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THE PAST, PRESENT AND FUTURE OF ENVIRONMENTAL REPORTING IN THE FINNISH FOREST INDUSTRY

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To my children, Mea and Peetu
- Aim high!

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ABSTRACT

Companies are surrounded by stakeholders who are interested in the companies' environmental performance. One way to answer the stakeholders' demands for greener production is to publish environmental reports. Environmental reports are companies' public statements of their past, present and future environmental performance. In Finland, the forest industry companies have been among the first companies to start to publish their environmental data. However, currently the Finnish forest industry needs a major change in order to survive in the changing operating environment. The demand for their traditional products – pulp, paper and board – is decreasing, and replacement products are being invented.

The current thesis is in the fields of futures research and environmental management. The aim of futures research is to systematically collect and present knowledge about the alternative futures. This approach is used in the thesis to answer the research question of 'How should the environmental reports of the Finnish forest industry be developed in order to give the reader a comprehensive description of the environmental aspects and impacts that their processes and operations are causing?'

The concept of alternative futures means that in the present moment we have multiple possible future states we could pursue. Some of these futures are preferable to others. The alternative futures concept is applied in the current research to create futures images. Futures images are mental tools to describe the possible future stages of a phenomenon. The phenomenon in question here is environmental reporting in the Finnish forest industry.

Three research methods were used to answer the research question. Qualitative content analysis is applied to 10–15 years of environmental reports published by the three biggest Finnish forest industry companies – Stora Enso, UPM-Kymmene and Metsä Board. Theme interviews were conducted among the experts of environmental management and forest industry. A three-round Delphi panel was organised on the topic of environmental measurement and reporting in the Finnish forest industry.

The results showed that the forest industry has a long tradition in environmental management. This means that they have been able to decrease the environmental impacts during the past decades. However, the development pace seems to be currently decreasing. The forest industry is good at measuring the environmental aspects of their own production. Forest industry companies have a long tradition in using different environmental management tools, one of which is environmental reporting.

Furthermore, this study showed that the environmental reports contain a lot of environmental information. Companies typically report on energy usage and production, and on the air and water emissions produced.

Besides the success factors, this research showed that the environmental reporting practices require further improvements. Two areas in particular need improvement. First, instead of focusing mainly on environmental aspects, the reporting should also cover the variety of environmental impacts caused by the operations. Second, as currently the reporting focuses on the actions and processes inside forest industry mills, more attention should be paid to the processes happening in the production chain before and after the mills.

In the thesis, the results are converted into four futures images. In the futures images, the role of the forest industry varies from a minor player to a significant operator. Similarly, the content of environmental reporting differs from non-reporting to mandatory and high-quality reporting. The first image is titled 'End of the Forest Industry', where literally, the role of the industry has diminished due to digitalisation and climate change mitigation. Therefore, the environmental reporting has also been reduced, as the industry does not cause significant environmental impacts anymore. The second image is called 'Strong Sustainability Focus'. The key driver of this image is the tight sustainability regulations, which require sustainability (including environmental) improvements from companies. One of these requirements is environmental reporting. The third image ('Survival of the Forest Giant') is the business-as-usual scenario where the industry produces the current products but has also been able to develop a set of new products. In relation to environmental reporting, the current trend prevails, which means that the amount of environmental information is decreasing. The fourth and last futures image is named 'Renewal of the Industry' and is where the operations are considered from the point of view of the circular economy. The industry operates with a new set of products. In addition, it has developed the reporting to high-quality and real-time reporting.

In order for the environmental reports to give a more comprehensive description of the environmental aspects and impacts that the industry is causing, the reporting should be developed towards the high-quality reporting of the fourth futures image. Here, 'high-quality' means that both environmental aspects and impacts are reported. The reporting covers the lifecycle and supply chain perspective.

KEYWORDS: environmental reporting, Finnish forest industry, futures research, futures images, qualitative research

TURUN YLIOPISTO
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MARILEENA MÄKELÄ: Suomalaisen metsäteollisuuden ympäristörapor-
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TIIVISTELMÄ

Yritykset toimivat sidosryhmien ympäröiminä. Sidosryhmät haluavat tietoa yritys-
ten toiminnasta. Tähän tietotarpeeseen yritykset voivat vastata esimerkiksi julkaise-
malla ympäristöraportteja, jotka ovat yritysten julkisia kuvauksia menneistä, nykyi-
sistä ja tulevista ympäristötoimista. Suomessa metsäteollisuuden yritykset julkaisi-
vat ensimmäisten joukossa tietoja ympäristötoiminnastaan. Tällä hetkellä metsäteol-
lisuus on murros- ja muutostilanteessa, jossa perinteisten tuotteiden (kuten massan,
paperin ja pahvin) kysyntä on laskemassa ja korvaavia tuotteita kehitellään.

Tämä väitöskirja kuuluu tulevaisuudentutkimuksen ja yritysten ympäristöjohta-
misen tieteenaloille. Tulevaisuudentutkimuksen tavoitteena on järjestelmällisesti ke-
rätä ja esittää tietoa vaihtoehtoisista tulevaisuuksista. Tätä näkökulmaa käytetään
tässä väitöstutkimuksessa vastaamaan seuraavaan tutkimuskysymykseen: "Kuinka
Suomen metsäteollisuuden ympäristöraportteja pitäisi kehittää, jotta ne antavat kat-
tavan kuvan toimintaan liittyvistä ympäristönäkökohdista ja toiminnasta aiheutu-
vista ympäristövaikutuksista?"

Tulevaisuuden tutkimuksen näkökulmasta tämän tutkimuksen kaksi keskeistä
käsitettä ovat vaihtoehtoiset tulevaisuudet sekä tulevaisuuskuvat. Vaihtoehtoisilla
tulevaisuuksilla tarkoitetaan sitä, että nykyhetkestä tulevaisuuteen katsottuna meillä
on useita mahdollisia tulevaisuuksia edessämme. Osa näistä on toivottavampia kuin
toiset. Vaihtoehtoisten tulevaisuuksien käsitettä havainnollistaan tässä tutkimuk-
sessa luomalla tulevaisuuskuvia metsäteollisuuden ympäristöraportoinnista. Tule-
vaisuuskuva tarkoittaa mentaalista mallia, joka havainnollistaa tulevaisuutta.

Ympäristöjohtamisen osalta tutkimuksen keskeisin käsite on ympäristöraportti.
Sillä tarkoitetaan yrityksen tekemää kuvausta ympäristötoimintansa menneisyy-
destä, nykyisyydestä ja tulevaisuudesta.

Väitöstutkimuksessa käytettiin kolmea tutkimusmenetelmää. Laadullisella sisäl-
lönanalyysillä tutkittiin kolmen suurimman suomalaisen metsäteollisuusyrityksen,
Stora Enson, UPM-Kymmenen ja Metsä Boardin, ympäristöraportteja 10–15 vuoden
ajalta. Teemahaastatteluilla hankittiin tietoa ympäristöjohtamisen ja metsäteollisuu-
den asiantuntijoilta. Kolmikierroksisella Delfoi-paneelilla kerättiin tietoa ympäris-
tönäkökohtien ja ympäristövaikutusten mittaamisesta ja raportoinnista suomalai-
sessa metsäteollisuudessa.

Tutkimuksen tulokset osoittivat, että metsäteollisuudella on pitkä historia ympäristöjohtamisessa ja -raportoinnissa, mikä näkyy onnistuneena työnä ympäristövaikutusten pienentämisessä. Tällä hetkellä kuitenkin näyttää, että esimerkiksi ilma- ja vesistöpäästöjen vähentämisnopeus on hidastunut. Lisäksi tutkimus osoitti, että metsäteollisuusyritykset ovat hyviä mittaamaan omaan toimintaansa liittyviä ympäristönäkökohtia. Samoin yritykset ovat hyödyntäneet toiminnassaan monia ympäristöjohtamisen työkaluja, joista yksi on ympäristöraportointi. Näitä raportteja yritykset ovat julkaisseet jo 1990-luvulta lähtien, ja raporteissa onkin paljon tietoa yritysten ympäristönäkökohdista. Erityisesti yritykset julkaisevat energian käyttöön ja tuotantoon liittyviä tunnuslukuja sekä tuotettujen vesi- ja ilmapäästöjen määriä.

Tunnistettujen vahvuuksien lisäksi tutkimus osoitti, että ympäristöraportoinnissa on vielä kehittämisen varaa. Erityisesti nousee esille kaksi seikkaa. Ympäristövaikutusten raportointia pitäisi kehittää nykyisen ympäristönäkökohtien raportoinnin sijasta. Toinen kehittämiskohde on elinkaarinäkökulman tuominen raportointiin. Tällä hetkellä raportointi keskittyy erityisesti omien tehtaiden toiminnan raportointiin. Tehtaiden toiminnan ohella pitäisi raportoida myös ympäristönäkökohdista ja -vaikutuksista ennen omia tehtaita ja niiden jälkeen.

Työn lopussa tulokset esitetään tulevaisuuskuvina. Näissä kuvissa metsäteollisuuden rooli Suomen taloudessa vaihtelee pienestä tekijästä keskeiseen toimijaan, ja tästä syystä myös ympäristöraportoinnin taso vaihtelee. Ensimmäinen tulevaisuuskuva on nimetty "Metsäteollisuuden lopuksi". Tässä kuvassa ala on näivettynyt digitalisaation ja ilmastonmuutoksen estämisen vuoksi. Koska ala ei aiheuta enää merkittäviä ympäristövaikutuksia, sen ei ole myöskään tarpeen raportoida niistä. Toinen kuva nimettiin "Vahvaksi vastuullisuudeksi", jonka keskeinen muutostekijä on tiukka vastuullisuuslainsäädäntö. Lainsäädäntö ohjaa yritysten vastuullisuustyötä ja samoin myös vastuullisuusraportointia. Kolmas tulevaisuuskuva "Metsäjätin pelastuminen" kuvaa nykytilanteen jatkumoa tulevaisuudessa. Metsäteollisuus on onnistunut kehittämään uusia tuotteita nykyisten tuotteiden rinnalle. Ympäristöraportointi jatkaa nykyistä linjaa, eli ympäristöasioista raportointi vähenee. Neljäs ja viimeinen kuva on nimeltään "Teollisuuden uudistuminen". Tässä metsäteollisuuden koko toiminta on mietitty uusiksi kiertotalouden näkökulmasta ja toiminta nojaa vahvasti uusiin tuotteisiin. Myös ympäristöraportointi on korkeatasoista ja reaaliaikaista.

Jatkossa ympäristöraportteja olisi hyvä kehittää niin, että ne paremmin kuvaisivat metsäteollisuusyritysten toiminnan ympäristönäkökohtia ja -vaikutuksia. Parhaiten tähän päästään noudattamalla viimeisen tulevaisuuskuvan korkealaatuista raportointia. Korkea laatu tässä yhteydessä tarkoittaa, että toiminnasta ei pelkästään raportoida ympäristönäkökohtia vaan myös aiheutettuja ympäristövaikutuksia. Raportoinnissa ei keskitytä vain yrityksen omien tehtaiden ympäristöasioihin, vaan raportoidaan myös elinkaaren mukaisesti toiminnasta ennen ja jälkeen tehtaita.

ASIASANAT: ympäristöraportointi, metsäteollisuus, tulevaisuudentutkimus, tulevaisuuskuvat, laadullinen tutkimus

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Table of contents

Tables

Figures

List of original publications

This dissertation is based on the following original publications, which are referred to in the text by their Roman numerals:

I   Koskela, M. – Vehmas, J. Defining eco-efficiency: Case study on the Finnish forest industry. *Business Strategy and the Environment*, 2012; Vol. 21 (8): 546–566.

II   Mäkelä, M. Environmental impacts and aspects in the forest industry: What kind of picture do corporate environmental reports provide? *Forest Policy and Economics*, 2017; Vol. 80: 178–191.

III   Mäkelä, M. Trends in environmental performance indicator reporting in the Finnish forest industry. *Journal of Cleaner Production*, 2017; Vol. 142: 1333–1346.

IV   Koskela, M. Expert views on environmental impacts and their measurement in the forest industry. *Journal of Cleaner Production*, 2011; Vol. 19: 1365–1376.

V   Koskela, M. Future of environmental reporting in the Finnish forest industry. *European Journal of Futures Research*, Supplement, 2014; 01/2014.

1 Introduction

1.1 Linking environmental reports, the Finnish forest industry and futures research

"Finland lives from the forests, is in the forest and is the forest." (Kuisma 2006, 19)

Finland is a land of forests, as the quotation above illustrates. About 70 per cent of the land surface is covered with forests (Finnish Forest Research Institute 2013). The forest industry therefore has a long tradition in Finland. The first forest-based export item was tar, and in fact, Finland was the most important exporter of tar in the world (Kuisma 2006). The sawmills slowly started to develop from the seventeenth century onwards, and in the 1830s sawmill products replaced tar as the number one export item. Paper-making technology developed from the 1800s onwards, and in the 1870s the first wood-using paper machines were installed in Finland. The value of paper products exceeded the value of sawmill products in 1913. (Kuisma 2006.)

There is a saying in Finnish that 'the country has a wooden leg', which refers to the major role of the forest industry as a pillar of the economy. The industry has been a major player in the economy in the past, but still today (in 2016), forestry accounts for about 15 per cent of industrial employees, about 20 per cent of the value of industrial production and about 20 per cent of exports (FFIF 2019). Due to the high production volumes, the environmental impacts caused by the industry are significant. Industries with significant environmental impacts can be expected to report on environmental issues.

This thesis studies the environmental reporting in the Finnish forest industry using a futures research approach. Companies publish environmental reports to inform their stakeholders of their environmental performance. Forest industry companies have been among the first companies in Finland to publish these reports. Currently, the industry is in need of a change due to the low demand for their products in certain markets. In particular, the demand for paper products has been decreasing in Europe (Donner-Amnell et al. 2011; Lindholm 2011). Low demand, together with over-capacity and low prices, has caused significant problems for the forest industry companies (Donner-Amnell et al. 2011). A futures research approach is used here to offer

insights into developing the environmental reporting in order for the reports to better describe the different environmental impacts caused by the companies.

Companies are surrounded by stakeholders that are, by definition, influenced by the companies or influencing the companies (Freeman 1984). These stakeholders can have various types of stakes in the companies (Näsi 1995). The literature has identified, for example, governments, NGOs, customers and the general public as stakeholders that demand environmental actions from companies (e.g., Delmas & Toffel 2004; Sprengel & Busch 2011). Often the stakeholders demand information from a company. One way to receive this information is to take a look at the different publications from the companies, and these include the environmental reports.

The forest industry in Finland is an interesting case from the point of view of stakeholders. In general, the industry has enjoyed high legitimacy in the country for long time (Donner-Amnell & Rytteri 2010). This view is also supported by a media analysis by Takala et al. (2019; 2020) that discovered a consensus-based view with a dominance on wood production discourse. However, different stakeholders at different times have raised the discussion of different sustainability issues. In the beginning of the industrial forest industry, for years, the main sustainability concern related to the working conditions of employees, while the state focused on the improvement of the financial environment for the industry (Donner-Amnell & Rytteri 2010). From 1960s, the stakeholders, such as the environmental NGOs, started to question the environmental practices of the industry, and authorities set stricter emission requirements (Donner-Amnell & Rytteri 2010). The same is visible in the media analysis. Takala et al. (2019) conclude that there has been a conflict between the economic targets and social-environmental targets. However, often in the media, the forest industry has been presented as capable to solve the conflicts with effective environmental and sustainability management (Takala et al. 2019). According to Donner-Amnell and Rytteri (2010), only the demands from international customers in the 1990s made the forest industry really pay attention to emission reductions and biodiversity. Consequently, at this time the industry started to publish environmental reports.

Environmental reports are voluntary public reports that companies publish (see Section 3.1 for more definitions). The content of the reports varies between companies, but they often contain information about companies' past environmental performance together with the future environmental targets. Although companies publish the reports in order to inform their stakeholders of their environmental performance, previous studies have noted that the reports do not really meet the stakeholders' demands for adequate environmental information.

