by Veleva et al. (2001).

For example, going through the table 5 in the literature review, all the aspects in the Economy column were discussed in the results. Also the issues in People column were mentioned during the interviews. Only job rotation and enrichment was not mentioned by anyone. Excluding closed loop manufacturing as such, all the other issues also in the Environment column were brought up by the two case companies. However, the idea of waste from one company being the raw material for another was present in the interviews of both of the companies.

It can be argued that this study has been able to find all the relevant issues mentioned in the literature about sustainable manufacturing. Thus, it supports the former studies on sustainable production. Nevertheless, as already mentioned above, the case companies' production still has to improve in order to be called sustainable but the issues discussed were the same as in the literature review.

Lastly, going through the results on actions enhancing sustainability in **marketing**, the biggest issue in literature review seemed to be the fear of green marketing being a mere bluff and a part of greenwashing campaigns of companies without any strategic support (e.g. Davis 1991; Peattie 1999; Polonsky & Rosenberger 2001). This was not so clearly present in the interviews or results. In fact, the interviewed companies were worried about not being able to communicate their sustainability efforts efficiently enough. Both of the case companies felt, just as Tervonen et al. (2014) reported more generically, that they had problems communicating sustainability, what they have done to enhance it and the value of their actions.

The communication of sustainable actions was seen to be twofold by the case companies. First, the companies felt that they should work more to market their sustainability actions. On the other hand, as stated by Polonsky & Rosenberger (2001), a company aggressively marketing itself as sustainable will be more critically evaluated by customers than companies that are more conservative in their marketing. Still, the first mentioned issue was dominating.

The need to educate customers about possible positive benefits of certain products and materials was mentioned by both of the companies. The other company was even educating customers regularly at its manufacturing site about new products. This way it could be ensured that even if the own sales people of the company would not tell the customers about new and interesting solutions, the customers would themselves have the knowledge to ask about them. The other company is struggling with changing the mindset of its customers and to make them realize that their product is a lot more sustainable than a material they are competing with. These issues were also mentioned by Wheeler (1992), Polonsky and Rosenberger (2001) and Peattie & Crane (2005).

The case companies also named some much more concrete issues and actions than what was presented in the literature review. For example organizing video meetings instead

of travelling, limitations to driving distances, standardization of the marketing efforts, changing the cars of the sales force and local sales were all something that was not brought up in the literature review. Either literature found for this research was mainly focused on a more higher level marketing, or the small things that can be done in marketing has not been researched that much.

The results indicate that also ethics could be added to the list of things that Peattie & Crane (2005) demand from sustainable marketing. Both of the companies were really strict about complying with the competition law. In addition, one of the companies highlighted its high morale in marketing. They will not sell their products in any shady circumstances and they have received good feedback about being a reliable partner really caring about their customers' needs.

5.3 External Service Providers Enhancing Sustainable Value

The last section of the discussion chapter covers the third sub-question which was stated as follows: "*How can an external service provider support the formation of sustainable value?*" Keeping the background of the study in mind, the partner company in this study is a service provider for both of the case companies. Interviewees from both of the case companies strongly argued during the interviews that sustainability work is not going to decrease in the future and that no one can handle the vast field of sustainability alone. This means that external service providers are needed.

The results of this study indicate that eco-efficiency can be enhanced by an external service provider affecting the activities of its customers, as also stated by Bartolomeo et al. (2003). One of the case companies had formed an industrial symbiosis with their service provider to reach sustainable value. This supports the idea of Paulraj (2011) that companies should try to find strategic partners that fit their capabilities and resources to be able to meet future goals. The findings indicate that in an industrial symbiosis type of tight cooperation a detailed knowledge on the operations of the customer is needed. This finding supports the view of Bartolomeo et al. (2003).

The results from one of the case companies clearly show that the external service provider is of most benefit in furthering sustainable development when it can form a tight industrial symbiosis with the parent company. When goals are set together and both sides are committed to the common cause leading to shared value, the benefits of cooperation exceed the possible benefits of both sides acting on their own. It can be said that sustainable development requires cooperation and external service providers as no one is capable of reaching sustainability alone. Also Tervonen et al. (2014) highlight the importance of common goals and cooperation between companies in different sectors.

In addition to Bartolomeo et al. (2003), also the findings of Anttonen (2010) in his study on chemical and resource management services seem to be supported by the case companies of this study. Same findings were made through interviews and observation:

- customer and service provider must align their business goals to reach sustainable value
- long-term contracts are needed to build up company and industry specific competence
- industry specific competence is needed to enable tight cooperation.

Relating to the findings of Anttonen (2010), the case companies clearly stated that there is an urge to move towards long-term contracts. At the moment both, case-by-case and partnerships are used but most benefits were seen to be reached with tighter collaboration.

Reasons to use external service provider is mainly related to two things: resources and know-how. The working environment of companies grows to be so complex that no one is able to have all the knowledge needed to operate a business in house. On the other hand, also resources of own workforce are limited and when big development projects or changes are made extra pairs of hands are needed. Related to both of the mentioned issues, also Fitzsimmons (1998) has argued that by outsourcing certain activities, companies are able to focus on the things they do best.

The findings of this study challenge the opinion of Seuring & Müller (2008) about customers not knowing the benefits of sustainable supply chain management (SCM) as a reason to not engage in improvement activities. As discussed in section 4.1.3, the case companies had no difficulties to express the possible benefits of sustainable operations and both of them are already using external service providers. For some reason, one of the companies had not been able to fully exploit the potential with its service providers.

According to findings, one of the reasons might be that companies do not allocate enough resources for integrating the service provider. If resources are lacking, no deep enough cooperation can be achieved and also the sustainability related projects will remain to be too general by nature. In addition, service provider should take a leading role if the customer is unsure of its goals or is not able to allocate enough resources for the collaboration. A service provider should also focus on limited number of things at a time and deal with those chosen issues first instead of trying to do it all at once.