As the forest industry is a member of heavy industry with high production volumes, their operations cause extensive environmental impacts, making this industry

an interesting example for the study of environmental reporting practices. The environmental regulations require the monitoring of the environmental aspects of companies that cause significant environmental impacts. In addition, many environmental aspects are related to costs. For example, the less wastewater is produced, the less water needs to be cleaned, which equals a lower cost. For these reasons, the forest industry surely has data to include in the environmental reports. The Finnish forest industry has actually been rather open in publishing the data. The industry's lobbying organisation, the Finnish Forest Industries Federation (FFIF), has collectively published environmental data on the member companies starting in the early 1990s. Similarly, the companies themselves started to publish public environmental reports at the same time. In other words, the industry has a long tradition of collecting and publishing its environmental data.

Today, the forest industry is facing a significant change, as it needs a line of new products, at least to add to its offerings of traditional products, such as paper, pulp, board and saw products. Especially, the demand for paper is decreasing due to the use of digital applications – for example, newspaper subscriptions are reduced with the increased availability of online news. Thus, the industry needs to come up with new products. The Finnish forest industry seems to view the future rather positively, as it trusts in the boom of the bioeconomy concept (see Section 2.6).

The current research is from the field of futures research. The research context is an old industrial sector, and the current need for radical change makes this topic very valid from the point of view of futures research. Futures research means to gather, critically analyse, creatively synthesise and systematically present knowledge about the futures (Rubin 2004). The forest industry needs to critically analyse the operating environment and creatively think about the futures and the possible products that it will be able to produce in order to succeed. At the same time, the change gives the industry an opportunity to innovate in terms of environmental reporting. Indeed, they have been the first to publish the data, but now there is a need for a new type of reporting.

1.2   Objectives of the study

This doctoral thesis studies the environmental reporting practices of the Finnish forest industry. The past, present and future environmental reporting practices are analysed. The aim of the thesis is to produce new knowledge about environmental reporting in the Finnish forest industry in order to enable the improvement of future reporting practices.

The main research question of this doctoral thesis is:

- How should the environmental reports of the Finnish forest industry be developed in order to give the reader a more comprehensive description of the

environmental aspects and impacts that their processes and operations are causing?

An answer to the main research question is provided by answering the three sub-questions that address the past, present and future of environmental reporting. The answers to these sub-questions are provided in the research papers.

1.   How have the Finnish forest industry companies reported environmental performance?

2.   What is considered a well-measured environmental performance versus an insufficiently measured environmental performance in the Finnish forest industry?

3.   What are the alternative future scenarios for environmental reporting in the Finnish forest industry?

1.3   The structure of the thesis

The remainder of the thesis is structured as follows. The next two chapters review the theoretical background of the thesis. Chapter 2 introduces the basic principles of futures research, namely knowledge about futures, alternative futures, values and futures research, and futures images, in order to provide conceptual clarity for the analysis of the prospects of the forest industry's environmental reporting. The chapter also reviews the futures of the Finnish forest industry with the intention to show that the need for change in the industry is acknowledged broadly. In Chapter 3, the focus is specified into corporate environmental reports and reporting. In addition to defining the basic concept of this research, this chapter reviews the current criticisms of environmental reporting, as the criticism has been one inspiration for this thesis. The chapter also covers the futures of environmental reporting in order to show that only limited previous studies have addressed it. Chapter 4 describes the qualitative methodological approach and the research context as well as the material and methods: the content analysis of the environmental reports, theme interviews and the Delphi method. In Chapter 5, the research articles that are a part of this thesis are described briefly. The main results are presented in Chapter 6 with first a short preview and then a more detailed discussion. The implications of the results and conclusions are derived in Chapter 7. Furthermore, the thesis results are interpreted as four futures images in this chapter. The futures images are titled as 'End of the Forest Industry', 'Strong Sustainability Focus', 'Survival of the Forest Giant' and 'Renewal of the Industry'. In these futures images the role of the industry in the national economy differs, and therefore, the role of the environmental reporting similarly differs.

The thesis has two sets of appendices. In the first set, the interview questions and the three rounds of the Delphi process are reported. In the second set, the original research papers with more detailed research results are published.

2 Futures research perspective

This thesis contributes to the field of futures research. The aim of this chapter is to describe the basic principles of futures research. The understanding of these principles lays the ground for studying the futures of environmental reporting, meaning how we can study the futures of a topic. For example, the chapter explains why the study is about futures in the plural rather than about 'the future'. The chapter begins with a brief introduction to the concept of futures research, following with a discussion of the four key characteristics of the field – knowledge about futures, alternative futures, values and futures images. Knowledge about futures is debatable, as we do not know the future that will come. However, we can have knowledge of the possible alternative futures (*futuribles*). Futures research is a value-bound endeavour, where the values of the studied organisation(s) or the researcher affect the alternatives formed. The values connect directly to the concept of alternative futures and futures images. The alternative futures can be presented as futures images that are mental tools to synthesise the knowledge of the futures. The different futures images reflect the values of different persons or organisations, as the preferability of futures images varies. As the forest industry is seen to be at a turning point, this is a good situation to consider the different futures based on different values. At the end of this chapter, the focus is shifted from the basic concepts to a review of futures in the Finnish forest industry. This shift shows how the theoretical concepts can be applied in a real-life context.

2.1 Main characteristics of futures research

Multiple concepts have been used over time to describe the research of futures or the actions of trying to predict futures, such as futurology, futures studies and futures research.[1] The use of the plural 'futures' is intentional here. As Dror (1971) explains it, the plural here refers to studying alternative futures. As Sardar (2010) points out, to use the singular form, 'the future', here would give too strong an indication that it is possible to discover the one, forthcoming future.

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[1]   A longer list of possible synonyms is provided by Sardar (2010) and Marien (2010).

Futurology is the first term that has been used to describe research that has focused on futures. This term was first used by Ossip K. Flechtheim in 1943 (Flechtheim 1970; Flechtheim 2017). Ketonen (1985) calls Flechtheim's thinking highly ideological and utopian (Ketonen 1985), as he promoted the prevention of war, the stabilisation of peace, and the removal of hunger, misery, oppression and exploitation (Flechtheim 1970). Flechtheim's view consists of three perspectives: (1) studying the futures (predictions and projections); (2) sketching and planning the futures in, for example, economics and traffic; and (3) futures philosophy (methodology, ethics), including the analysis of goals, norms and values (Flechtheim 2000; 2017). Futurology understood this way would include, in addition to the actual research about futures, also religious prophecies, fortune-telling and laypeople's hunches about the future (Malaska & Mannermaa 1985). These non-science-based futures approaches have given the term 'futurology' a bad reputation (also Bell 2009; Sardar 2010), and therefore new concepts, such as 'futures studies' and 'futures research', have been brought into use (Kuusi 1999).

In this research, the term 'futures research' is used to describe the field. The use of this concept is primarily reasoned with a selected approach. The aim here is to empirically research the current futures images, which follows the 'normal' social science research approach. Similarly, the concept seems to be more commonly used in Finland; for example, it is used in the thesis published in the Turku School of Economics (e.g., Kuosa 2009; Laakso 2014). Furthermore, the recent journal in this area, *European Journal of Futures Research*, uses this concept in its name. Lastly, but not least, this research has been conducted at a research institution, Finland Futures Research Centre (FFRC). At the FFRC, the major subject is called 'futures study' where the 'studying' evidently refers to students, whereas the institute is called the 'Futures Research Centre', referring to the research conducted there.

An alternative term for 'futures research' would have been 'futures studies'. The futures studies concept is used by, for example, Masini (1993), Bell (2009) and Marien (2010). Its use is advocated by the World Futures Studies Federation (Masini 2010). Bell's reasoning for the term is that it is the one typically used in the United States. The selection of 'futures research' in this study does not imply that it would be a better term to use, but 'futures research' seems to be the term used in Finland and in Europe and therefore it is used in the current thesis.

Futures research means to gather, critically analyse, creatively synthesise and systematically present knowledge about the futures (Rubin 2004). Goldingay and Moynagh (1999, 416) nicely summarise futures research's aim as to seek 'to explore the future [*sic*] in a systematic way'. The results should be justifiable descriptions of alternative futures (Mannermaa 1998; 2003; Rubin 2004). As from the futures research perspective, futures represent a collection of 'different possibilities, contingencies, near certainties and uncertainties, constraints and opportunities, some more

probable than others' (Bell 2009, 151). Typically, futures research focuses on the identification of the future trends of the society (Rubin 2004) to create 'a deep understanding of social interaction and culture' (Kaivo-oja et al. 2004, 538). These trends can be physical, biological, psychological, economic, social, political or cultural (Kamppinen et al. 2003; Bell 2009). Further, the trends can be predictable, unpredictable or difficult to predict, and the interest is especially in the trends that are difficult to predict (Kamppinen & Malaska 2003) but also in irregularities and anticipated new events and structures (Malaska & Mannermaa 1985; Kamppinen & Malaska 2003). Bell (2009, 83) further emphasises the break from 'conventional, orthodox or traditional thinking' in order to find the unusual and/or unpopular perspectives. As Bell (2009) points out, futures can consist of physical, biological or social features that have not existed before. But still, as Rubin (2004) points out, even in the wild future predictions one needs to be able to show the logical and possible path to them.

The aim of futures research is not to predict the future (Niiniluoto 1998; 2003a; Kamppinen et al. 2003) that shall come,[2] but to, as Bell (2009, 2) explains it, 'to demystify the future [*sic*], to make possibilities for the future [*sic*] more known to us, and to increase human control over the future [*sic*]'. In addition, futures research aims to reveal all the possibilities and search for the alternative futures, the so-called *futuribles* (Mannermaa 1998; 1999; Kamppinen et al. 2003; Rubin 2004; see also Section 2.3). Furthermore, Bell (2009, 73) sees the aim as 'to discover, or invent, examine and evaluate, and propose possible, probable and preferable futures'. The aim is also to widen the current options (Rubin 2004) in order for us to make better decisions about the future (Cole 1990; Mannermaa 1999; Rubin 2004; Bell 2009). Therefore, Mannermaa (1998; 1999; 2003) calls futures research instrumental, as the aim is often to change something in, for example, the actions of a government, a parliament, a company or municipality, or the general opinion (Mannermaa 2003). In other words, the aim is to make such decisions today that we will have a good future and are able to avoid future threats (Niiniluoto 2003a). Malaska (2003) sees futures research's aim at more of a grassroots level: he argues that the aim is to ex-

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[2] Futures research sees the future indeterministically (also Mannermaa 1999): futures are open with alternative options, out of which one will come true (Niiniluoto 2003a; Rubin 2004). Malaska (2003) explains further that people's actions will shape the future, contrary to the deterministic view, which claims that the future is determined beforehand. In addition, Rubin (2004) explains the unpredictability of the future: although the future forms based on the decisions and selections we make today, we cannot predict it just based on these decisions and selections. The future is a complex mix of different events that we are not aware of today.

pand people's awareness of the futures and the possibility for them to shape the future. To summarise this, the aim is to invent, value and suggest possible and probable futures (Rubin 2004).

This thesis is built on these definitions. The aim is not to predict the future of environmental reporting in the Finnish forest industry but to show, based on the past trends, in which alternative directions the reporting could be going. As will be shown in the following, the trends might not be too favourable in every regard. Therefore, suggestions for how to improve the reporting are made in order to have better reports in the future.

If not through prediction, then how and by what means can we gain knowledge about futures? The next section tries to answer this epistemological question.

2.2   Knowledge about futures

Scientific knowledge has some universal features, such as that science cannot achieve absolute and final truths (Niiniluoto 1998). Even the best scientific knowledge is to a certain degree uncertain and improvable (Niiniluoto 1998). Scientific knowledge is 'a justified true belief' (Kamppinen & Malaska 2003; Malaska 2003). Gabriel (2014, 2) further emphasises the need for justification, as it 'is needed to create acceptance, consensus, or coherence'. However, the scientific knowledge about futures is somewhat of a special case, as will be discussed below.

Can we know about the future at all? What can we know about the future? Those are the key questions that futures research tackles. A typical argument for futures research not being a field of scientific enquiry says that one cannot research futures, as one cannot have (scientific) knowledge about futures (Niiniluoto 1999). In an exact sense, we cannot have observation-based knowledge about the future, as it has not happened yet and is not happening now (Malaska & Mannermaa 1985; Niiniluoto 1998; 1999; Mannermaa 2003; Gabriel 2014). We cannot make experiments, and we cannot verify or repeat the experiments about the future (Ketonen 1985; Masini 1993; Malaska 2003). Mannermaa (1998, 20) puts the same very practically: 'We cannot interview the futures, we cannot send surveys to the futures nor can we place futures under the microscope in order to examine it'. But as Niiniluoto (1998; 1999) points out, we can make well-grounded guesses about the futures which turn out to be right by using, as Rubin (2004) says, the knowledge about past trends and the future needs and expectations of societies, the economy, culture and individuals.

Gordon (1992) further explains that we are able to make partial forecasts, which means to limit the forecast in time and scope and to simplify the model. Gabriel (2014) follows this idea: he states that predictions about the near future are possible, as typically structural changes do not have time to affect it. But he continues that

'[f]or the mid- or long-term future [*sic*], the assumption of constant structures becomes a pitfall that can create illusions' (Gabriel 2014, 8). Although Gabriel (2014) shares the view that in the scientific way we cannot know the future, this does not mean that we would not be able to know something about the futures.

Kamppinen et al. (2003) define futures knowledge as the knowledge about the alternative futures. The alternative futures have different prerequisites of occurrences about which we have more or less exact knowledge. These prerequisites of occurrence differ based on the associated risks and values, which makes them preferable or avoidable for people. (Kamppinen et al. 2003.)

In futures research, the knowledge interest is towards the futures (Mannermaa 2003), but the interest is not to search for the final truth (Malaska & Mannermaa 1985; Mannermaa 2003), nor is it even possible (Gordon 1992; Kamppinen & Malaska 2003; Bell 2009; Gabriel 2014). The reason here is contingency. Regarding futures, the target of the knowledge is contingent: the events occasionally happen and occasionally do not happen (von Wright 1985; Malaska 2003; also Kamppinen & Malaska 2003).

Malaska (2003) presented a categorisation of knowledge in different fields of research (Table 1 is an adaptation from it). In his original table, Malaska classifies them based on level of certainty of the knowledge and targets of the knowing. In the original table, the extremities of the targets of knowing are called 'defined and certain' and 'undefined and contingent'. Malaska's example of a defined and certain field is the natural sciences, and futures research represents an undefined and contingent field of knowledge. I changed the 'certain' to 'factual', as by definition not even the knowledge in natural science is 'certain', as the process of science is meant to increase our knowledge and possibly change what we currently hold as 'certain'. In addition, I added a heading for the middle row ('less defined and factual'). Malaska's original did not have a heading. I also made some changes in the second axis by changing the heading to 'goal of knowledge about the target is'. The reason for the change is that I feel that the new title better represents the differences of the sciences regarding uncertainty. In the natural sciences, surely the target is to eliminate uncertainty, meaning to understand what we do not currently know. For that matter, in futures research the aim is to analyse the uncertainty. We do not know the future, but we can analyse what could happen in the future. In Malaska's original version, counter-factual history research was in the middle (together with social sciences and history research), but I felt that it is more accurately in a cell of 'acknowledge uncertainty' and 'undefined and contingent'. The final adaptation is that 'social-ecological scenarios' is added to the table, as they represent a mix of natural sciences and futures research; the calculations are based on the principles of the natural sciences, but the whole approach is from futures research.

The concept of knowledge in futures research is nearer to that of the social sciences than the natural sciences (see Table 1). However, in futures research the concept of knowledge is broader. The knowledge is never value-free, yet it is still based on the application of systematic research methods. The knowledge about futures is knowledge about the 'possible' and therefore contingent; in the future, this knowledge can become true or be different. To summarise, Malaska (2003) describes futures knowledge as visionary, insightful, value-bound and meaning-giving.

Table 1. Knowledge about futures is uncertain and contingent (adapted from Malaska 2003)

Goal of knowledge about the target is to:	Targets of knowing are:		
	Defined and factual	Less defined and factual	Undefined and contingent
Eliminate uncertainty	Natural sciences		Socio-ecological scenarios
Acknowledge uncertainty		Social sciences History research	Counter-factual history research[3]
Analyse uncertainty			Futures research

De Jouvenel (2012) points out that the knowledge about futures relates to uncertainty. He gives the following example. From the past, we can say as a fact that 'we saw Peter on our way here'. But when we make the same statement of the futures, 'we shall see Peter on our way back', we are making assumptions. De Jouvenel (2012) actually writes about opinions when considering the knowledge about futures.

Bell's view on the theory of knowledge in futures research is that theory does not exist yet. However, he proposed critical realism as the theory. According to critical realism, 'we cannot have certain knowledge, if we define knowledge as justified true belief' (Bell 2009, 210). However, this does not mean that one should not try to have it. He agreed that some knowledge is objective, typically when we talk about knowledge about something that is external and independent of the human mind. But as critical realism points out, this is too narrow an approach to knowledge. Therefore, he used the concept of 'conjectural knowledge'. He further added that this knowledge can be beyond a reasonable doubt if it has been tried to be falsified without success.

Epistemology means how we can know and receive knowledge about the world. In futures research, epistemology aims to explain how we can know about the future. Futures exists in a different way than the past and present, and knowing about the

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[3]   Counter-factual history research means to describe the alternatives to historic events.

futures is different than the knowing of past and present. In scientific thinking, we need to be able to think that reality is based on the past, present and future. The present exists in our immediate perceptions. We can only make measurements about the events of the present. With the measurements, we can receive objective knowledge about an event. We cannot make measurements of the past or future. However, we have traces of the past existing in the present, which we can examine and use to make logical conclusions about the past. We have memories of the past, and therefore our knowledge about the past includes both factual and interpreted knowledge. Kamppinen and Malaska (2003) call the knowledge about the futures 'visionary'. We do not have either facts or memories about the future. The knowledge about the futures is in our minds (Kamppinen & Malaska 2003) and it reflects the values of the researcher (Malaska & Mannermaa 1985).

The above-mentioned definition of scientific knowledge includes a part that says that we need be able to verify the belief. Objective knowledge is verified by observations. Interpreted knowledge has the potential to cause counter-arguments and re-interpretations. Visionary knowledge, the knowledge about futures, is highly subjective. One way to verify visionary knowledge is to have a dialogue with the potential users of the knowledge. (Kamppinen & Malaska 2003.)

Malaska and Mannermaa (1985) apply Habermas's interests in knowledge in futures research (see Table 2). Habermas divides these knowledge interests into three, namely technical, hermeneutic and emancipatory. All three are relevant to and applied in futures research. In addition, one study can apply multiple knowledge interests. A study that applies technical research interest tries to present predictions that are based on knowledge that is as sound as possible. Afterwards, the business or other operations are run by these predictions. Typically, the technical research is done in companies and often also in public research institutions. Hermeneutic knowledge interest guides the research towards communication, consensus and shared actions. This approach is typical in the future-focused stories written by individuals. Emancipatory research focuses on creating different futures images based on both theoretical and empirical research. The aim here is to be critical about the existing ideologies and search for other options. (Malaska & Mannermaa 1985.) A classic example of emancipatory research is the Club of Rome's report, 'The limits to growth' (Meadows et al. 1972).

Table 2. Knowledge interests in futures research (Malaska & Mannermaa 1985)

	Aims of futures research		
Knowledge interest in futures research	What is possible?	What is probable?	What is preferable?
Technical	Irrelevant to find out new options, focus on trends Objectivity	Key point Aim in predictions	Not relevant Unscientific Self-evident
Hermeneutic	Aim in communication: the tasks of futures research blend with societal understanding		
Emancipatory	Increasing the options: make the 'impossible' become 'possible'	'Probable' is one option and target of the critic	Aim is more to influence the 'preferable' than to find out the 'probable'

Slaughter (1999) describes the roots of futures research by listing the different traditions (see Table 3 for details). His description is close to Malaska and Mannermaa's (1985) Habermasian approach, but he adds a fourth dimension, which is multicultural/global tradition. Slaughter sees this as an emerging field with a strong focus from global organisations such as UNESCO and WFSF.

Table 3. Traditions of futures research (Slaughter 1999)

Traditions	Description	Background	Researchers
Empirical/analytic tradition	Data-driven	Positivistic	Herman Kahn, Julian Simon
Critical/comparative tradition	Socially critical approach	Acknowledges different approaches to knowledge and different social interests	Hazel Henderson, Sohail Inayatullah
Activist/participatory tradition	Facilitation and activism	Social movements (e.g., peace, women's and environmental movements)	Robert Jungk, Elise Boulding, Warren Zieglar, Joanna Macy
Multicultural/global tradition	Emerging field in futures research	Non-Western context, UNESCO, WFSF	Zia Sardar, Tony Stevenson, Sohail Inayatullah

In their article, Ahlqvist and Rhisiart (2015) sketch out the future development of critical futures research (see Table 4). They offer three emerging pathways, which they name 'futures and social-technical practices', 'futures-oriented dialectics' and 'socio-economic imaginaries in the construction of futures'. Their application levels differ – 'futures and social-technical practices' are typically applicable in different organisations, whereas 'socio-economic imaginaries in the construction of futures'

would be a policy development tool. Ahlqvist and Rhisiart's (2015) first pathway is a practice to be applied daily in the corporate strategic planning which results in banal and mundane futures. 'Futures-oriented dialectics' is interested in the alternative futures that contain contradictory trajectories. The last pathway, 'socio-economic imaginaries in the construction of futures', focuses on composing broad descriptions of the futures that include the different socio-economic perspectives and details. The idea here would be that the future states would be accessible for the citizen to test (via simulations or games) or at least to discuss.

Table 4. Emerging socio-theoretical pathways for critical futures research (Ahlqvist & Rhisiart 2015)

Pathways	Key arguments	Key theoretical foundations	Examples
Futures and social-technical practices	Futures are constructed, channelled and mobilised in particular and mundane socio-technical practices realised in different societal and expert contexts	Social constructivism Social constructionism Science and technology studies	Banal and mundane futures Taken-for-granted futures Futures as administrative common sense at the level of organisations and companies Futures as common sense at the level of civil society
Futures-oriented dialectics	Futures are understood as complex events or pathways that always embody contradictory trajectories The events and pathways are outcomes of an interplay of theses and antitheses	Philosophical foundations: Hegelianism, Marxism Critical political economy Human geography	Futures as tensioned positions between opposing development trajectories Futures as alternative openings between opposing trajectories
Socio-economic imaginaries in the construction of futures	Futures are understood as socio-economic imaginaries The imaginaries are scripts formed in order to induce management and control	Cultural studies Cultural political economy Critical futures studies	Futures as socio-economic imaginaries Partial views transposed into total perspectives 'Post-conventional' futures studies

Malaska and Mannermaa's, Slaughter's, and Ahlqvist and Rhisiart's classifications show that futures research has developed over time and that the knowledge interests have varied over time and can actually still vary in futures research.

The above definitions of futures knowledge are from a theoretical viewpoint. But for example, Dufva and Ahlqvist (2015) have more a practice-oriented way of defining what futures knowledge is. They analyse in their research the knowledge creation in a futures workshop setting. Their conclusion is that futures knowledge is 'socially constructed in an interactive process' (Dufva & Ahlqvist 2015, 264). They further add that '[f]utures knowledge is, in its core, interpretative and speculative knowledge. It is something that is always embedded in the historical bedrock and heavily affected by the weight of the present, but simultaneously it has the capacity to be partially open, the potential to become' (Dufva & Ahlqvist 2015, 264).

I have discussed above the characteristics of futures knowledge. As has been mentioned, one cannot have direct observations of the futures. However, people have perceptions of futures, and one can study these, as Tapio (2002b) points out. In addition, Rubin (2013) argues that these perceptions have an impact on the choices and actions that people take and make. This means that the perceptions shape the future. Therefore, one can claim that in studying the current futures images, one is, in a nondirect way, studying actual futures as well.

To predict the future is not the aim of this research, but rather to find ways to improve the current reporting practices. Regarding the knowledge interests, this thesis applies to a certain degree all the knowledge interests of futures research. As technical knowledge interest focuses on the probable future, the current thesis shows the trend regarding the direction of environmental reporting. The hermeneutic interest of the current research is evident, as the data are collected from multiple sources and therefore represent the societal understanding of the topic. The emancipatory knowledge interest then emphasises the preferable future. The interest is in where we want to go rather than where we seem to be going. Therefore, this thesis will point out the probable future of environmental reporting as a reference case to the preferable future.

Since there is not a single possible future, in the next section the concept of alternative futures is dealt with in more detail.

2.3   Alternative futures – *futuribles*

The concept of alternative futures is one of the basic assumptions of futures research (Masini 1993; Bell 2009; de Jouvenel 2012). It also relates to the ontology of futures research. Ontology means how we understand reality (Kamppinen & Malaska 2003). Based on Kamppinen and Malaska (2003), the ontology of futures research is an emergent system ontology. Emergent system reality consists of multiple levels which each have new, unique features that cannot be reduced to the lower-layer characteristics. Here, the different layers are physical, chemical, biological, psychologi-

cal, social and cultural, in this order. Systems consist of physical and chemical reactions that make the biological, psychological, social and cultural processes possible. The role of layers is to enable the actions of the layer above, and they can only narrow down something that cannot happen in the layer above. 'Emergent' means here the emergence of new properties, which cannot be present in the lower levels, but the lower levels can change because of the emergence. Furthermore, this is called a system because of the separate but interconnected layers. (Kamppinen & Malaska 2003.) Kamppinen and Malaska (2003) argue that emergent system ontology is a suitable ontology for futures research because it does not rule out the possibilities beforehand.

The alternative futures are often called *futuribles* (de Jouvenel 2012; also Masini 1993; Niiniluoto 1998; 1999). 'Alternative futures' means the possible future options, out of which only some will come true (Niiniluoto 2003a), but at the moment we do not know which ones (Malaska & Mannermaa 1985). As Mannermaa (1999) explains the need for this concept, it is too complicated a task to predict the future, as the economic, technological and societal boundaries are so complex to model. However, the alternative futures should be based on the current knowledge (Malaska & Mannermaa 1985) and they should be justifiable (Mannermaa 1998; 1999; Rubin 2004). On the other hand, as Malaska and Mannermaa (1985) point out, futures research should find out the futures that seem impossible at the moment but can be possible in the future. They give as examples the moonwalk and oil crisis, which were impossible to imagine in the early 1900s. De Jouvenel's (2012, 19) definition of the concept is that 'the *futuribles* should be thought of as those descendants from the present state that now seem to us possible.'

The alternative futures can also be represented as a futures tree (Niiniluoto 1998; 1999; 2003b) or future pathways (Kamppinen et al. 2003).[4] In Niiniluoto's (1998; 1999; 2003b) metaphor, the sprawling branches of the tree represent the possible future directions for where to go. Kamppinen et al. (2003), on the other hand, call the future pathways possible chains of events, which lead to the different, possible futures (see Figure 1). The futures researcher's aim is to find out the accessibility (i.e., decisions and actions) of these alternative futures. The accessibility depends on the decisions and actions that we make today but also on biological, physical, psychological, economic, social, political and cultural factors. (Kamppinen et al. 2003.)

Masini (1993) further develops the idea of alternative futures by highlighting that the desirability of the different futures differs between individuals. As individual

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[4]   History can be described the same way. Realised history can be seen as a solid line, but in reality there have been multiple directions available (Malaska & Mannermaa 1985). Counter-factual history research focuses on the historical possibilities that could have happened (Malaska & Mannermaa 1985).

values and choices vary between generations, cultures and experiences, the desirability varies as well (Masini 1993). Therefore, Masini (1993) introduces four different futures: preferable, plausible, probable and possible futures. Some futures are 'possible' based on the current knowledge and data. Some of these are 'probable' or even 'plausible', as they are more likely to occur. 'Preferable' futures are those that are valued by persons or the whole society. Bell (2009) shares Masini's view. He, however, focuses on the possible, probable and preferable futures. As he explains it, 'Futurists seek to know: what can or could be (the possible), what is likely to be (the probable) and what ought to be (the preferable)' (Bell 2009, 73).
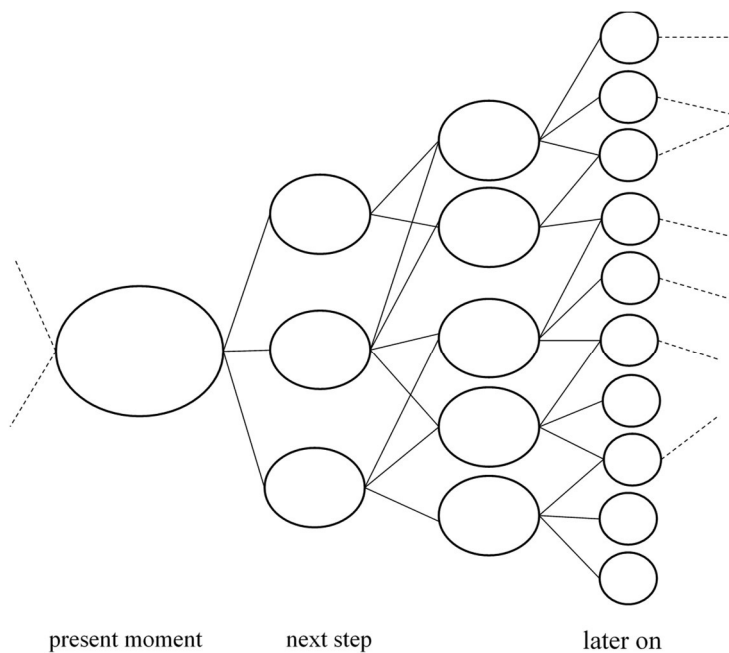
Figure 1. Pathways to alternative futures (Kamppinen et al. 2003)

Voros (2003; 2017) has further developed the range of alternative futures and their visual representation (see Figure 2). His list includes seven types of futures: potential, preposterous, possible, plausible, probable, preferable, projected and predicted (Voros 2017). Potential futures mean that the futures start beyond the present moment. Preposterous futures (red circle in the Figure) include those futures that seem too far-fetched to be possible. Possible futures (black circle) are the futures that people think might happen, while plausible futures (gray solid circle) are, based on

the current knowledge, something that could happen as well. Probable futures (blue solid circle) are considered as being likely to happen based on the current trends. Preferable futures (green solid circle) we want to see happening in the future. The seventh type is the projected future (solid blue line in the middle of the circles), which Voros (2017) describes as a singular, baseline future where the current development trends have continued into the future.
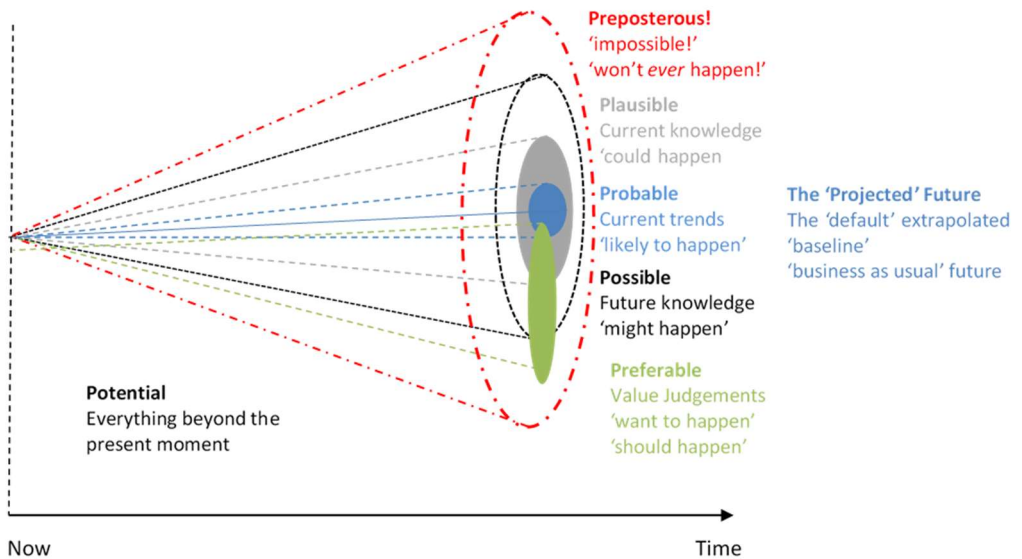
Figure 2. The range of alternative futures (Voros 2017[5])

The concept of *futuribles* is applied in the current research mainly according to the lines presented by Masini and Bell. Here, both the probable future and preferable future of environmental reporting are investigated. The preferable future is based on values, which is discussed in the next section. Contrary to science's target of being value-free, futures research is value-bound.