One of the case companies stated that to be sustainable a company has to have an inner urge or culture for sustainability. External service provider might help in the process of achieving sustainable operations, but it all begins inside the firm itself. Also Lämsiluoto & Järvenpää (2010) have noticed in their study that sustainability is based on the values of a firm. Thus, if no real desire to be sustainable is present, no single service provider can do a few magic tricks and alter the operation of a company to be sustainable.

6. CONCLUSIONS

This chapter concludes the study. First, it is evaluated how the objectives of the research were met. Then the academic contribution and managerial implications of the study are discussed. Fourth, the limitations to the study are examined and the last section gives proposals for future research.

6.1 Meeting the Objectives

The aim of the study was to create more knowledge on the formation of sustainable value in industrial environment. The research question to be answered was:

How is sustainable value formed in industrial processes?

The explorative study was organized around the different functions of company. The creation of value was examined at strategic level, in R&D, manufacturing and marketing. This was achieved by interviewing people from all of these functions. In addition, the attitudes towards, reasons for, and the benefits and harms of sustainability were discussed in order to clarify the concept of sustainable value. One specific point of interest was the role of external service provider in the sustainable value creation.

Summing up the answers for the main research question, it all begins with the definition of sustainable value. Based on the results, the triple bottom line view on sustainable operation is understood in the two case companies. The effects of sustainable operation are broadly acknowledged, including benefits to the natural and social environment and to the company itself. Sustainability is fostered for multiple reasons, as can be seen in the table 10. So far the main reason for sustainable operation has not been own will or sustainability itself but customer demands and law and regulations.

Quite surprisingly, and against the pre-assumptions made based on the literature review, sustainability work and sustainable value creation is not systematic and mainly only reporting tools such as GRI sustainability reports are used to assist the process. Reasons for this were not mapped and there is a possible theme for future research. Building blocks of sustainable value are understood as the indicators used to guide the sustainability work and as the actions in different functions to foster sustainable development. Indicators in use were not systematical sets formed in order to foster sustainability, but individual indicators in a general KPI system. Only in the manufacturing function indicators were followed and effectively used to guide the operation. This was seen to be so because of the long tradition of measuring culture in production.

The actions enhancing sustainable operations were diverse and they were recognized at each examined function of a company. Most important were the broad enough view on sustainability at the strategic level, anticipation in R&D, overall continuous improvement in manufacturing, and communication and customer education in marketing. The results also indicate that so far the sustainability issues have been least considered in R&D and the biggest concern of companies relates to organizing their communication about sustainability in the right way.

External service providers were seen to be very helpful in fostering sustainable value creation. It was seen that the need for external service providers is not going to decrease, but instead increase in the future. Service providers are used in sustainability related issues for two reasons: resources and know-how. Tighter collaboration and industrial symbiosis seems to bring more benefits than more loose cooperation. However, both types of collaboration are needed. Service providers should take care of one thing at a time and then move on to the next issue, and customers should make sure that they allocate enough resources to the integration of service providers.

Given the explanation above, it can be said that the study reached its objective of acquiring more information on the formation of sustainable value. Some areas were not fully covered and some ideas need further research but in general the aims were met.

6.2 Academic Contribution

This research has given more information about sustainable value and its formation in industrial processes. Small contributions at different little aspects were realized. First, the view of Nidumolu et al. (2009) stating that trying to make the most out of sustainability in form of new products and innovations can also be a source of competitive advantage, was supported. One of the companies saw sustainability more as a given from law and regulations, whereas the other case company was able to reach substantial benefits by being ahead of regulations.

Second, the research has questioned the current strong academic contribution to different types of identification and assessment tools of sustainable value. The literature review highlighted at least strong contribution to the LCA method (e.g. Chapas et al. 2010; Bhandar et al. 2003), the VSM and its derivatives for sustainability (e.g. 2012; Paju et al. 2010) and the SBSC (e.g. Figge et al. 2002b; Fulop et al. 2014). None of these methods were actively used in the studied organizations.

Third, this research has given more insight on the role of the external service provider in the sustainable value creation. Discussion on the role of external service provider has been missing from the SCM (e.g. Seuring & Müller 2008) and partly also from industrial symbiosis literature. The role of external service provider has now been justified and a possible new area of discussion has also been indicated.

Fourth, the research offers a great basis to build on and plan future studies. The research has offered an overview on the state of sustainability thinking in Finnish process industry. It has also offered examples on how companies have distributed the sustainability work between the different functions: in which functions sustainability is already considered and where improvement proposals could be the most beneficial.

6.3 Managerial Implications

The research has offered managerial implications for manufacturing companies wanting to act sustainably and also for external service providers that offer services supporting the sustainability efforts of their customers. Starting with companies seeking more sustainable operations, one of the most important things is to recognize the “sustainability readiness” of the industry the company is operating in. If no sustainability premium can be charged, it does not make sense to compete with sustainability or do more than is required, as these actions are not rewarded by the customers. However, improvements simultaneously lowering costs and improving the sustainability performance of the firm might still exist and could be exploited. If sustainability premium can be charged, competing with sustainability should be considered as an option.

Sustainability should be treated as a comprehensive part of all actions and not as a necessary evil that is only done because of law and regulations. If sustainability is seen through wide enough lenses, sensible solutions are more likely to be found. Benefits from sustainable solutions might include value for the company, its employees, environment, surrounding community and customers alike. Although sustainability is a lot more than just financial profitability, it must be remembered that it still is a requirement for being sustainable.

Being sustainable all by oneself might prove to be rather difficult. One solution is to find a service provider or an industrial partner, with which a common goal providing benefits to both parties can be thought of. Examples include finding a byproduct in manufacturing that is not exploited yet and finding a new application for it. If an external service provider is used, it is of utmost importance to allocate enough resources for the collaboration. Other example is to figure out how to make the operation of the customer more sustainable. If the product being manufactured can somehow affect the operation of customers, there might be a chance to offer customers better user safety, environmental performance or other sustainability enhancing product features.