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[5]   In 2017, Voros explained the origin and his interest in general in this type of representation of alternative futures, the so-called 'futures cone'. His drawing originates from the model of Hancock and Bezold (1994) (Voros 2003; 2017).

2.4   Values and futures research

Science is traditionally considered as being value-free (Masini 1993; Malaska 2003), and the ideal scientific knowledge is regarded as objective and value-free (Malaska 2003). Visala (2010) argues that this view is based on the positivistic tradition, in which the scientific methods and results do not relate to the surrounding ideological presumptions. The opposite of value-free is value-bound. In addition to this approach, Visala (2010) adds the concepts of value-neutral and value-relevant. His definition of value-neutral explains science as value-neutral when the scientific results are not relevant for a certain ideology.

Futures research treats values[6,7] differently from the traditional science perspective. Values are part of futures research (Malaska 2003), and they are not regarded as shared and universal (Niiniluoto 1999; Kamppinen et al. 2003; Malaska 2003). At the same time, Bell (2008) points out that there are universal, or near-universal as he calls them, values that all or almost all societies share. According to Bell, these are knowledge, evaluation, justice and cooperation. In the current research, the role of values is a bit of a tricky question. The researcher would like to propose an addition to Bell's list of universal values. The addition would be the value of nature. At the same time, the researcher acknowledges that in a corporate context the value of nature might not be the first pursued value. This suggests that in the current research context, the values are not shared and universal.

Values actually have a bigger role in futures research than in other social sciences (Masini 1993; Mannermaa 2003). Mannermaa (2003) argues this by explaining that futures research is always shaping the future. In his mind, futures research is instrumental, as the aim is to influence a government, parliament, company, municipality or the general opinion.

Niiniluoto (2003a) sees that values have three different roles in futures research. First, the researcher's own values can determine which of the alternative futures are worthy of pursuing. Second, customers of the research (e.g., municipality, company or NGO) might want to promote their interests, in which case the researcher needs to consider how to endorse the customer's values. Third, the creation of scenarios always involves persons whose values are unique. This means that the content of the scenarios varies based on the decisions that the individuals make. Malaska's (2003)

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[6]   'Value-bound' is one of the reasons why futures research is often not regarded a true science among all scientists (Malaska 2003).

[7]   Rubin (2004) defines values as symbols that 'describe behaviour, choices and evaluation in decision making and in different actions'. She further adds that values hold the society together. Kamppinen et al. (2003) see values as the basis of decision-making, risks, visions and missions. They add that 'without values, we would not have motivated actions nor would the future make any sense'.

addition to the role of values in futures research is that the understanding of value conflict and value-rational argumentation is a key part of futures research. Malaska and Mannermaa (1985) see a problem here: if the research is funded with public money, whose values determine the choices made? Kamppinen et al. (2003) continue this by saying that it would be important to highlight which values make which alternative futures worth pursuing.

As mentioned above, a key part of futures research is the actions to shape the future. The shaping is done based on the values that persons have (Mannermaa 1998; 1999). In other words, we shape the future based on our desires (Ketonen 1985). Masini (1993, 21) offers a longer list by declaring futures research to be interested in the 'specific values, desires, wishes or needs of the future'. Values evidently have a significant role in futures research, as Masini (1993) points out that we have the concepts of possible, probable and plausible futures as they are based on values. She further adds that values are present when we consider 'where we are going and where we want to go' (Masini 1993, 41).

Masini (1993) presents a typology of futures research where the role of values is explained in the three different types of futures research (see Table 5). The role of values differs in these types. They have the biggest role in utopians, often based in imagination; the author wants to create something that is totally different from the present. The role is rather large in visions, but still they need to have a more down-to-earth approach than in utopians. In prognosis or extrapolation, values only affect the choice of topics and data.

Table 5. Three different ways of futures (Henrici 1977 ref. Masini 1993)

Name	Background data	Role of the values	In use
Prognosis/Extrapolation	Past and present	Present, in the choice of area and data	After end of WWII to the 1960s or early 1970s
Utopian	Often contradicts the present Invention, innovation, imagination	Key part	Many centuries (e.g., Plato, Thomas More, Bacon, H. G. Wells)
Vision	Past and present, emerging trends, vision for the future	Key part but connected with the real world	Starting from the 1980s and early 1990s

In the current research, the values are also visible. The research question of this study assumes that there is a development need in the current environmental reporting practices in the Finnish forest industry. Surely, it is a value-based argument in which direction the reports should be developed.

Alternative directions for development are described as futures images (still images of the alternative futures) or as scenarios (images together with the paths to reach the images). The current research uses futures images as a key element for summarising the findings.

2.5   Futures images

'Composed of beliefs, expectations, opinions, and assumptions of what the future might be like, images of the future therefore are systemic by nature … They are built with information about the past, perceptions from the present, cultural and social knowledge, personal taste, values, and needs, as well as the expectations of how things "normally" are. They emerge as hopes, fears, and expectations, and therefore influence decision-making, choices, behaviour, and action.' (Rubin 2013, S40)

The above citation from the late Anita Rubin captures the essential elements of futures images, which are one of the key concepts of futures research.

In general, 'an image can be seen as a mental tool, flexible, changeable, and very personal in nature' (Rubin & Linturi 2001, 269) or, as Beers et al. (2010, 725) describe it, as 'a simple, metaphorical representation of a complex, real-world phenomenon'. When this is applied in the context of futures research, we see that 'futures images are mental tools that deal with possible future states' (Rubin & Linturi 2001, 269). Rubin (2013, S40) beautifully describes them as 'formed from knowledge and flavoured with imagination'. Furthermore, Bell and Mau (1973) call them expectations of future states at some point in the future. The futures images can be used for envisioning, structuring, crystallising and parallelising different views (Kuhmonen 2017).

The literature uses different concepts, such as 'images of the future' (Polak 1973; Bell 2009; Rubin 2013; Son 2013; Kaboli & Tapio 2018) and 'future image' (Vinnari & Tapio 2009; Nygrén et al. 2017). However, in this thesis the concept of 'futures images' (also used by Kuhmonen 2017) is used for two reasons: for its simplicity and for its use of 'futures' in the plural.

Futures images can be private, i.e., each individual has his/her own futures image(s), or public, shared by a group of persons (Polak 1973; also Rubin & Linturi 2001; Rubin 2013). There is a relatively vast body of literature that focuses on the private, individual futures images, such as the work done by Rubin on adolescents' futures images (e.g., Rubin & Linturi 2001; Rubin 2013). However, from the point of view of this thesis, more interesting and relevant are the shared futures images. Surprisingly, only a rather limited number of studies were found using the concept in this way and where futures images of a topic were also created. The topics of these

studies varied a great deal: anything from the futures of multicultural young adults' views (Kaboli & Tapio 2018), rural futures (Kuhmonen & Kuhmonen 2015), food (Kuhmonen 2017), meat consumption (Vinnari & Tapio 2009), energy (Ruggiero et al. 2015) and lake management (Nygrén et al. 2017), to even the futures of a country (Son 2013). In the previous studies, the number of created futures images varied from four to five. In addition, the images typically included a dystopian, utopian and business-as-usual futures image. So far, the forest industry has not been a target of futures image research.

The literature provides several classifications of the futures images. One of the first is Polak's (1973) categorisation. He categorises futures images by influence and essence. Essence means the 'unchangeable course of events', and influence the 'possibility of human intervention' (Polak 1973, 17). This categorisation creates four futures images (see Table 6) where the worldview ranges from highly positive (both influence and essence optimism) to highly negative (both influence and essence pessimism).

Table 6. Polak's categorisation for futures images (Polak 1973; see also Kaboli & Tapio 2018)

		Influence	
		Optimism	Pessimism
Essence	Optimism	World is a naturally good place. Human beings can improve it to a better place.	World is a naturally good place. Humans have no control over the course of events.
	Pessimism	World tends to decline toward evil; human beings are able to influence and combat this trend.	Chaos is unavoidable. Humans have no control or ability to affect it.

Dator (2002; 2009) has proposed four generic futures, originally from the perspective of societal growth. Dator's (2009; also Smart 2018) proposed futures are continuation, limits and discipline, decline and collapse, and transformation (see Figure 3). Continuation is the business-as-usual situation where the current growth continues. The limits-and-discipline scenario is a situation where the current growth meets its upper limit and stays there (Dator 2009), typically controlled with values of ancient, traditional, natural or ideological origin (Dator 2002). A decline-and-collapse state reflects a turning point where the growth turns into decline (2009) due to, for example, environmental overload, resource exhaustion, economic instability and/or military attack (Dator 2002). Last, the transformation state means exponential growth (Dator 2009) with the help of a new set of beliefs and behaviour (Dator 2002). Dator's generic futures will be applied in the current research for creating futures images of the environmental reporting in the Finnish forest industry.
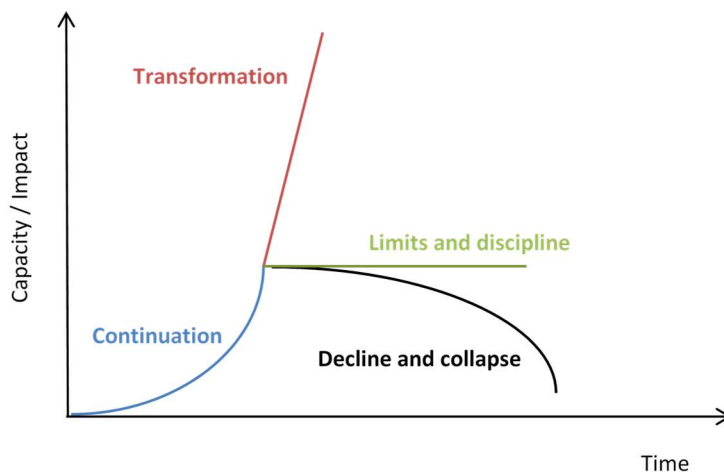
Figure 3. Dator's four generic futures (modified from Smart 2018)

So far, this chapter has introduced the key concepts of futures research, namely knowledge about futures, alternative futures, values in futures research, and futures images. The current research argues that we can have knowledge about futures without using a deterministic forecasting approach. In addition to the past and present, this research focuses on the alternative futures of environmental reporting in the Finnish forest industry by creating futures images of the possible futures based on Dator's four futures archetypes (see Section 7.1). This research also acknowledges the value-bound nature of futures research by taking it as a starting point that the environmental reports should have a comprehensive view on environmental impacts and aspects causing the impacts of the forest industry.

The next section brings the theoretical approach closer to an organisational practice as the research on the futures of the Finnish forest industry is reviewed. The Finnish forest industry is currently a good context for the application of both futures research and environmental reporting. The Finnish forest industry needs a change of operating practices, as there is lower demand of the traditional bulk products, such as paper and board. The tools and methods of futures research can help in finding futures for the industry. However, if the industry remains a large-scale consumer of the forest resources, the management of environmental issues stays relevant for the industry. Therefore, environmental reporting is a requirement for the future as well. If the structure of the industry changes significantly, naturally the content of the environmental reports change as well. Furthermore, the industry itself promotes their sustainability approach as will be highlighted in the following section.

2.6   Futures of the Finnish forest industry

This section reviews the previous literature on futures research on the Finnish forest industry (see summary in Table 7). Those studies are included that address the future beyond 2019. The main data sources are the publications of the FFIF, the publications of Finnish universities and research institutions, and the studies published in scientific journals with the topic of futures research or forest industry. The review is narrowed to the topic of this thesis, the Finnish forest industry, and thus studies regarding global or European forest industry in general were disregarded.[8] The analysis is narrowed to the studies of forest industry. For example, the studies that analyse the forests as an energy source are typically excluded unless they address the topic from the point of view of the current forest industry.[9] Another limitation is that the studies covered here are mainly published from 2010 onwards.

The FFIF has been very active in producing different future-focused publications. The publications cover multiple topics from improving sustainability to developing business opportunities. Typically, these publications are not scientific in a sense that the data-gathering and applied methods are not described, with the exception of two publications (Salovaara 2006; Säilä & Hagström-Näsi 2010). However, all the publications are included in this sample.

Finnish research organisations (such as the University of Eastern Finland, University of Helsinki, and Finnish Forest Research Institute) have done some studies regarding the futures of the forest industry. The topics have varied from the analysis of separate industries inside the forest industry, such as sawmills (Rautanen 2009), to the analysis of the whole forest sector (Pitkänen et al. 2010; Pitkänen et al. 2011; Niinistö et al. 2012). Typically, the topic has related to the scanning the future business possibilities for the industries with a time span up to 2050. The methods used have varied, but most commonly Delphi or workshops have been applied.

A few studies in academic journals were found to address the futures of the Finnish forest industry. The majority of those address the bioenergy business as a new business opportunity for the forest industry. The research methods used in these studies did not vary much, as all except two studies used the Delphi method.

Five characteristics can be highlighted regarding the research of the futures of the Finnish forest industry. These will be discussed in detail in the following:

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[8]   The futures of the Finnish forest industry has been studied as a part of the international forest industry (e.g., Korhonen (2016) in her thesis and in the articles (Korhonen et al. 2014; Korhonen et al. 2015; Korhonen et al. 2016; Pätäri et al. 2016)), but these are excluded here.

[9]   For example, forest bioenergy is analysed from the European perspective by Hänninen et al. (2014).

1. There was a difference in how positive the future was seen to be for the industry.

2. The publications shared the perception of the need for new products and business models for the industry.

3. Often, cooperation with customers and other business sectors was seen as a key to future success.

4. Most often, the energy products were seen as a business opportunity for the forest industry.

5. One major challenge for the forest industry will be competitive forest uses.

There was a difference in the future orientation of the reports published by different organisations. The reports of the FFIF all share a very positive future orientation, whereas the reports of the research institutions have a more critical voice and raise future challenges.

The reason for the bright future, according to FFIF, is that the industry seems to have multiple business opportunities based on the bioeconomy approach (Säilä & Hagström-Näsi 2010; FFIF 2012a; 2012b; 2014a; 2015; 2016). For example, in the report 'An Eye to 2025', the FFIF (2014) calls Finland the model country for bioeconomy. According to this view, everything starts with the raw material, wood, that is renewable and recyclable (Säilä & Hagström-Näsi 2010; FFIF & Metsäteho 2012; FFIF 2012a; 2012b; 2014a; 2015).

In addition, the FFIF recognise sustainability and sustainable development as the success factors of the industry (FFIF & Metsäteho 2012; FFIF 2012a; 2012b; 2015; 2016). Also, Toppinen et al. (2018) emphasise the role of sustainability as a future sales argument regarding the wooden multi-storey construction in Finland and Sweden. This is an important link to the current research. The industry sees sustainability as a success factor, and therefore, the reporting of sustainability in general and environmental issues especially could be assumed to be important in the future.

From the societal perspective, the FFIF see that the forest industry has a vital role in achieving the low-carbon economy (Säilä & Hagström-Näsi 2010; FFIF 2012a; 2012b; 2014a; 2015). The reason for this is that the forest industry is currently the biggest producer and user of renewable energy in Finland with, for example, a 70 per cent share of the production of renewable energy (FFIF 2015).

Table 7. Future-oriented publications of the Finnish forest industry

Publication	Time span	Topic	Method	End result: Key messages
Finnish Forest Industries Federation (FFIF)				
Sustainable growth from bioeconomy: Forest industry's forest environment programme (FFIF 2016)	2016–2020	Sustainable forest management	NA	Industry has set two targets: (1) to assess forest management practices, and (2) to develop more environmentally friendly and more economic practices to manage forests.
Sustainability in the heart of bioeconomy: Forest industry's environmental and sustainability commitments (FFIF 2012b)	2020	Environmental and sustainability commitments	NA	Industry has made 10 environmental commitments.
Towards 2020: Forest industry's environmental and sustainability commitments – Midterm report (FFIF 2015)	2020	Environmental and sustainability commitments	NA	Industry has made 10 environmental commitments. Five commitments have already been fulfilled in 2014 and five are yet to be fulfilled.
Towards more efficient wood logistic: Wood product logistics 2020 – Vision and R&D programme (FFIF & Metsäteho 2012)	2020	Development of wood logistics	NA	Target of 30 per cent improvement of cost efficiency of wood logistics was set by applying various technical improvements.
Finnish wood product industry 2020: Final report of scenario and strategy work (Salovaara 2006)	2020	Vision for the wood product industry	Environmental scanning (PESTEC)	Two scenarios (growth and bioenergy; a part of a successful housing cluster in the near markets) and visions for the business sectors were created.
An eye to 2025: Renewable forest industry – Success from the bioeconomy (FFIF 2014a)	2025	The new business opportunities of forest industry	NA	As a key part of the upcoming bioeconomy, the forest industry has new business opportunities in the areas of, e.g., housing, renewable energy, clothing and packaging.
Forest cluster's research strategy: World's leading forest cluster in 2030 (Säilä & Hagström-Näsi 2010)	2030	Research strategy for the whole forest cluster	Futures workshops, internet-based discussions	Target of doubling the value of products and services and being the world leader was set.
With bioeconomy towards a low coal future: European forest industry in 2050 (FFIF 2012a)	2050	Bioeconomy		The forest industry is a key player in the bioeconomy. The forest offers a multitude of possibilities for future business.
Finnish research institutions				
Estimate of the production and use of wood in the Finnish forest industry in 2015 and 2020 (Hetemäki & Hänninen 2009)	2015–2020	The amount of production and use wood in the wood product industry	Modelling	The amount of production in the pulp and paper industry is estimated to decrease by more than 30 per cent and in wood product industry by 17 per cent. In the same way, the use of wood is also estimated to decrease.
The demand and the customers of Finnish sawmill industry – Present state and future scenarios (Rautanen 2009)	–2020	Demand and customers of the Finnish sawmills	PECTEC analysis, interviews, Delphi	Three scenarios of the sawmills were created: (1) hard price competition of basic products, (2) cooperation with wood product industry with high quality products, and (3) cooperation with bioenergy cluster to utilise the side streams.

Futures workshop of the forest sector, 28th May 2010. Summary report. (Hietanen 2010)	−2050	Report the results of one futures workshop regarding the future of forest sector	Futures workshop	The results were summarised as five future challenges and three common themes: (1) target-oriented forest ownership, (2) welfare forests, (3) forests as a source of energy, (4) service export, (5) new technologies, (6) balance between different use modes, (7) environmental friendliness of forest products, and (8) target of strong economic growth.
The futures workshop of the forest sector, part II (Pitkänen et al. 2010)	−2050	Report the results of one futures workshop regarding the future of forest sector	Futures workshop	The workshop created six futures images: (1) target-oriented forest ownership, (2) welfare forests, (3) forests as a source of energy, (4) service export, (5) new technologies, and (6) paper and board.
Strengthening the foresight in the forest sector: The final report of the futures process (Pitkänen et al. 2011)	−2050	Promote the future thinking in the forest sector	Futures workshops, meeting, internet-based survey	Result was a model to promote foresight in the forest sector.
Review of the long-term foresight studies of the forest sector and its operating environment (Niinistö et al. 2012)	NA	Review of the previous futures studies affecting the forest sector	Literature review	Review identified the global trends affecting the forest sector.
Journal articles about the future of the Finnish forest industry – future of forests or forest industry				
Packalen et al. (2017)	−2020	Future operating environment of sawmill industry	Delphi and scenario workshop	Three scenarios were created: (1) high quality products, (2) bulk products, and (3) energy production.
Kunttu et al. (2020)	2030	Futures of wood product industries	Delphi	Three preferable scenarios were developed: (1) pulp and bioenergy, (2) versatile uses, and (3) long-lifetime products.
Toppinen et al. (2018)	2030	Future of wooden multistory construction, sustainability perspective	Delphi	Sustainability will be a significant sales argument in the future.
Häyrinen et al. (2017)	NA	Future use of forests	Interviews and focus groups	Results indicate two angles: (1) cooperation with bioenergy sector and (2) business models for nature tourism.
Journal articles about the future of the Finnish forest industry – future of forests as an energy source				
Wan et al. (2012)	2020	Bioenergy as a business opportunity of sawmills	Delphi	The key success factors were cooperation with customers, raw material availability and existing technologies.
Hämäläinen et al. (2011)	NA	Business opportunities for forest biorefineries	Survey and interviews	Biofuel production and chemical production are the key for future success.
Näyhä and Pesonen (2012)	NA	Diffusion of forest biorefineries	Delphi	Biorefineries were seen as a possible future business due to the existing technological know-how and the infrastructure.
Näyhä and Pesonen (2014)	NA	From traditional forest industry towards biorefining business	Delphi	Major problems were recognised in the current way of managing the companies, although the need for change is evident.
Pätäri (2010)	NA	Development of forest energy business	Delphi and interviews	Cooperation between the forest and energy industries is needed, and the current success factor is the logistics of the forest's raw material.

Researchers do not necessarily share the optimism. Although they agree that the forest industry companies have opportunities for future success, they are critical of certain procedures in the industry. For example, when Näyhä and Pesonen (2014) asked their expert panel to take a look at the changes needed to become a successful player in the biorefinery business, the forest industry was seen as too slow to change. The industry was seen as holding on to the traditional paper-making processes, although they acknowledge the business problems in that sector, i.e., the low demand for paper in Western countries. The organisational culture was seen to be old-fashioned, and leadership was rated as non-existent according to this expert panel.

These differences in future optimism fit Polak's categorisation of futures images. Polak classifies the images regarding optimism and pessimism in influence and essence (see Section 2.5 and Table 6 for details). The FFIF's view on futures is optimistic both in influence and essence, and therefore, they see the forest industry's role as an improver for the better. As said, the researchers do not share this image. The researchers, however, have an influence optimism view but essence pessimism.

Almost all the reports share the view that future forest industry needs new products and business ideas in comparison to the current selection. According to them, the large role of the current products (bulk paper-, board- and timber-based products) will remain, but the competition will increase, and the price and profit expectations are rather modest. Hetemäki and Hänninen (2009) use mainly mathematical modelling to create the estimates for the amounts of production and use of wood in the forest industry by 2020. Due to the low demand in the United States and the so-called FI70 countries[10], the amount of production will decrease, in their estimates, by around 3.7 million tonnes by 2020. They continue by estimating the consumption of wood products in Finland and in other countries and summarise their findings in the following way: wood consumption in the pulp, paper and board industry will most likely decrease, and it is possible that wood consumption in the wood product industry will increase. On the other hand, according to the FFIF's reports 'An Eye to 2025' (FFIF 2014a), 'Forest Cluster's Research Strategy' (Säilä & Hagström-Näsi 2010) and 'With Bioeconomy towards a Low Coal Future' (FFIF 2012a), the current products, especially in the packaging industry and wood products, are most likely to have a stable future.

The majority of the reports highlight that in order for the forest industry to succeed, it needs to cooperate with its (future) customers and with other industries. In particular, the new cluster approach is highlighted (Salovaara 2006; Säilä & Hagström-Näsi 2010): the forest industry is not seen any longer as a strictly defined,

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[10]   FI70 countries are the countries that constitute 70 per cent of markets today. They include Australia, Austria, Belgium, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland and the United Kingdom.

singular cluster but as connected more and more with the clusters of energy, chemistry, environment and construction (Salovaara 2006; Säilä & Hagström-Näsi 2010). New opportunities can been found, for example, in the medical industry, textile industry (already currently, e.g., viscose, rayon, lyocell) and chemical industry (such as biochemical, bioplastics) (FFIF 2012a; 2014a).

The energy business was most often mentioned as a new business opportunity for the Finnish forest industry. All the studies that produced either scenarios or futures images of the forest industry had energy production as one scenario (see descriptions of the produced scenarios or futures images in Table 8). The reasons for the energy scenarios range from rising energy costs to global business opportunities and the need for renewable energy.

Table 8. Scenarios or futures images of the previous studies

Reference	Scenarios/futures images
Salovaara (2006)	'Growth and bioenergy': The industry's operating capability and productivity has increased; the industry has a place in the markets; bioenergy is a part of the new businesses; globalisation has changed the ownership structures.
	'Part of successful housing cluster in the near markets': Globalisation has increased the living standard and the quality of housing; the population is ageing and housing concentrates in quality city communities; wood products create quality housing; wood products slow down climate change.
Rautanen (2009)	'Whirlpool of markets': Due to the economic recession, the demand is low and only big operators are able to be in business. The markets are mainly inside Finland as, due to the high costs there, the industry is not able to compete with low-cost foreign operators.
	'Tomorrow of sustainable construction': Wooden houses are seen as an important sink to bind the carbon for the long term (i.e., climate change mitigation). Customers demand eco-friendly solutions for housing and furnishing. The sawmills develop their production to meet the special needs of the customers, instead of bulk production. The customer structure is quite narrowly focusing only on Finland and the very near markets.
	'Energy-focused markets': The focus here is on renewable energy production due to the climate change mitigation targets. The renewable energy source that the sawmills are able to provide is the wood-based side streams. The sawmill industry cooperates with the chemical industry cluster and energy cluster.
Hietanen (2010), Pitkänen et al. (2010), Pitkänen et al. (2011)	'Target-oriented forest ownership' is based on the fact that forest ownership is driven by economic factors.
	'Welfare forests' focuses on profitable nature tourism. Forests were seen as an important part of the welfare society.
	'Forests as an energy source' is built on the idea that forests offer different types of fuels and sources of energy: electricity, heat, transportation fuels, and solid, liquid and gas fuels. (3.1) Local and national level (massive energy wood plantations in the south

	of Finland and solar energy will replace biomass) or (3.2) global business opportunities (the Finnish forests equal the current oil reservoirs). 'Service export' emphasises Finland's good knowledge on how to use the forests. This forestry-based knowledge is processed as service companies that export the knowledge globally. 'New technologies' is literally building on new technologies that increase the value chain in comparison to the current situation. The new technologies could be found from, e.g., areas of printed intelligence, cellulose-based products and replacements for plastics. In 'Paper and board' the basic assumption is that paper and board products will be used in the future. They agreed that paper could be used differently in the future: the solutions would relate to the areas where the ICT solutions just do not work. In addition, they highlighted that the future use would be high-value products with high aesthetic value.
Säilä and Hagström-Näsi (2010)	'Global bioeconomy': The threat of climate change is taken seriously and actions towards low carbon economy are taken. 'Forests to bioenergy': Due to the rising energy costs, forests are seen as an important energy source, and there is a competition in using forests for energy or higher-value products and services. 'Business as usual': Europe leads the development in the forest industries. 'Self-sufficient society': Due to climate change, food production has moved north, forest damage has increased and areas not suited for food production are taken into biomass production.
Packalen et al. (2017)	'Comeback of the west + Building for sustainability'[11]: The products are sold to a narrow segment with high-level know-how and high price expectations. 'Battle of the blocks + Swirling with the markets': The production is efficient and optimised bulk production with low price expectations. 'Stimulus and collapse + Milling for energy': Energy production is the main source of income together with the traditional sawmill products.

In addition, the majority of the futures research articles found concerning the forest industry focused on the different sides of wood energy, and these were often on biorefineries. For example, Näyhä has studied biorefinery diffusion in Finland. In Hämäläinen et al. (2011), Näyhä and others studied the biorefineries as a business opportunity. They found that biofuel production together with chemical production would be a significant future business opportunity for the industry. Näyhä and Pesonen (2012) also studied the diffusion of forest biorefineries in northern Europe and North America. Here the main results suggested that the forest industry would

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[11] The first part of the name refers to the global market situation and the second part to the Finnish sawmill industry situation.

be the key player in the future biorefinery business due to the existing infrastructure and technological know-how. In Näyhä and Pesonen (2014), they have a rather critical approach to the biorefinery future by concluding that unless some significant changes are made, the role of the forest industry in biorefineries will be limited to that of a raw material provider.

Pätäri (2010) also focuses on forest energy. Her focus is on the cooperation of the forest and energy industries in order to develop the forest energy business. The experts in her Delphi panel acknowledged the need for the development of forest energy, as the experts thought that traditional paper-making will not be a sufficient business in the future. As a success factor, wood raw material logistics was recognised. However, regarding the business use of forest energy, the high investment costs were recognised and the underdeveloped technology raised concerns. The results indicated that cooperation between the energy and forest industries is needed.

One major challenge for the forest industry will be the competing forest uses.[12] If, for example, the forest energy sector would rise and use more and more virgin forests instead of the current side and waste streams of the forest industry, it would raise the price of the raw material. Another example of competitive use would be the rise of nature tourism, which would hinder the harvesting of the forests. In this category, the increase in forest conservation and use of forests as carbon sinks could hinder raw material acquisition. In other words, also in the future, the forests are typically seen as raw material source. In the reports of Hietanen (2010) and Pitkänen et al. (2010), the competing uses of forests are raised as a challenge for the industry.

The obvious need for change in the forest industry affects the core research object of the current research, namely environmental reporting, which will be discussed in detail in the next chapter. The Finnish forest industry has a long tradition of environmental reporting in Finland, as these companies were among the first to publish environmental reports. However, if the current operations change, then the content of the environmental reports needs to change as well. The forest industry itself highlights the link to sustainability and sustainable business due to the renewable raw material. However, the environmental impacts caused by the industry do not only relate to the raw material acquisition, as will be elaborated upon in Section 4.2.1. Moreover, as the current discussion in the Finnish media shows, one might not be able the draw the conclusion that the sheer volume of raw material acquisition (i.e., logging) is sustainable even in Finland. Also, the competing forest uses are an interesting point of view of environmental management. So far, the Finnish forests have mainly been used for the purposes of traditional forest industry, but what would it

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[12]   Although, as Takala et al. (2019) point out, there is still a hegemony and domination of wood production discourse in the Finnish media. The recreation discourse is currently rising, and the non-timber forest product discourse is at a very low level.

mean for the environment if, in addition, the forests would be used increasingly for the purposes of the energy industry, chemical industry and nature tourism? Similarly, the possible rise of forest biodiversity conservation would be an interesting feature. Furthermore, as the industry itself sees sustainability as a key success factor for the future, this requires emphasis on developing the environmental performance, and hence environmental reporting.

3 Corporate environmental reports and reporting

The previous chapter reviewed the fundamentals of futures research. Next, the focus is shifted to corporate environmental management, which is the other field of research relevant to studying the futures of environmental reporting[13] in the Finnish forest industry. There is a connection between futures research and environmental reporting. Both of these approaches can be used for the strategic management of a company. Tools and methods of futures research can be used to find future directions for a company. The Finnish forest industry has recognised that sustainability is a clear future success factor for them. Environmental management is a vital part of sustainability, the other two fields being social and economic sustainability. Another similar feature in these fields is that futures research, evidently, has a clear future focus, and environmental reporting has or at least should have it too. The main difference between futures research and corporate environmental management is that corporate environmental management is also an operational tool for a company. For example, environmental reports can be used to monitor environmental performance against set targets. The literature of environmental reports will be reviewed in the following sections.

3.1 Defining environmental reports and reporting

The aim of corporate environmental management is twofold. Firstly, the aim is to decrease the environmental impacts that the company is causing (Schaltegger et al. 2003; also Welford 1999). Secondly, the aim should be to connect the environmental issues to business practice (e.g., Welford 1999; Schaltegger et al. 2003). By connecting the environmental issues to business strategy, companies are able to reap benefits from the improved performance (Welford 1999, Schaltegger et al. 2003). Companies

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[13] The author acknowledges that companies nowadays report of wider sustainability approach, including economic, environmental and social sustainability. However, this thesis is narrowed to environmental sustainability, in order to allow a more detailed focus on environmental reporting.

use various tools to achieve these aims. One of the tools is environmental reports and reporting.

Some definitions of the concepts are provided in Table 9. Environmental reporting refers to the process of gathering environmental data. One concrete result of this process is the publication of an environmental report. In addition, as Niskala et al. (2009) and Schaltegger et al. (2003) point out, environmental reporting supports the managerial decision-making at the company. Schaltegger et al. (2006) further suggest that sustainability reporting (including environmental reporting) is a way for both managers and employees to cooperate in sustainability target setting. Typically, an environmental report is a voluntary[14] description of company environmental performance (e.g., Brophy & Starkey 1998). It can take many forms (e.g., Azzone et al. 1997), from only marketing brochures to a stand-alone environmental report and sections in the annual reports. The content of the reports varies, but typically it should include descriptions of past, current and future activities and performances (e.g., Berthelot et al. 2003). Often the environmental reports are used to gain legitimacy from the external stakeholders (e.g., Branco et al. 2008).