Assessing and identifying sustainable value creation might prove to be difficult but a good common sense can already offer a sufficient basis for operations. In production it is usually pretty straightforward to combine sustainability and cost savings. For example, energy and material efficiency, and safety and well-being of workers lead to cost savings because of lower purchasing costs for material and energy, and fewer absences and stoppages because of accidents. In marketing the most important thing is to be able

to communicate the sustainability actions in the right way. The balance between too much marketing and the need for marketing and also education must be found. Sometimes the customers have to be educated about sustainability benefits of certain material or product.

In addition, the frameworks offered by literature (section 2.2) might provide a possible way to create a culture of sustainability or strengthen the present one. For example, building a Sustainable Balanced Scorecard (SBSC) forces the target entity to carefully go through its strategy and think about the possible courses of actions. This way sustainability might be fostered and the whole organization may make the commitment more easily. Although the companies were not using this kind of frameworks and models, they should be considered as a possible way to support sustainable operations.

For service providers the most important thing is to be able to hear the customers and their needs. Long lasting partnerships allow for learning specific competencies needed for each individual case. When trying to find the common area of interest, a solution to a certain set of problems at a time is better than trying to do it all at once. Quick answers, whether being “yes, we can” or “no, we cannot”, about possible future projects is better than a long lasting silence. Honesty is appreciated. If the customer is not allocating enough resources to the cooperation, it might be that the service provider should take a more active and leading role and demand the support it needs from the customer.

Summing up the section 6.3, a list of possible actions is presented. In order to get the most out of sustainability, companies should:

- recognize the sustainability readiness of their industry and act accordingly
- treat sustainability as a possibility and comprehensive issue instead of necessary evil
- keep in mind that profitability is a prerequisite for sustainability
- find partners that fit their operations and allocate enough resources to the cooperation
- map the possible unused byproducts of their production process and make use of them
- decrease material and energy usage, and accidents in production as they also bring cost savings
- communicate their sustainability work carefully and educate customers when needed
- be aware of the tools and models offered by literature and see them as one possible option for improving their operations.

6.4 Limitations of the Study

First limitation is related to the literature review. It is always possible that something important has not been noticed and thus, something important and relevant was not considered in the scope of this study. The possibility for this was minimized by iterative process of literature review; the literature was partly completed during and after the interview process.

Next limitation is related to the validity of the study. Validity expresses whether the results of a study truly represent the phenomenon that they are claimed to represent (Carmines & Woods 2005). The semi-structured interviews used in this study are good to offer the respondents the possibility to freely state their opinions on different issues but the loose phrasing of the questions might lead to misinterpretations and the respondents might end up giving answers that are not valid in the context of the study. To avoid misinterpretations, the results were validated at the case companies and at the service provider. They all had the chance to comment on a draft before submitting the final version of this thesis.

Furthermore, the semi-structured interviews affect the reliability of the study. As the questions are not so strictly formulated, the researcher might ask them a little differently each time, thus weakening the reliability of the study. Reliability is understood as the extent to which the same results could be achieved if the research would be repeated (Carmines & Woods 2005). This is especially relevant in this study as the researcher's experience is limited. Additional attention was given to the interview events in order not to weaken the reliability of the study.

Another limitation that relates to the role of the researcher is the subjective interpretation of the interviews. Researcher can never be totally objective and thus, researcher reflects his/her own experiences and assumptions while analyzing interviews. To decrease the effects of subjective analysis, the interviews were systematically analyzed using ATLAS.ti computer program for qualitative analysis. Cooper & Schindler (2003, p. 461) state that systematical analysis improves the validity and reliability of the study.

In addition, the study only covers two cases in the process industry in different sub-segments. This means that only a really narrow view on the situation of sustainability in the Finnish industry could be offered. Some differences in the answers can possibly be explained by the differences between the two sub-segments of process industry. Furthermore, only few employees per studied function were interviewed which might lead to bias as these few interviewees might not represent general views of the case companies.

6.5 Proposals for Future Research

Due to the explorative nature of this thesis, it offers new research possibilities as the issues examined could not be deeply covered. One of the most surprising results was that sustainability is not being evaluated through systematical frameworks, tools and methods. This thesis is not able to answer why and thus, there is a need for further research. It should also be validated that the methods are not widely used, as it might be the case only in these two case companies studied in this thesis.

The actions to enhance sustainability in production and marketing were possible to be researched in the frame of this study but the actions in R&D were not covered well enough. There is a need for further research to find out the R&D related sustainability actions. It can be argued that they most probably exist based on the literature review conducted, and that it is a mere coincidence that the case companies of this study did not employ any systematical actions in R&D.

Also the role of an external service provider seems to have a significant effect on the capability of manufacturing companies' sustainability performance. However, this study has only scratched the surface and there is a need for more research on the role of external service provider in enabling sustainable operations for manufacturing companies. Possible themes could be, for instance, what are the circumstances that enable the birth of beneficial collaboration or how is the external service providers' business opportunities affected by legislation.

On the whole, more studies with similar set-up could be conducted in order to map the same themes in different countries and industries. This would allow for more extensive reasoning about the state of sustainability thinking in companies. It would also allow for the comparison between industries, and thus create new knowledge about differences between industries.