As said, the companies need to have an internal process to gather and process the environmental data in order to produce an environmental report. The process is useful both internally – it facilitates the environmental decision-making – and externally, as it makes it possible for the stakeholders to evaluate the environmental performance of the company (e.g., Schaltegger et al. 2003; Niskala et al. 2009).

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[14]   There are some countries that have legal requirements for environmental reporting. Currently, there is an EU regulation (Directive 2014/95/EU) requiring sustainability (including environmental) reporting from certain large companies. The regulation leaves the type of reporting and also the content rather open for companies. Regarding environmental issues, the regulation only says that the 'statement should contain, as regards environmental matters, details of the current and foreseeable impacts … on the environment, and, as appropriate, on … the use of renewable and/or non-renewable energy, greenhouse gas emissions, water use and air pollution' (§7).

Table 9. Definitions of environmental reports and reporting

Reference	Definition
Environmental reports	
Deegan and Gordon (1996, 187)	'Environmental disclosures … include, among other things, disclosures relating to the interaction between an organisation and its physical and social environment. … reporting may include information about environment, energy, human resources and community involvement.'
Azzone et al. (1997, 699)	'… environmental reports can range from a simple public relations statement to a detailed and in-depth examination of the company's environmental performance, policies, practices and future direction.'
Lober et al. (1997, 58)	'… corporate environmental reports represent voluntary efforts wherein companies collect and communicate information on their environmental performance. They are generally analogous to annual reports in their corporate level presentation and style, but focus on environmental … issues.'
Brophy and Starkey (1998, 175)	'Corporate environmental reports … are publicly available, stand-alone reports issued voluntarily by companies on their environmental activities.'
Berthelot et al. (2003, 2)	'… corporate environmental disclosure as the set of information items that relate to a firm's past, current and future environmental management activities and performance.'
Lovio (2004, 172)	'An environmental report is a company's account to the stakeholders, how its environmental management has developed during the reporting period.'
Branco et al. (2008, 139)	'Environmental disclosure is seen … as one of the strategies used by companies to seek acceptance and approval of their activities from society. … LT [legitimacy theory] suggests that environmental disclosure provides an important way of communicating with stakeholders, and convincing them that the company is fulfilling their expectations.'
Environmental and sustainability reporting	
O'Dwyer (2003, 92)	'… CER [corporate environmental reporting] is taken to involve the process of communicating externally the environmental effects of organizations' economic actions through the corporate annual report or a separate stand-alone publicly available environmental report.'
Schaltegger et al. (2003, 251)	'Environmental accounting [i.e., reporting] provides monetary, physical and qualitative information to management about the environmental impacts of business and the financial consequences of environmentally relevant business activities-information that supports internal and external decision-making, reporting and accountability.'
Schaltegger et al. (2006, 4)	'The term sustainability reporting is usually used to refer to the publication of external reports … However, one main effect of sustainability reporting is the involvement of management and employees in setting sustainability goals for the cooperation, collecting data, and creating and communicating sustainability information.'
Niskala et al. (2009, 15)	'For a company, sustainability reporting is a tool to report usable information to support decision making. It supports the management systems and the integration of sustainability into the business practice. Sustainability reporting is also a way to increase the transparency according to the stakeholders' expectations and to mitigate the image risk.'

The history and development of environmental reporting is reviewed briefly in the following. Companies started to publish environmental reports in the late 1980s and early 1990s (Kolk 2004; Herzig & Schaltegger 2006; Buhr 2007; Hahn & Kühnen 2013). According to Herzig and Schaltegger (2006), the reason for this was corporate environmental accidents and disasters, such as a methyl isocyanate gas explosion accident at the Union Carbide India Ltd. site in Bhopal, India, and the Chernobyl nuclear power plant accident in Pripyat in Ukraine. It became evident that companies were causing visible environmental problems. Therefore, companies tried to increase the legitimacy of their operations by starting to publish reports about their environmental performance. In Finland, the first companies published environmental reports in 1992–1993, and the companies, or their predecessors, of this research in 1992–1995.

The next phase of environmental reporting was to combine the reporting of environmental issue together with other areas of sustainability, namely economic and social sustainability. Companies started to publish sustainability reports in the 2000s (Herzig & Schaltegger 2006; Buhr 2007; Hahn & Kühnen 2013). In 2000, the Global Reporting Initiative (GRI) launched the first version of the sustainability reporting guidelines (GRI 2020). The guidelines covered economic, environmental and social sustainability. Finnish companies followed the trend, and the companies of this research moved to sustainability reports in 2002–2004. Currently the companies publish the environmental issues as a section either in their sustainability reports or in annual reports.

The next step in reporting seems to be integrated reporting <IR>. The aim of integrated reporting is to report all the different capitals (financial, manufactured, intellectual, human, social and relationship, and natural) in one report (The International Integrated Reporting Council 2013). However, at this point it is difficult to say how successful this is. For example, de Villiers and Sharma (2017) are doubtful of integrated reporting's potential to replace the current sustainability reports.

In 2015, the United Nations (UN) launched the 2030 Agenda for Sustainable Development, which includes 17 Sustainable Development Goals (UN 2020). The Sustainable Development Goals (SDGs) are applicable by different stakeholders including business and industry. For that reason, companies have started to report on their impact and progress against the SDGs. Out of these 17 SDGs, four directly address environmental issues: SDG 6 covers clean water and sanitation, SDG 7 affordable and clean energy, SDG 14 life below water and SDG 15 life on land.

As was shown above, currently companies report environmental data as a part of sustainability reports or their annual report. Therefore, in the following, the references cited deal with both environmental and sustainability reports and reporting which will allow the use of the recent articles. In addition, as the body of literature on environmental and sustainability reporting is rather large, reference is made

mainly to studies that have used a qualitative approach in analysing the reports, as the qualitative studies tend to have a deeper approach to the nature and content of the reporting, whereas the quantitative studies more often focus on the categorisation of companies based on their reporting style.

3.2   Criticisms of environmental reports

The environmental reports, the sustainability reports nowadays, and the whole reporting practice have received a lot of criticism. The content of the reports has been criticised, for example, by Adams (2004; Adams & Frost 2008) from the point of view of the accountability of the reports, which means that the reporting of the companies does not completely reflect their sustainability performance (Adams 2004). Azzone et al. (1997), Deegan and Rankin (1999) and Hammond and Miles (2004) show that the reports do not meet the stakeholders' expectations of the information. Niskanen and Nieminen (2001), Adams and Frost (2008) and Spence (2009) notice that companies tend to report mainly positive news. The reporting process is criticised for not having the stakeholders as a part of the process (Adams 2004; Brown & Dillard 2015), even though the reports are or at least should be prepared for the stakeholders. The process is considered managerial (e.g., Brown & Fraser 2006), meaning it assumes direct financial business benefits as a result. These and additional criticisms are reviewed in the following.

   The accountability of the reports has been questioned. For example, Adams (2004) compares what a company reports to external sources and notices that the different sources paint a different picture of the company's performance. Especially, she notices that the company tends to favour reporting on positive performance. The accountability problem has been shown recently by Cho et al. (2018). They compare the sustainability reporting of US oil companies with the data of companies' political funding contributions. They found that although the companies highlight in their reports their values for nature and natural conservation, their backstage actions tell a different story by ensuring oil-drilling possibilities in natural reservoirs. Niskanen and Nieminen (2001) studied the objectivity of the environmental reporting by comparing it with the news disclosed in the media. They conclude that environmental reporting cannot be considered objective, as the companies report less negative news than is reported of them in the media. Later, Adams and Frost (2008) studied seven companies and their approach to integrating sustainability practices into business practice. They notice that the accountability of the sustainability information towards the external stakeholders is compromised if the information could present the company negatively. Moreover, Spence (2009) studied the target audiences of sustainability reporting. He finds that the main target audiences are employees and investors,

but the sustainability reporting itself is still not really targeted on stakeholder communication but just to promote a certain (positive) image of the company.

The quality of the reports has been studied and found to be somewhat problematic. In 1999, Deegan and Rankin proved the existence of the expectation gap between the environmental report preparers and users. This means that the users of environmental reports expect to get more high-quality environmental information than the preparers are providing. Hopkinson et al. (1999) researched the UK water industry reporting and noticed that the industry does not use the standardised environmental performance indicators. What makes the comparison even more difficult is the use of different units of measurements. Hammond and Miles (2004) examine the perceptions of the report quality among the preparers of the reports and the assessment organisations. Their findings show that the preparers of the reports had lower requirements for the quality. Later, Dragomir (2012) analysed greenhouse gas emission reporting of five companies with the conclusions that their reporting is of low quality regarding credibility and relevance.

Studies have shown that **the image of a company's performance** is different when comparing the company reporting with the external sources. Laine has noticed that different pictures emerge even from inside the companies. Mäkelä and Laine (2011) compare the CEO message of annual reports to those in sustainability reports. They find that in the annual reports, the CEOs highlight the economic dimensions like growth and profitability. However, in sustainability reports, the same CEOs have a 'wellbeing' discourse, which means that companies provide 'wellbeing in the society at large' (Mäkelä & Laine 2011, 228). Cho et al. (2015) show that even the company itself can provide multiple images (or façades, as they name them) of itself. They show that based on the annual reports, the companies emphasise the economic dimension (rational façade). In the sustainability reports, the companies describe their actions with less concrete topics, such as future-oriented decisions and possible actions (progressive façade), and broad statements and general commitments (reputation façade).

As said, not only the reports but **the whole reporting process** is critiqued by the researchers (e.g., Adams 2004). In Adams's (2004) opinion, if a company wants to produce a high-quality report and meet the stakeholders' expectations, the stakeholders should be consulted in the process, but quite often the reports are produced without the participation of the stakeholders. The second major critique of the reporting deals with the managerial approach. Brown and Fraser (2006) nicely explain why the managerial approach is problematic. They describe, for example, that the sole purpose of reporting would be to yield business profits for the company and the shareholders. The wider approach of stakeholder accountability is not the question here. According to Brown and Fraser, reporting is seen as a tool of risk management.

Gray goes even further by suggesting that sustainability reporting might even promote the unsustainable practices of the companies. In Gray and Bebbington (2000), he argues that environmental accounting (including environmental reporting) is a managerial practice and the aim of managerial actions is to promote business, which typically causes environmental impacts. Therefore, environmental accounting and reporting cause environmental impacts. His worry is that researchers often think that if companies participate in environmental reporting, the companies are reducing environmental impacts. Gray's argument is that environmental reporting does not automatically transform into a decrease in environmental impacts.

The critiques of the environmental reports and reporting can be seen as a key motivation for this study. The interest in studying the environmental reports and reporting in the forest industry began because I knew that they were the first to start publishing environmental reports in Finland. This equalled the opportunity to get a long data series for the study. However, together with reading the literature and analysing the reports, it became evident that these reports suffer from some weaknesses, as will be explained in Section 6.4.

3.3   Environmental reporting in the forest industry

This chapter reviews the prior research on environmental reporting in the forest industry.[15] The found studies are summarised in Table 10. Relatively few studies were found – only 16. This is a very small number compared to the body of literature on sustainability reporting: Fifka (2012) found 198 studies and Hahn and Kühnen (2013) 178 in their meta-analysis. In addition, the previous studies have typically focused on analysing the large body of the largest companies (Fifka 2012) and not focusing on the analysis of a certain industry. However, recently forest industry has received increasing attention – four studies were published in 2017 and 2018.

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[15]   Quite strict boundary selection has been applied: only those studies are included here that solely focus on the forest industry. For example, studies are excluded that analyse, in addition to the forest industry, other industrial sectors. The only exception is the study of Laine (2010), as he studies one forest industry company and two non-forest industry companies. This study is included, as the forest industry results are presented separately. Furthermore, only the studies that analyse environmental reporting are included. For example, sustainability reporting analyses are included when they report the results of environmental reporting. If only social reporting is analysed, these studies are excluded

Table 10. Content analysis of forest industry reports

Reference	Case companies	Companies of the current research	Topic of the study	Key environmental reporting results
Sinclair and Walton (2003)	Top 100 global forest industry companies according to PricewaterhouseCoopers's list	At least Stora Enso (the analysed companies are not listed but Stora Enso is given as an example)	Forest management and fibre procurement	Largest companies published environmental reports more often than the smaller ones. Asia-Pacific companies (esp. Japan) reported most often; also, European and North American companies reported often. Forest management was often reported by the companies but only from the point of view of forest certification. Fibre procurement was seldom reported by the companies and with various indicators.
Mikkilä and Toppinen (2008)	Top 10 global pulp and paper companies (1)	All three companies: Stora Enso, UPM-Kymmene and Metsä Board	Sustainability reporting	Environmental reporting is in general highly institutionalised among the companies: companies report similarly about environmental management systems, raw material supply, pollution prevention, energy and recycling. However, use of some indicators is diversified, such as environmental economic indicators (e.g., costs, investments) and sustainable forest management.
Vidal and Kozak (2008a)	Top 100 global forest industry companies according to PricewaterhouseCoopers's list (51 companies)	Two companies: Stora Enso and UPM-Kymmene	Sustainability reporting	Forest industry companies' mostly report on sustainable forest management. Other often-reported environmental aspects related to recycling, certification, air and water. The Asian, Oceanic and European companies focus on environmental aspects in their reporting.
Vidal and Kozak (2008b)	Top 100 global forest industry companies according to PricewaterhouseCoopers's list (20 companies)	Two companies: Stora Enso and UPM-Kymmene	Sustainability reporting	The amount of environmental information is decreasing in the reports (as companies report more on other areas of sustainability). But still, sustainable forestry is the most commonly reported theme of sustainability.

				In the top 10 most commonly reported themes, other environmental aspects were certification, energy and procurement.
Laine (2010)[16]	One forest industry company (and two non-forest industry companies)	One company: Stora Enso	Sustainability reporting	Environmental sustainability is reported by Stora Enso very early on (at least from 1992 and 1993 onwards). In recent years, sustainability becomes a business concept (instead of a society-wide concept) which meant that, e.g., only climate change issues are reported regarding the environmental impacts.
Li et al. (2011)	Top 100 global forest industry companies according to Pulp and Paper International (66 companies)	All three companies: Stora Enso, UPM-Kymmene and Metsä Board	Sustainability reporting	Environmental indicators are most often reported by the forest industry companies.
Toppinen et al. (2011)	Top 100 global forest industry companies according to Pulp and Paper International (66 companies)	All three companies: Stora Enso, UPM-Kymmene and Metsä Board	Sustainability reporting	As the article focuses on strategic groups of sustainability reporters, environmental reporting is not analysed in detail. However, the results show that environmental indicators are the most often reported by forest industry companies.
Han and Hansen (2012)	Top 100 global forest industry companies according to PricewaterhouseCoopers's list (80 companies)	All three companies: Stora Enso, UPM-Kymmene and Metsä Board	Sustainability reporting	Environmental responsibility was the most commonly reported area. Inside environmental responsibility, resource and energy use, sustainable forestry, climate change, and pollution and water management were the most commonly reported.
Toppinen and Korhonen-Kurki (2013)	Three large forest industry companies	One company: Stora Enso	Sustainability reporting	Environmental responsibility was the most commonly reported area.

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[16]   Laine (2010) is included here, although two out of the three analysed companies are not forest industry companies. The reason for inclusion is that Stora Enso's reporting is described in detail. The results covered in the table of this research focus only on Stora Enso's results.

Rodrigue et al. (2015)	A Canadian forest industry company	None of the companies	Environmental reporting	Topics related to sustainable development (such as recycling, conservation of natural resources and forest management) were the most often reported environmental issues. The company reported very little on laws and regulation, and on land contamination. In general, the company hardly reported any negative items for its performance.
Toppinen et al. (2015)	Top 100 global forest industry companies (2)	The analysed companies are not listed	Sustainability reporting	Environmental disclosure is more common than social disclosure both in CEO letters and on social media.
Lähtinen et al. (2016)	13 large, global forest industry companies	Two companies: Stora Enso, UPM-Kymmene	Biodiversity and ecosystem services in supply chain management	Companies more often reported the indirect environmental impacts than the direct impacts. Companies also reported more often on the positive contributions than on the negative. Regarding the supply chain focus, the companies reported more on the upstream activities than on the downstream.
Jones and Comfort (2017)	Top 10 global forest industry companies (PricewaterhouseCoopers)	Two companies: Stora Enso, UPM-Kymmene	Sustainability reporting	Forest industry companies report mainly on environmental and social responsibility. Inside environmental responsibility, companies typically reported on climate change, energy, sustainable forest management, biodiversity, water management, and waste management and recycling.
Liubachyna et al. (2017)	Nine state forest enterprises	None of the companies	Sustainability reporting	Environmental performance indicator reporting varies between the state forest companies. Sustainable forest management is the most often reported environmental performance indicator. Other environmental indicators that the state forest enterprises use are biodiversity, waste management, pollution and energy.
Lu et al. (2017)	42 Chinese forest industry companies	None of the companies	Sustainability reporting	Environmental reporting is more common than economic and social reporting. However, there is great variation in the amount of environmental information that the companies provide, as some companies do not report on the environment at all.