REFERENCES

- Adams, C. a. & Frost, G.R. 2008. Integrating sustainability reporting into management practices. *Accounting Forum*, 32(4), pp. 288–302.
- Alves, T. da C., Tommelein, I. & Ballard, G. 2005. Value stream mapping for make-to-order products in a job shop environment. In: *Construction Research Congress 2005*. San Diego, CA, pp. 1–11.
- Anttonen, M. 2010. Greening from the front to the back door? A typology of chemical and resource management services. *Business Strategy and the Environment*, 19(3), pp. 199–215.
- Anttonen, M., Halme, M., Houtbeckers, E. & Nurkka, J. 2013. The other side of sustainable innovation: Is there a demand for innovative services? *Journal of Cleaner Production*, 45(April 2013), pp. 89–103.
- Atkinson, G. 2000. Measuring corporate sustainability. *Journal of Environmental Planning and management*, 43(2), pp. 235–252.
- Ball, P.D., Evans, S., Levers, A. & Ellison, D. 2009. Zero carbon manufacturing facility - towards integrating material, energy, and waste process flows. In: *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*. pp. 1085–1096.
- Bansal, P. 2002. The corporate challenges of sustainable development. *The Academy of Management Executive*, 16(2), pp. 122–131.
- Bansal, P. & Mcknight, B. 2009. Looking forward, pushing back and peering sideways: Analyzing the sustainability of industrial symbiosis. *Journal of Supply Chain Management*, 45(4), pp. 26–37.
- Bartolomeo, M., Dal Maso, D., De Jong, P., Eder, P., Groenewegen, P., Hopkinson, P., James, P., Nijhuis, L., Örnings, M., Scholl, G., Slob, A. & Zaring, O. 2003. Eco-efficient producer services - What are they, how do they benefit customers and the environment and how likely are they to develop and be extensively utilised? *Journal of Cleaner Production*, 11(8), pp. 829–837.
- Bereketli, I. & Erol Genevois, M. 2013. An integrated QFDE approach for identifying improvement strategies in sustainable product development. *Journal of Cleaner Production*, 54(1 September), pp. 188–198.
- Bhander, G.S., Hauschild, M. & Mcaloon, T. 2003. Implementing Life Cycle Assessment in Product Development. *Environmental Progress*, 22(4), pp. 255–267.
- Brown, H.S., de Jong, M. & Levy, D.L. 2009. Building institutions based on information disclosure: lessons from GRI's sustainability reporting. *Journal of Cleaner Production*, 17(6), pp. 571–580.

- Carmines, E.G. & Woods, J.A. 2005. Validity Assessment. In: Encyclopedia of Social Measurement, 3rd ed., pp. 933–937.
- Chalmeta, R. & Palomero, S. 2010. Methodological proposal for business sustainability management by means of the Balanced Scorecard. *Journal of the Operational Research Society*, 62(7), pp. 1344–1356.
- Chapas, R., Brandt, V., Kulis, L. & Crawford, K. 2010. Sustainability in R&D. *Research-Technology Management*, 53(6), pp. 60–63.
- Chertow, M.R. 2007. “Uncovering” Industrial Symbiosis. *Journal of Industrial Ecology*, 11(1), pp. 11–30.
- Chitturi, R.M., Glew, D.J. & Paulls, A. 2007. Value stream mapping in a jobshop. In: IET International Conference on Agile Manufacturing (ICAM 2007). pp. 142–147.
- Commission on Sustainable Development 2007. Indicators of Sustainable Development: Guidelines and Methodologies. New York. 99 p.
- Cooper, D.R. & Schindler, P.S. 2003. Business research methods. 8th ed., McGraw-Hill. 857 p.
- Costanza, R. & Patten, B. 1995. Defining and predicting sustainability. *Ecological economics*, 15(3), pp. 193–196.
- Dalkey, N. & Helmer, O. 1963. An Experimental Application of the DELPHI Method to the Use of Experts. *Management Science*, 9(3), pp. 458–467.
- Davis, J.J. 1991. A Blueprint for Green Marketing. *The Journal of Business Strategy*, 12(4), pp. 14–17.
- Desrochers, P. 2001. Cities and industrial symbiosis: Some historical perspectives and policy implications. *Journal of Industrial Ecology*, 5(4), pp. 29–44.
- Dias-sardinha, I. & Reijnders, L. 2005. Evaluating Environmental and Social Performance of Large Portuguese Companies: A Balanced Scorecard Approach. *Business Strategy and the Environment*, 14(2), pp. 73–91.
- Dias-sardinha, I., Reijnders, L. & Antunes, P. 2002. From environmental performance evaluation to eco-efficiency and sustainability balanced scorecards. *Environmental Quality Management*, 12(2), pp. 51–64.
- Dias-sardinha, I., Reijnders, L. & Antunes, P. 2007. Developing Sustainability Balanced Scorecards for Environmental Services: A Study of Three Large Portuguese Companies. *Environmental Quality Management*, 16(4), pp. 13–34.
- Dingwerth, K. & Eichinger, M. 2010. Tamed Transparency: How Information Disclosure under the Global Reporting Initiative Fails to Empower. *Global Environmental Politics*, 10(3), pp. 74–96.

- Dufloy, J.R., Seliger, G., Kara, S., Umeda, Y., Ometto, A. & Willems, B. 2008. Efficiency and feasibility of product disassembly: A case-based study. *CIRP Annals - Manufacturing Technology*, 57(2), pp. 583–600.
- Elkington, J. 1994. Towards the suitable corporation: win-win-win business strategies for sustainable development. *California management review*, 36(2), pp. 90–100.
- Elkington, J. 1997. *Cannibals With Forks: The Triple Bottom Line on 21st Century Business*. Oxford, Capstone Publishing Ltd. 416 p.
- Epstein, M. & Roy, M. 2001. Sustainability in action: Identifying and measuring the key performance drivers. *Long range planning*, 34(5), pp. 585–604.
- Epstein, M. & Wisner, P. 2001. Using a balanced scorecard to implement sustainability. *Environmental Quality Management*, 11(2), pp. 1–10.
- Esty, D.C., Levy, M., Srebotnjak, T. & de Sherbinin, A. 2005. 2005 Environmental Sustainability Index. New Haven, Yale Center for Environmental Law & Policy. 414 p.
- Faulkner, W. & Templeton, W. 2012. Visualizing sustainability performance of manufacturing systems using sustainable value stream mapping (Sus-VSM). In: *Proceedings of the 2012 International Conference on Industrial Engineering and Operations Management*. Istanbul, Turkey, pp. 815–824.
- Fearne, A., Martinez, M. & Dent, B. 2012. Dimensions of sustainable value chains: implications for value chain analysis. *Supply Chain Management: An International Journal*, 17(6), pp. 575 – 581.
- Feng, S. & Joung, C. 2009. An overview of a proposed measurement infrastructure for sustainable manufacturing. In: *Proceedings of the 7th Global Conference on Sustainable Manufacturing*. pp. 1–6.
- Figge, F. & Hahn, T. 2004. Sustainable Value Added—measuring corporate contributions to sustainability beyond eco-efficiency. *Ecological Economics*, 48(2), pp. 173 – 187.
- Figge, F., Hahn, T., Schaltegger, S. & Wagner, M. 2001. Sustainability Balanced Scorecard. *Wertorientiertes Nachhaltigkeitsmanagement mit der Balanced Scorecard*.
- Figge, F., Hahn, T., Schaltegger, S. & Wagner, M. 2002a. The sustainability Balanced Scorecard – Theory and Application of a Tool for Value-Based Sustainability Management. *Greening of Industry Network Conference 2002, Gothenburg*, pp. 1–32.
- Figge, F., Hahn, T., Schaltegger, S. & Wagner, M. 2002b. The sustainability balanced scorecard—linking sustainability management to business strategy. *Business strategy and Environment*, 11(5), pp. 269–284.

- Filho & Leal, W. 2000. Dealing with misconceptions on the concept of sustainability. *International Journal of Sustainability in Higher Education*, 1(1), pp. 9–19.
- Fitzsimmons, J. a., Noh, J. & Thies, E. 1998. Purchasing business services. *Journal of Business & Industrial Marketing*, 13(4-5), pp. 370–380.
- Forno, A.J.D., Pereira, F.A., Forcellini, F.A. & Kipper, L.M. 2014. Value Stream Mapping: a study about the problems and challenges found in the literature from the past 15 years about application of Lean tools. *The International Journal of Advanced Manufacturing Technology*, 72(5-8), pp. 779–790.
- Fukushige, S., Yamamoto, K. & Umeda, Y. 2012. Lifecycle scenario design for product end-of-life strategy. *Journal of Remanufacturing*, 2(1), pp. 1–15.
- Fulop, G., Hernadi, B., Jalali, M., Meidute-kavaliauskiene, I. & Ferreira, F. 2014. Developing of Sustainability Balanced Scorecard for the Chemical Industry: Preliminary Evidence from a Case Analysis. *Inzinerine Ekonomika-Engineering Economics*, 25(3), pp. 341–349.
- Global Reporting Initiative 2013. G4 Sustainability Reporting Guidelines. , p. 94. Available at: <https://www.globalreporting.org/resourcelibrary/GRIG4-Part1-Reporting-Principles-and-Standard-Disclosures.pdf> [Accessed February 26, 2015].
- Gordon, R., Carrigan, M. & Hastings, G. 2011. A framework for sustainable marketing. *Marketing Theory*, 11(2), pp. 143–163.
- Graedel, T. 1996. On the concept of industrial ecology. *Annual Review of Energy and the Environment*, 21, pp. 69–98.
- Guidry, R.P. & Patten, D.M. 2010. Market reactions to the first-time issuance of corporate sustainability reports: Evidence that quality matters. *Sustainability Accounting, Management and Policy Journal*, 1(1), pp. 33–50.
- Halldórsson, Á., Kotzab, H. & Skjoett-Larsen, T. 2009. Supply chain management on the crossroad to sustainability: a blessing or a curse? *Logistics Research*, 1(2), pp. 83–94.
- Hamilton, J. 1995. Pollution as news: media and stock market reactions to the toxics release inventory data. *Journal of environmental economics and management*, 28(1), pp. 98–113.
- Hansen, E.G. & Schaltegger, S. 2014. The Sustainability Balanced Scorecard: A Systematic Review of Architectures. *Journal of Business Ethics*, Online(September 2014), pp. 1–29.
- Hart, S.L. & Milstein, M.B. 2003. Creating sustainable value. *Academy of Management Executive*, 17(2), pp. 56–67.
- Hauschild, M., Wenzel, H. & Alting, L. 1999. Life Cycle Design - a Route to the Sustainable Industrial Culture? , 48(1), pp. 393–396.

- Hedberg, C.-J. & von Malmborg, F. 2003. The Global Reporting Initiative and Corporate Sustainability Reporting in Swedish Companies. *Corporate Social Responsibility and Environmental Management*, 10(3), pp. 153–164.
- Henriques, J. & Catarino, J. 2014. Sustainable Value and Cleaner Production - research and application in 19 Portuguese SME. *Journal of Cleaner Production*, In press, pp. 1–8.
- Hertog, P. Den 2000. Knowledge-Intensive Business Services as Co-producers of Innovation. *International Journal of Innovation Management*, 4(4), pp. 491–528.
- Hines, P. & Rich, N. 1997. The seven value stream mapping tools. *International Journal of Operations & Production Management*, 17(1), pp. 46–64.
- Hines, P., Rich, N. & Esain, A. 1999. Value stream mapping: a distribution industry application. *Benchmarking: An International Journal*, 6(1), pp. 60–77.
- Hsu, C.-W., Hu, A.H., Chiou, C.-Y. & Chen, T.-C. 2011. Using the FDM and ANP to construct a sustainability balanced scorecard for the semiconductor industry. *Expert Systems with Applications*, 38(10), pp. 12891–12899.
- Hsu, Y.-L. & Liu, C.-C. 2010. Environmental performance evaluation and strategy management using balanced scorecard. *Environmental monitoring and assessment*, 170(1-4), pp. 599–607.
- Hubbard, G. 2009. Measuring organizational performance: beyond the triple bottom line. *Business Strategy and the Environment*, 18(3), pp. 177–191.
- Hussey, D.M., Kirsop, P.L. & Meissen, R.E. 2001. Global Reporting Initiative Guidelines: An Evaluation of Sustainable Development Metrics for Industry. *Environmental Quality Management*, 11(1), pp. 1–20.
- Isaksson, R. & Steimle, U. 2009. What does GRI-reporting tell us about corporate sustainability? *The TQM Journal*, 21(2), pp. 168–181.
- Jaggi, B. & Freedman, M. 1992. An examination of the impact of pollution performance on economic and market performance: pulp and paper firms. *Journal of Business Finance & Accounting*, 19(5), pp. 697–713.
- Kaplan, R. & Norton, D. 1992. The balanced scorecard: measures that drive performance. *Harvard business review*, Jan-Feb, pp. 172–180.
- Kaplan, R.S. & Norton, D.P. 1996a. *The Balanced Scorecard: Translating Strategy into Action*. Boston, Massachusetts, Harvard Business Review Press. 322 p.
- Kaplan, R.S. & Norton, D.P. 1996b. Using the balanced scorecard as a strategic management system. *Harvard business review*, (January-February), pp. 75–86.
- Karjalainen, S. 2014. End-of-Life Strategies for Sustainable Business - A Literature Review. 34 p.