Colaço and Simão (2018)	37 forestry companies operating in Congo Basin	None of the companies	Sustainability reporting	Environmental reporting is more common than economic and social reporting. Forest protection is the most commonly reported theme of environmental reporting, followed by certification, management of resources and energy, biodiversity, transportation, origin and traceability, and climate change.

Note on Table:

(1) The selection criteria for the companies are not specified in Mikkilä and Toppinen (2008); they just speak of 'the world's ten largest pulp and paper companies'.

(2) The selection criteria for the companies are not specified in Toppinen et al. (2015); they just speak of 'the world's 100 largest pulp and paper companies'.

Mainly, the previous studies have analysed sustainability reporting. Only three exceptions were found. Sinclair and Walton (2003) analyse forest management and fibre procurement reporting. Rodrigue et al. (2015) compare the environmental reporting of a Canadian forest industry company with the reporting of the external stakeholders. Lähtinen et al. (2016) analyse biodiversity and ecosystem services reporting. But as noted above, all the studies selected here report the results of environmental reporting.

The previous studies have mainly focused on the top global companies, which means that it is mainly the forest industry practices of Western companies that have been analysed. Some exceptions, however, do exist. Lu et al. (2017) analyse the Chinese forest industry's reporting, and Colaço and Simão (2018) focus on the forest industry companies operating in the Congo Basin. In terms of environmental reporting, a few characteristics can be highlighted here. The previous studies have frequently noticed that environmental aspects are the most often reported in comparison to the other areas of sustainability. What is really reported on environmental issues varies between the studies. However, some common elements can be found. For example, eight studies mentioned that forest industry companies report on forests (either on sustainable forest management or on forest certification). Furthermore, in six studies, companies report on energy. In four studies, the companies report on management systems and certification, as well as on raw material supply. Three studies say the companies report on environmental impacts, such as climate change and biodiversity.

In addition, the studies have shown that typically it is the largest companies and companies from Europe that report on environmental aspects. However, Sinclair and Walton (2003), Mikkilä and Toppinen (2008), Liubachyna et al. (2017) and Lu et al. (2017) show that environmental reporting varies between companies. Sinclair and Walton (2003) notice that fibre procurement was seldom reported by the companies. Lu et al. (2017) show that environmental issues are not reported by all of the studied forest industry companies.

Last, two characteristics of the previous studies are worth mentioning. Vidal and Kozak (2008b) notice that, when comparing the forest industry reporting of 2002 and 2005, the amount of environmental information is decreasing in the reports. They saw this positively, as it means that the other areas of sustainability received more focus. Furthermore, both Rodrigue et al. (2015) and Lähtinen et al. (2016) show that the companies tend to report positively: Lähtinen et al. (2016) show that their case companies report mainly on the positive achievement of environmental management in comparison to the negative impacts. Rodrigue et al. (2015), on the other hand, show that their case company had only two negative sentences out of the total 870 sentences.

As the review above shows, there is a rather limited body of research on environmental or sustainability reporting in the forest industry. The main body of the literature has focused on analysing the broad area of sustainability reporting, as only a few have narrowed the analysis to a certain topic of environmental or social reporting. The current research contributes to this literature by going deeper on the environmental reporting of a branch seldom analysed: the forest industry.

3.4　Futures research on environmental reporting

Next, the two main areas of this research – futures research and environmental reporting – are linked together. The sustainability reporting literature is reviewed in order to find out how the futures reporting is covered. Only a handful of studies were found, and these are reviewed in the following.

Four studies were found to directly focus on the future of sustainability reporting in different contexts. Several meta-analyses were found that suggested, based on the literature review, avenues for future research. One of these (Lee & Hutchison 2005) address the environmental reporting, while the rest focus on sustainability reporting. Third, some researchers have narrowed the literature review approach either by countries or by sectors. Last, the new feature of reporting, integrated reporting, has already been reviewed.

In their study, O'Dwyer et al. (2005) focus on the future of sustainability reporting from the point of view of Irish NGOs by interviewing the NGO representatives. Their main conclusion can be summarised as that the NGOs want 'stand-alone, mandated, externally verified' reporting (O'Dwyer et al. 2005, 14). The interviewed NGOs emphasised their right to information, i.e., the 'public's right to know about the key corporate activities impacting on their lives' (O'Dwyer et al. 2005, 22). The NGOs demanded information that is credible and reflects the actual performance. Belal and Owen (2007) studied the current state and, briefly, the future of social reporting in Bangladesh by interviewing company representatives. Their results regarding the future reporting state that social reporting would become more common in the future in Bangladesh. The reason behind this is that the external stakeholders (like investors, foreign customers and international organisations) would require it. In the future, the role of national NGOs might increase in promoting the reporting.

Milne and Gray (2007) analyse the past sustainability reporting trends and extrapolate them to the future. They first analyse the quantity of reporting: there is a rise of from fewer than 100 in 1993 to more than 1500 in 2003. Although this sounds significant, the problem is that already in 2007, when Milne and Gray wrote the chapter, the increase was slowing. In addition, according to their statistics, it is typically up to 50 per cent or less of the companies in an industrial sector that publish a report. What Milne and Gray are more worried about is the quality of the reports.

Very few companies provide reports that would be of even reasonable quality. Milne and Gray aggravate this by stating 'perhaps at best 0.2 per cent of multinationals provide credible and reasonable accounts of their vast impacts on society and the environment' (Milne & Gray 2007, 192). As Milne and Gray point out, their figures here cover only the large companies, and globally SMEs and non-profit organisations should report about sustainability issues. A third point that worries them, in relation to the quality of the reports, is that what the companies report has little to do with the true sustainability challenges faced in the world. Their conclusion about the future is that if companies' reporting would really be called sustainability reporting, it should be required from every company and it should address how unsustainable the company is.

Adams and Whelan (2009) analyse the role of external stakeholders (governments, academia, NGOs, media and sustainability industry) in influencing the future of sustainability reporting. Their research was based on the previous literature. Their main conclusion is that the external stakeholders should, in the future, cooperate in order to make the companies realise that high-quality sustainability reports are needed. They reason this with the fact that the managers are not keen to react based on just one stakeholder's concerns but the different stakeholders have a different level of influence on the companies: For example, governments can set laws to require reporting. The articles published by researchers might be easily ignored by the companies, as some NGOs certainly are. The media were seen to have strong influence by spreading bad publicity about companies. Sustainability industry was valuable for companies, as it can offer sustainability models to follow.

A meta-analysis of the previous literature typically offers ideas or research questions for the future. Lee and Hutchison (2005) analyse the previous environmental reporting literature from the point of view of what determines the reporting. They raise, for example, the following as future research questions: what should be disclosed? How do the national requirements for reporting differ? What affects the decision to publish?

Burritt and Schaltegger (2010) analyse the previous sustainability reporting literature from two perspectives, first from the critical perspective that sees sustainability accounting and reporting as causing the sustainability problems of companies. Yet the second, or the management perspective, on the contrary, sees sustainability accounting and reporting as one tool for company managers to use to make better decisions. The future based on these two is that both are important in order to make companies more sustainable. According to the critical perspective, one would need to understand that the current tools do not promote sustainability, and according to the management perspective, one would need to accept that no fast improvements are achievable, but still one would need to work to improve the current tools.

Moreover, Fifka (2012; 2013) performed an extensive literature review by focusing first on the development of sustainability reporting (Fifka 2012) and then on the determinants of sustainability reporting (Fifka 2013). In the fashion of meta-analysis, his suggestions for future research include:

1.   The reporting practices of developing countries should be researched more.

2.   Though we know quite a lot about the companies' reporting practices, we know only a little of the perceptions of the report readers.

3.   We know little about the companies' targets for publishing the results (for example, who are they trying to reach). In this regard, Fifka (2013) points out that research methods other than just content analysis should be used.

4.   Reports published in languages other than just in English should be studied. Similarly, it would be interesting to study whether companies operating in non-English-speaking countries publish the reports (only) in English.

5.   As the research has mainly focused on the content of the reports, more emphasis in the future should be placed on the quality of the reports. In this regard, he remarks that as the previous studies have mainly been quantitative, one should carefully assess whether we are researching the right features with these studies.

6.   Regarding the size of the studied companies, the SMEs should be studied, as the main focus so far has been on large, multinational companies.

7.   The research so far has mainly focused on the annual reports, standalone sustainability reports and webpages, yet companies still publish sustainability-related material in other sources as well (labels, booklets and print or television advertisements), and these should be studied.

Hahn and Kühnen (2013) reviewed the reporting literature from 1999 onwards focusing on the determinants of sustainability reporting. In addition, they suggest future research topics. They raise five general topics, namely voluntary vs. mandatory reporting, governance issues at the company and country level, reporting quality, stakeholder engagement and perception, and external assurance. From each of these, they name the specific research questions that should be addressed. Their future research questions are, e.g.:

•   Does legal pressure increase comparability and/or quality of the reporting?

- Can global standards and soft law overcome the drawbacks of voluntary disclosure?

- Does sustainability reporting (practice and guidelines) improve stakeholder accountability, and does stakeholder integration improve credibility and accountability?

- Does sustainability reporting convey a true and fair view of corporate sustainability performance?

- Does the reporting of negative aspects influence stakeholder perception?

- Is sustainability reporting oriented towards the information needs of certain stakeholders (e.g., investors)?

- Does assurance influence (perceived) reporting quality?

The next group of studies (three studies in all) consists of literature reviews, but instead of general literature reviews, these have been narrowed to certain countries or industries. Belal and Momin (2009) studied the sustainability reporting practices in developing countries via a literature review. They suggest directions for future research. They, for example, recommend that in developing countries, one should study how the different media for reporting are used and whether there are differences in the content; why corporate social responsibility (CSR) reporting is done by large companies; what the NGOs think about CSR reporting; and why, in general, companies report so little or nothing at all on CSR.

In addition, Lodhia and Hess (2014) performed a literature review, but the focus was solely on the sustainability reporting literature of the mining industry. Based on their review, they make several suggestions for future research. For example, they name the topical issues, such as integrated reporting, climate change and water accounting, as worth researching. They also highlight that more studies should be conducted in developing countries. Lohdia and Hess (2014) stress the importance of social issues together with environmental issues. Lastly, they name the roles of stakeholders in reporting and the legal aspects of reporting as areas for future research.

Similarly, Ceulemans et al. (2015) reviewed the literature focusing only on the sector of higher education. Based on their review, they raise four topics for future research: sustainability reporting and organisational learning and change; the stakeholder engagement process and third-party assurance; linking sustainability reporting to general sustainability management; and studying tools and indicators for sustainability reporting.

At present, a new way of reporting is the integrated reporting framework. De Villiers and others have already analysed its futures. Although integrated reporting could be seen as the future of sustainability reporting, de Villiers et al. (2014) point

out that, at least now, their starting points are different: 'While sustainability reporting aims at providing social, environmental and economic information to a wide range of stakeholders, integrated reporting now seeks to present information related to broad risk evaluation and potential future value growth thus appealing to capital providers and potential investors' (de Villiers et al. 2014, 1059).

De Villiers et al. (2014) list multiple future research questions, out of which I highlight a few in the following. They, for example, list the following as possible future research ideas:

- the differences between of (traditional) sustainability report and an integrated report,
- the organisations' abilities to predict the future,
- the differences in reporting in different countries (i.e., in different cultures),
- the effects of integrated reporting in the auditing and assurance process,
- the stakeholder demands for information in integrated reporting,
- the role of integrated reports in comparison to the mandatory annual reports, and
- the evaluation of the quality of an integrated report.

In the second paper (de Villiers et al. 2017), they propose a set of future research topics. First, they raise multiple research questions in relation to the financial benefits of integrated reporting for a company, e.g., the effects on firm value, cost of equity capital and liquidity. As integrated reporting is still a new practice, more research is required from different countries (in order to analyse of the cultural influence). Moreover, de Villiers et al. highlight the research of changes caused by the reports: for example, whether investors change investment decisions or managers make decisions based on the IR reports.

In sum, this chapter has shown that sustainability reporting is a wide research area. However, only a very limited number of studies have focused on the future of sustainability reporting. Typically, the future is addressed as recommendations or conclusions of the meta-analysis of previous research. Based on the studies above, some common features about the future of sustainability reporting can be raised. The researchers shared the concern regarding the quality of the current reports. In essence, two suggestions were made: that reporting should be mandatory and that the reports should be externally verified. Although the researchers acknowledged that there already exists a wide body of literature, some areas are less researched. For example, the reporting practices in developing countries are under-researched, as are those of small and medium-sized companies and non-profit organisations. In addition, the previous research has focused almost solely on the published reports, and

recently to a certain degree on webpages, but still companies publish a great deal of other sustainability-related material that has not been the subject of much research. Last, the content of the reports has been rather thoroughly researched, but the perceptions of the readers and preparers of the reports is less studied.

The thesis partly answers the abovementioned shortcomings and, partly, this research allows for strengthening the results of the previous sustainability reporting studies. The previous studies have shown that environmental reports often have the problem that they do not give a comprehensive picture of the environmental performance of the company. The acknowledgment of this problem is the starting point of this research. The main aim here is to describe how the Finnish forest industry's reports could and should be improved in the future. Also, this study contributes to the narrow field of futures research in sustainability reporting. Furthermore, the previous studies have shown that the study of sustainability reporting should not only focus on the sustainability reports. In the current research, the environmental reports are a major part of the data, but data are also gathered via expert interviews and with a Delphi panel. However, as has been said, the majority of the previous studies have focused on the large, multinational Western companies, and the current research is no exception here, as the large Finnish forest industry companies are in fact large multinational enterprises, the two largest with 10 billion euros in sales.

4 Methodological approach, material and methods

## 4.1 Methodological approach

This research represents a qualitative research approach. According to Hirsjärvi et al. (2001), the starting point of qualitative research is to describe real life. Sandelowski (2004) further explains the aim of understanding and describing a phenomenon (also Koskinen et al. 2005; Eriksson & Kovalainen 2013). Eriksson and Kovalainen (2013, 3) further specify the meaning in business research by explaining that qualitative research 'gives the researcher an opportunity to focus on the complexity of business-related phenomena in their context'. The business-related phenomena here are environmental reporting practices, and the context is the Finnish forest industry. Following the logic of qualitative research, the aim here has been to understand and describe the reporting in order to offer suggestions for future improvement.

A characteristic of qualitative research is that it provides a critical and reflexive view of the phenomenon (Eriksson & Kovalainen 2013). Hirsjärvi et al. (2001) add that qualitative research typically offers the possibility to research the topic widely. The topic of this research has been studied rather widely: the past, present and future of environmental reporting have been researched with multiple methods. Another typical principle in qualitative research is purposive sampling (Hirsjärvi et al. 2001; Sandelowski 2004), which was used here. The experts both in the interviews and in the Delphi panel were handpicked to represent expertise in environmental reporting in the Finnish forest industry.

The study uses multiple methods to describe the past, present and future reporting practices of the Finnish forest industry. Qualitative content analysis is applied to 10–15 years of environmental reports of three Finnish forest industry companies in order to describe the past trends of the reporting. Theme interviews were conducted with experts of environmental management and the forest industry to gather insights into the current reporting and measuring practices of the Finnish forest industry. A Delphi panel evaluated the perspectives of the measurement and reporting of environmental performance in the forest industry. The focus of the Delphi panel was to collect ideas for the improvement of the current reporting practices in the future in

the Finnish forest industry. Within each material, the main analysing method or approach is qualitative. The methods and materials are explained in detail in Section 4.3.