- Khanna, M., Quimio, W. & Bojilova, D. 1998. Toxics release information: a policy tool for environmental protection. *Journal of Environmental Economics and Management*, 36(3), pp. 243–266.
- Khaswala, Z. & Irani, S. 2001. Value network mapping (VNM): visualization and analysis of multiple flows in value stream maps. *Proceedings of the Lean Management Solutions Conference*, pp. 1–18.
- Klassen, R. & McLaughlin, C. 1996. The impact of environmental management on firm performance. *Management science*, 42(8), pp. 1199–1214.
- Konar, S. & Cohen, M. 1997. Information as regulation: the effect of community right to know laws on toxic emissions. *Journal of environmental Economics and Mana*, 32(1), pp. 109–124.
- Konar, S. & Cohen, M. 2001. Does the market value environmental performance? *Review of economics and statistics*, 83(2), pp. 281–289.
- Korhonen, J. 2004. Industrial ecology in the strategic sustainable development model: Strategic applications of industrial ecology. *Journal of Cleaner Production*, 12(8-10), pp. 809–823.
- Lowe, E. a. & Evans, L.K. 1995. Industrial ecology and industrial ecosystems. *Journal of Cleaner Production*, 3(1-2), pp. 47–53.
- Lovelle, J. 2001. Mapping the value stream. *Institute of Industrial Engineers (IIE) solutions*, 33(2), pp. 26–33.
- Lovins, A., Lovins, L. & Hawken, P. 1999. A road map for natural capitalism. *Harvard business review*, pp. 145–159.
- Lämsiluoto, A. & Järvenpää, M. 2008. Environmental and performance management forces. *Qualitative Research in Accounting & Management*, 5(3), pp. 184–206.
- Lämsiluoto, A. & Järvenpää, M. 2010. Greening the balanced scorecard. *Business Horizons*, 53(4), pp. 385–395.
- Lämsiluoto, A. & Järvenpää, M. 2012. Integrating greenness into a balanced scorecard in a food processing company. *The TQM Journal*, 24(5), pp. 388–398.
- Mahapatra, S. 1984. Investor reaction to a corporate social accounting. *Journal of Business Finance & Accounting*, 11(1), pp. 29–40.
- Nidumolu, R., Prahalad, C.K. & Rangaswami, M.R. 2009. Why sustainability is now the key driver of innovation. *Harvard business review*, pp. 56–64.
- Nikolaou, I.E. & Tsalis, T. a. 2013. Development of a sustainable balanced scorecard framework. *Ecological Indicators*, 34(November 2013), pp. 76–86.

- Oates, C., McDonald, S., Alevizou, P., Hwang, K., Young, W. & McMorland, L. 2008. Marketing sustainability: Use of information sources and degrees of voluntary simplicity. *Journal of Marketing Communications*, 14(5), pp. 351–365.
- Oxford Dictionaries 2014. Oxford Dictionaries. Available at: http://www.oxforddictionaries.com/definition/english/sustainable?q=sustainability#sustainable__7.
- Pagell, M. & Wu, Z. 2009. Building a more complete theory of sustainable supply chain management using case studies of 10 exemplars. *Journal of Supply Chain Management*, 45(2), pp. 37–56.
- Paju, M., Heilala, J., Hentula, M., Heikkilä, A., Johansson, B., Leong, S. & Lyons, K. 2010. Framework and indicators for a sustainable manufacturing mapping methodology. In: *Proceedings of the 2010 Winter Simulation Conference*. pp. 3411–3422.
- Papadopoulos, I., Karagouni, G., Trigkas, M. & Platogianni, E. 2010. Green marketing: The case of Greece in certified and sustainably managed timber products. *EuroMed Journal of Business*, 5(2), pp. 166–190.
- Paulraj, A. 2011. Understanding the Relationships Between Internal Resources and Capabilities, Sustainable Supply Management and Organizational Sustainability. *Journal of Supply Chain Management*, 47(1), pp. 19–37.
- Peattie, K. 1999. Trappings versus substance in the greening of marketing planning. *Journal of Strategic Marketing*, 7(2), pp. 131–148.
- Peattie, K.J. & Crane, A. 2005. Green marketing: legend, myth, farce or prophecy? *Qualitative Market Research: An International Journal*, 8(4), pp. 357–370.
- Polonsky, M.J. & Rosenberger, P.J. 2001. Reevaluating green marketing: A strategic approach. *Business Horizons*, 44(5), pp. 21–30.
- Porter, M. & Kramer, M. 2011. Creating shared value. *Harvard business review*, (January 2011), pp. 1–13.
- Pujari, D. 2006. Eco-innovation and new product development: Understanding the influences on market performance. *Technovation*, 26(1), pp. 76–85.
- Pujari, D., Wright, G. & Peattie, K. 2003. Green and competitive influences on environmental new product development performance. *Journal of Business Research*, 56(8), pp. 657–671.
- Rose, C.M. & Ishii, K. 1999. Product End-of-Life Strategy Categorization Design Tool. *Journal of Electronics Manufacturing*, 9(1), pp. 41–51.
- Rose, C.M., Stevels, A. & Ishii, K. 2002. Method for Formulating Product End-of-Life Strategies for Electronics Industry. *Journal of Electronics Manufacturing*, 11(2), pp. 185–196.

- Saaty, T.L. 2001. Analytic network process. *Encyclopedia of Operations Research and Management Science*, pp. 28–35.
- Saunders, M., Lewis, P. & Thornhill, A. 2009. *Research methods for business students*, 5/e. 5th ed, Harlow, Pearson Education Limited. 614 p.
- Searcy, C. 2012. Corporate Sustainability Performance Measurement Systems: A Review and Research Agenda. *Journal of Business Ethics*, 107(3), pp. 239–253.
- Seuring, S. & Müller, M. 2008. Core Issues in Sustainable Supply Chain Management – a Delphi Study. *Business Strategy and the Environment*, 17(8), pp. 455–466.
- Singh, B., Garg, S.K. & Sharma, S.K. 2011. Value stream mapping: literature review and implications for Indian industry. *The International Journal of Advanced Manufacturing Technology*, 53(5-8), pp. 799–809.
- Singh, R.K., Murty, H.R., Gupta, S.K. & Dikshit, a. K. 2009. An overview of sustainability assessment methodologies. *Ecological Indicators*, 9(2), pp. 189–212.
- Slaper, T. & Hall, T. 2011. The triple bottom line: what is it and how does it work? *Indiana Business Review*, 86(1), pp. 4–8.
- Solding, P. & Gullander, P. 2009. Concepts for simulation based Value Stream Mapping. *Proceedings of the 2009 Winter Simulation Conference (WSC)*, pp. 2231–2237.
- Srivastava, S.K. 2007. Green supply-chain management: A state-of-the-art literature review. *International Journal of Management Reviews*, 9(1), pp. 53–80.
- Stevenson, W.J. 2010. *Operations Management*. 10th ed., New York, McGraw-Hill/Irwin. 906 p.
- Tervonen, N., Hannola, L. & Ojanen, V. 2014. How to be green? Specifying the value of sustainable business. In: *Proceedings of the ISPIM Asia-Pacific Innovation Forum*. pp. 1–14.
- Thitz, O. 2013. The development potential of waste management companies' service business. Master's Thesis.
- Torres, A.S.J. & Gati, A.M. 2009. Environmental Value Stream Mapping (EVSM) as Sustainability Management Tool. In: *PICMET 2009 Proceedings*. Portland, Oregon USA, pp. 1689–1698.
- Ueda, K., Takenaka, T., Vánca, J. & Monostori, L. 2009. Value creation and decision-making in sustainable society. *CIRP Annals - Manufacturing Technology*, 58(2), pp. 681–700.
- Vachon, S. & Klassen, R.D. 2006. Extending green practices across the supply chain: The impact of upstream and downstream integration. *International Journal of Operations & Production Management*, 26(7), pp. 795–821.

- Veleva, V. & Ellenbecker, M. 2001. Indicators of sustainable production: framework and methodology. *Journal of Cleaner Production*, 9(5), pp. 519–549.
- Veleva, V., Hart, M., Greiner, T. & Crumbley, C. 2001. Indicators of sustainable production. *Journal of Cleaner Production*, 9(5), pp. 447–452.
- Wheeler, W. a. 1992. The revival in reverse manufacturing. *Journal of Business Strategy*, 13(4), pp. 8–13.
- White, P. 2009. Building a sustainability strategy into the business. *Corporate Governance*, 9(4), pp. 386 – 394.
- Vinodh, S., Arvind, K.R. & Somanaathan, M. 2011. Tools and techniques for enabling sustainability through lean initiatives. *Clean Technologies and Environmental Policy*, 13(3), pp. 469–479.
- Wolf, J. 2011. Sustainable Supply Chain Management Integration: A Qualitative Analysis of the German Manufacturing Industry. *Journal of Business Ethics*, 102(2), pp. 221–235.
- World Commission on Environment and Development 1987. *Our Common Future*. Oxford, Oxford University Press.
- Yin, R.K. 2009. *Case Study Research: Design and Methods*. 4th ed., Thousand Oaks, California, SAGE Publications, Inc. 219 p.
- Zhu, Q., Sarkis, J. & Lai, K. 2012. Examining the effects of green supply chain management practices and their mediations on performance improvements. *International Journal of Production Research*, 50(5), pp. 1377–1394.
- Ziout, A., Azab, A. & Atwan, M. 2014. A holistic approach for decision on selection of end-of-life products recovery options. *Journal of Cleaner Production*, 65(February), pp. 497–516.

Appendix A: The interview outline (in Finnish)

Haastattelurunko

Kestävyyden arvon muodostuminen teollisissa prosesseissa

0. Aloitus ja tutkimuksen esittely
 - Mikä on nimenne?
 - StraSus (Strategic business models and governance for sustainable solutions)
 - Tavoitteet (Auttaa yrityksiä löytämään keinoja parantaa ja tehostaa liiketoimintaansa)
 - Tausta (VTT, Aalto, LUT, TUT ja Fortum, Nokia, Solita, Vapo sekä Ekokem)
 - Vastausten käsittely, julkaisumuoto, tulosaineiston tarkastaminen ennen julkaisua
(täysi luottamuksellisuus, dippa ja konffapaperi, kommenttikierros ennen julkaisua)
 - Missä muodossa tutkimuksen tulokset on käytettävissä
 - o case-kohtaiset erillisenä purkutilaisuutena yrityksen sisäisesti
 - o kokonaisuudessaan valmiina diplomityönä ja mahdollisesti konferenssiartikkelina
 - Haastateltavan omat odotukset tutkimukselle
 - Motivointi, mitä hyötyä tutkimuksesta tulee olemaan
(saattaa löytyä uusia tapoja edistää kestävää kehitystä taloudellisesti kannattavalla tavalla ja oppia muilta haastateltavilta toimintatapoja)
 - Tämän jälkeen nauhuri päälle (jäljitettävyyks, eikä hukata aikaa)
1. Taustoittavat kysymykset
 - Henkilö:
 - o Titteli
 - o Mikä on toimenkuvanne ja toiminto/prosessi, jossa työskentelette?
 - o Koulutustausta ja työkokemus (tässä firmassa ja yleensä)
 - Firma:
 - o Ketkä ovat yrityksen asiakkaita (teollisuudenalat)? (ei kysytä, jos selviää muuten)
 - o Teettekö ympäristö-/vastuullisuusraporteja? (ei kysytä, jos löytyy netistä)
 - o Minkälaista jätettä ja hukkaa toiminnassanne muodostuu?
2. Toimintaympäristö
 - Minkälainen on toimiala ja toimintaympäristö, jossa yrityksenne toimii ja minkälainen on sen nykytilanne?
 - Tulevaisuus?
 - o Muutostekijät, jotka vaikuttavat tässä toimintaympäristössä
 - o Kasvaa, kuihtuu?
 - o Trendit? (Kaupungistuminen, väestön ikääntyminen jne.)
 - o Miten kestävä kehitys/tiukkenevat säännöt vaikuttavat toimintaympäristöön ja toimialaan?

3. Kestävyys ja kestävä kehitys

- Mitä mielestänne tarkoittaa kestävyys ja kestävä kehitys?
 - o Teille itsellenne?
 - o Firmalle virallisesti?
 - o Käytännössä?
- Mitkä ovat mielestänne kestävä kehityksen päämäärät?
- Mihin yrityksenne tarvitsee kestävä toimintaa ja kestävä kehitystä?
- Miten yrityksenne huomioi kestävyden ja kestävä kehityksen toiminnassaan?
 - o Missä toiminnoissa?
 - o Miten se näkyy ja toteutetaan?
- Onko yrityksessänne käytössä menetelmiä/työkaluja joilla varmistetaan kestävyden ja kestävä kehityksen toteutuminen? Käytättekö työkaluja/viitekehyksiä/strategiaa:
 - o Millaisia? (esim. VSM tai BSC)
 - o Koetteko hyödyllisiksi?
 - o Jos kyllä, niin mikä on niistä saatava hyöty? Miten ne auttavat jäsentämään/ymmärtämään/arvioimaan kestävä kehityksen mukaista toimintaa?
- Miten prosessi, jossa itse olette mukana, toteuttaa kestävyden periaatetta?
 - o Käydään läpi esimerkitapaus toiminnasta (esim. R&D:ssä tuotekehitysprosessi alusta loppuun; myynnissä myyntiprosessi; tuotannossa vaikka tietyn tuotteen kulku läpi valmistusprosessin) ja keskustellaan miten prosessissa voidaan tunnistaa kestävyden periaate
 - Kriittiset kohdat, joissa kestävyys on mukana ko. toiminnossa/prosessissa
 - Miten haitat vältetään tai hyödyt varmistetaan?
 - Miten ympäristöllinen tai sosiaalinen hyöty/haitta syntyy?
 - o Mitkä ovat konkreettiset toimet, joilla kestävyttä toteutetaan?
 - o Mihin tarvitaan ulkopuolisia palveluntarjoajia?
- Mikä saa yrityksenne ajattelemaan kestävyttä ja toimimaan vastuullisesti?
 - o Lainsäädäntö?
 - o Oma tahto?
 - o Taloudellinen hyöty?
 - o Asiakkaan vaatimus?
- Mihin kestävä kehityksellä tulisi yrityksessänne mielestänne pyrkiä lähitulevaisuudessa?
 - o Mahdolliset saavutettavat hyödyt?
 - o Uhat ja mitä kysymyksiä tavoitteeseen liittyy?
 - o Miten toimintaa voitaisiin kehittää konkreettisesti?
 - o Pystyttekö tunnistamaan prosesseja, prosessinosia, joissa voitaisiin toimia vastuullisemmin?
 - o Materiaalivirtoja tai jätettä, joita ei käsitellä/hyödynnetä?
 - o Oman työnnö/toimintonne näkökulmasta?
- Entä pitkällä aikavälillä?
 - o Mahdolliset saavutettavat hyödyt?
 - o Uhat ja mitä kysymyksiä tavoitteeseen liittyy?
 - o Miten toimintaa voitaisiin kehittää konkreettisesti?

- Pystytekö tunnistamaan prosesseja, prosessinosa, joissa voitaisiin toimia vastuullisemmin?
- Materiaalivirtoja, joita ei käsitellä?
- Oman työnne/toimintonne näkökulmasta?

4. Kestävyyden arvon muodostuminen

- Mitä hyötyä kestävästä toiminnasta/kehityksestä on ollut:
 - Yrityksellenne?
 - Ympäristölle?
 - Työyhteisölle?
 - Asiakkaille?
 - Muille sidosryhmille?
 - Mitä haittoja?
- Miten kestävyiden arvo tunnustetaan?
 - Onko käytössä toistuvia strukturoituja menetelmiä tai työkaluja?
 - Mihin huomio kiinnitetään näillä menetelmillä?
 - Miten arvo määritellään?
 - Mistä tekijöistä kestävyiden arvo muodostuu?
- Miksi kestävyiden ja kestävä kehityksen mukainen toiminta on yrityksellenne arvokasta?
 - Miten kestävyys/kestävä kehitys muuntuu kilpailueduksi?
- Voiko yksittäinen yritys olla kestävä vai tarvitaanko verkostoajattelua?

5. Ulkopuolisten palveluntarjoajien rooli

- Mikä on ulkopuolisten toimittajien/palveluntarjoajien tilanne/osuus/osallistuminen kestävyiden periaatteen mukaisessa toiminnassa tällä hetkellä?
 - Tiivistä yhteistyötä vai arm's length?
 - Koettu hyöty?
- Onko ulkopuolis(t)en palveluntarjoajan/-tarjoajien toiminta ollut sitä mitä luvattiin/odotettiin?
- Miten näette ulkopuolisen palveluntarjoajien roolin kestävä kehityksen edistäjänä tulevaisuudessa?
 - Millä osa-alueella?
 - Tarvitaanko lisää, vähemmän?
 - Neuvonantaja, asiantuntija, kokonaisratkaisuja, halutaanko itse osallistua mitenkään (kaikki vastuu palveluntarjoajalla) vai tarvitaanko ollenkaan?
- Miten toimintaa/yhteistyötä voisi jatkossa konkreettisesti kehittää?
 - Miten hyötyjä voitaisiin jakaa?
 - Miten tavoitteet tulisi määritellä?

6. Lopettelevat

- Lisättävää?
- Muut haastateltavat? (tarvittaessa)
- Sopivia havainnoinnin kohteita? (tarvittaessa)
- Kommentteja haastatteluun yleisesti?