Figure 4 connects the research methods with the timescale of the thesis. Past of the reporting is analysed via content analysis of the environmental reports of the companies of the study. These results are reported in Articles I–III. The present situation is gathered from the reports, expert interviews and Delphi panel. This is reported in all of the articles (I–V). Last, the future is addressed in the interviews and in the Delphi panel and reported in the last two articles (IV–V). The content of the research papers is reported briefly in Chapter 5.

THE TIMESCALE OF THE THESIS

METHODS | PAST | PRESENT | FUTURE

CONTENT ANALYSIS — Articles I, II, III (RQ1)

INTERVIEWS — Article IV (RQ2)

DELPHI — Article V (RQ3)
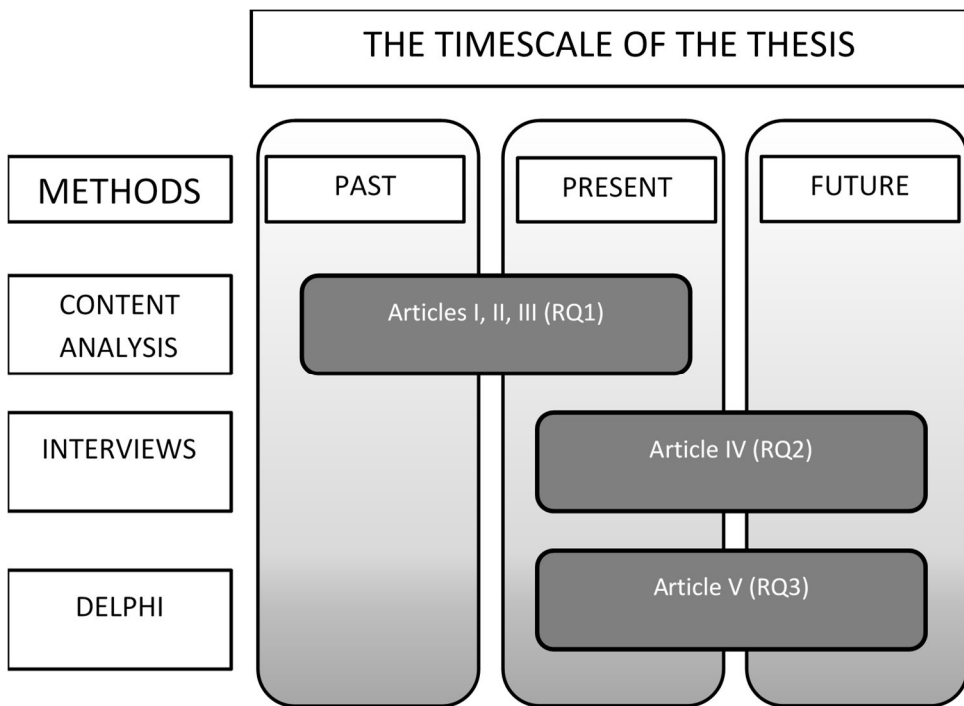
Note on the Figure:
RQ = research question

Figure 4. Connecting the research methods with the thesis timescale

4.2 Research context: Environmental reporting in the Finnish forest industry

4.2.1 Environmental aspects and impacts in the Finnish forest industry

The forest industry belongs to material-intensive 'heavy' industry. They use a considerable amount of raw materials, water and energy in production and, as a result, produce (besides the wanted products) various types of emissions and solid waste. Both these inputs and outputs cause environmental impacts that range from effects on the landscape and biodiversity (Mielikäinen & Hynynen 2003) to eutrophication, acidification and climate change (Klein et al. 2015). Logging affects landscape, biodiversity and the loss of carbon sinks. Nitrogen and sulphur oxides emissions to air cause acidification, and greenhouse gas emissions cause climate change. Nutrient and organic matter emissions to water cause eutrophication and some other substances cause chemicalisation.

The Finnish forest industry seems to have a rather good environmental track record. Nationally, the forest industry is an interesting research topic from the environmental management and reporting point of view. In the 1960s and 1970s, the forest industry companies were one of the worst polluters in Finland. Many of the waterworks by which they operated were badly polluted. But due to changes in public opinion and environmental legislation, the forest industry has gradually cleaned up its practices.

The industry itself promotes, as a success, that they have been able to decrease the amount of emissions that they have caused. In order to show a positive development, the industry openly publishes their environmental data starting from the early 1990s. Especially when taking a look at the specific emission[17] reduction rates (see Table 11), the improvements in the industry have been noteworthy. However, currently the pace of improvement has decreased or even stopped. Between 1992 and 2012, significant improvements (over 80 per cent reductions) have been achieved in the specific emissions of sulphur dioxide (SO_2), particle matter, biological oxygen demand (BOD), adsorbable organic halides (AOX), and in the specific amount of landfill waste. In 2012–2016, however, the development had levelled off in emissions of SO_2, nitrogen oxides (NO_x), particles, and phosphorous (P). Despite the good environmental record of accomplishments in Finland, the industry still causes considerable environmental impacts in the country. For example, the Finnish forest

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[17]   The term 'specific emissions' refers to emissions relative to the amount of production.

industry consumed about 20 TWh electricity in 2013, which equals 24 per cent of all the Finnish industry's electricity consumption (FFIF 2014b).

Table 11. The development of specific emissions in the pulp and paper industry in Finland (1992–2016) (FFIF 2013; 2017b)

	Emissions (kg)/Production (tn) 1992	Emissions (kg)/Production (tn) 2012	Emissions (kg)/Production (tn) 2016	Development 1992–2012 (%)	Development 2012–2016 (%)
Air emissions					
CO_2	478 (1)	193	178	-60	-8
SO_2	2.0	0.3	0.3	-85	0
NO_X	1.8	1.3	1.3	-28	0
Particles	1.2	0.2	0.2	-83	0
Water emissions					
BOD	5.7	0.7	0.6	-88	-14
COD	31.1	9.7	9.8	-69	+1
AOX	1.1	0.2	0.1	-82	-50
Solid particles	3.3	1.0	0.8	-70	-20
P	0.04	0.01	0.01	-75	0
N	0.3	0.2	0.1	-33	-50
The amount of wastewater	70	33	30	-53	-9
Waste					
Landfill waste	89	11	5	-88	-55

Note on the Table:
(1) Compared with 1990.
CO_2 = carbon dioxide
SO_2 = sulphur dioxide
NO_X = nitrogen oxides (refers to NO and NO_2)
BOD = biological oxygen demand
COD = chemical oxygen demand
AOX = adsorbable organic halides
P = phosphorus
N = nitrogen

Although the relative emissions have considerably decreased, the absolute emissions figures are nonetheless high due to the high production volumes of the industry. In 2016, air emissions were as follows: direct carbon dioxide (CO_2) emissions amounted to 3.1 million tonnes, NO_X emissions were at 18,000 tonnes and SO_2 emissions at 1770 tonnes (FFIF 2017b). Furthermore, in 2016, the following water emissions were released: total suspended solids (TSS) 10,600 tonnes, BOD 8,700 tonnes, chemical oxygen demand (COD) 137,000 tonnes and AOX 860 tonnes (FFIF 2017b). Landfill waste is produced by the industry, amounting to 68,500 tonnes in 2016 (FFIF 2017b). In Table 12, the changes in absolute emissions of the industry in 1992–2012 and 2012–2016 are compared. The absolute emissions have decreased significantly, especially with regard to the water emissions of BOD and AOX, and in air emissions of sulphur and particles. However, the removal of nitrogen oxides in air emissions has only been modest (5–6 per cent). In addition, the emissions reduction rates are slowing. In 1992–2012, the reduction rates were over 50 per cent (except for nitrogen compounds), whereas in 2012–2016 the reduction rates were only up to 21 per cent (except sulphur in air emissions).

In comparison to the total industrial emissions of Finland, the forest industry emissions are significant. Table 13 presents a set of emissions to air and water from the forest industry and from the industry in total. The forest industry's share of air emissions varies from 9 to 64 per cent. The forest industry is the main contributor of bio-based CO_2 emissions, particles and carbon monoxide in Finland (Statistics Finland 2019). Energy production is the main contributor to greenhouse gas emissions. Regarding the emissions to water, the forest industry produces over 60 per cent of the amount of wastewater and over 60 per cent of the emissions to water. Industrial BOD, COD and AOX emissions are almost completely caused by the forest industry.

Table 12. Absolute emissions and their changes in the Finnish forest industry, 1992–2016 (FFIF 1993; 2013; 2017b)

	Amount in 1992 (tonnes)	Amount in 2012 (tonnes)	Amount in 2016 (tonnes)	Development 1992–2012 (%)	Development 2012–2016 (%)
Production					
Paper and board	9,100,000	10,700,000	10,100,000	+18	-6
Pulp	5,400,000	10,200,000	7,500,000	+89	-26
Water emissions					
Solid particles	35,000	13,500	10,620	-61	-21
BOD	61,000	9,950	8,660	-84	-13
COD	330,000	132,910	137,190	-60	+3
AOX	4,900	930	860	-81	-8
Phosphorous	480	130	120	-73	-8
Nitrogen	3,330	2,180	1,980	-34	-9
Air emissions					
Sulphur (in SO_2)	31,300	4,840	2,090	-85	-57
Nitrogen oxides	19,100	18,140	17,960	-5	-1
Particles	13,000	2,730	2,480	-79	-9
CO_2	NA	3,100,000	3,100,000	NA	0
Waste					
Toxic waste	1,850	NA	NA	NA	NA
Landfill waste (as dry waste)	NA	146,600	68,500	NA	-53
Other waste (including toxic waste)	NA	13,600	5,100	NA	-63

Note on the Table:

CO_2 = carbon dioxide

SO_2 = sulphur dioxide

BOD = biological oxygen demand

COD = chemical oxygen demand

AOX = adsorbable organic halides

Table 13. Emissions in the forest industry and in the industry of Finland (Statistics Finland 2019; Finnish Environment Institute 2019)

Emissions	Forest industry (tonnes)	Industry in total (tonnes)	Share of forest industry's emissions (%)
Emissions to air in 2016			
Greenhouse gases	3,100,000	29,900,000	10
CO_2 from biofuels	20,500,000	32,100,000	64
Particles	2,500	6,000	43
Carbon monoxide	25,300	49,300	51
Ammonia	50	600	9
Emissions to water in 2015			
The amount of wastewater	574,300	852,700	67
Particles	12,600	15,200	83
BOD_7	8,330	8,360	99
COD_{cr}	149,600	151,600	99
AOX	770	780	99
Ptot	130	150	87
Ntot	2,100	3,100	68

Note on the Table:
CO_2 = carbon dioxide
BOD = biological oxygen demand
COD = chemical oxygen demand
AOX = adsorbable organic halides
P = phosphorus
N = nitrogen
Due to the different origins of the statistics, the air emissions are from 2016 and water emissions from 2015.

4.2.2 Application of environmental management tools in the Finnish forest industry

Forest industry companies have a long tradition of environmental reporting in Finland. As mentioned already, these companies were among the first to start to publish environmental reports in the early 1990s in Finland (Lovio & Kuisma 2004). Metsä Board started to publish environmental reports in 1992, UPM-Kymmene in 1995 and Stora Enso in 1998. The long tradition means that there are long data series to be studied. In the current research, 10–15 years of reports are studied. For each year, each company's main environmental report was selected for analysis (see Table 14

for details). This means that not every report published by the case companies during the timeframe was selected (i.e., annual reports were mostly excluded even if they contained environmental information). The boundary setting of 10–15 years of reports caused the limitation of the study to the three biggest Finnish forest industry companies. The other Finnish forest industry companies either do not report at all or have not reported for a long period. Mostly, the reason behind this is that the rest of the other companies are rather small ones that operate only in Finland or only locally.

The three biggest forest industry companies in Finland were studied in this research. Basic information of these companies is presented in Table 15. All the companies have their headquarters in Finland, but they operate globally. Stora Enso was established in 1998 after the merger of Enso Ltd, a Finnish company, and Stora Kopparbergs Bergslags Limited, a Swedish company. Today Stora Enso has mills in 20 countries. UPM-Kymmene was formed in 1995 from two Finnish corporations: Kymmene Corporation and Repola Ltd and its subsidiary United Paper Mills Ltd. Today, UPM-Kymmene operates in 46 countries. Metsä Board was established in 2012 when the Finnish company M-real (previously Metsä-Serla) changed its name to Metsä Board. Metsä Board is part of a larger corporation called the Metsä Group. Metsä Board operates in two European countries and Metsä Group in 30 countries. Stora Enso is the largest of these three and Metsä Board the smallest, as measured by sales.

All three of these companies have a long tradition in environmental management, including in environmental reporting. Regarding the environmental management system certifications, Metsä Board has ISO 14001 certification in its every mill, whereas the ISO 14001 certification percentage is 80 for Stora Enso and 92 for UPM-Kymmene. Stora Enso and Metsä Board do not make available their figures for EMAS certifications. UPM-Kymmene, however, is actively promoting EMAS registration and is currently also registering the mills outside Europe accordingly. Regarding the chain-of-custody certification, both the Forest Stewardship Council (FSC) and Programme for the Endorsement of Forest Certification (PEFC), Metsä Board has registered all its sites and UPM-Kymmene around 90 per cent. Stora Enso has had a somewhat different approach: they have registered almost all of their sites with the FSC, but for PEFC certification, their rate is around 70 per cent. As Tuppura et al. (2016) point out, international figures for the number of certifications are difficult to find. Based on their survey of large, international forest industry companies, they found that 26 (43 per cent) companies have registered with the PEFC and 45 companies (75 per cent) with the FSC out of the 60 companies that replied to the survey. Regarding ISO 14001, the certification rate was 47 companies (78 per cent) (Tuppura et al. 2016). In comparison to these figures, Stora Enso is in line with the international figures, and UPM-Kymmene and Metsä Board a bit ahead.

Table 14. The type and length of the forest industry's reports, 1998–2019

	Stora Enso		UPM-Kymmene		Metsä Board	
Year	Type	Pages	Type	Pages	Type	Pages
1998	CER	40	CER	32	CER	50
1999	CER	36	CER	44	CER	54
2000	CER	40	CER	48	CER	50
2001	CER	34	CER	48	CER	44
2002	CER	36	CSRR	52	CER	49
2003	CSRR	56	CSRR	83	CER	40
2004	CSRR	66	CSRR	63	CSRR	60
2005	CSRR	58	CSRR	63	CSRR	60
2006	CSRR	58	CSRR	51	AR	112
2007	AR	217	AR	136	AR	124
2008	CSRR	37	AR	142	AR	127
2009	CSRR	48	AR	145	AR	134
2010	CSRR	52	AR	166	AR	134
2011	CSRR	64	AR	180	AR	126
2012	CSRR	72	AR	150	AR	124
2013	*CSRR*	*80*	*AR*	*147*	*AR*	*120*
2014	*CSRR (1)*	*102*	*AR*	*147*	*AR*	*122*
2015	*CSRR (1)*	*83*	*AR*	*155*	*AR*	*122*
2016	*CSRR (1)*	*75*	*AR*	*176*	*AR*	*122*
2017	*CSRR (1)*	*75*	*AR*	*188*	*AR*	*122*
2018	*CSRR (1)*	*74*	*AR*	*200*	*AR*	*124*
2019	*CSRR (1)*	*74*	*AR*	*228*	*AR*	*144*

Note on the Table:
CER = corporate environmental report
CSRR = corporate social responsibility report
AR = annual report
In italics are the reports that are not analysed
(1) Stora Enso's CSR reports from 2014–2019 are a part of the annual reports but published as separate reports on the corporate webpage.

Table 15. Basic information about the studied companies in 2017 (Metsä Board 2018; Stora Enso 2018; UPM-Kymmene 2018)

	Stora Enso	UPM-Kymmene	Metsä Board
Number of employees	25,700	19,100	2,456
Deliveries paper (tonnes) board (tonnes) wood products (m^3) market pulp (tonnes) corrugated board (m^3)	4,713,000 3,839,000 5,097,000 2,135,000 1,103,000	9,430,000 0 2,539,000 3,595,000 0	0 1,803,000 0 515,000 0
Sales (million €) 2017	10,045	10,010	1,849
EMAS registration (%)	NA	39[18]	NA
ISO 14001 certification (%)	80 (1)	92	100 (1)
FSC certification (%)	97 (1)	92	100 (1)
PEFC certification (%)	74 (1)	92	100 (1)

Note on the Table:
(1) Stora Enso and Metsä Board certification figures are from 2018.

4.3 Material and methods

In the following sections, the methods of qualitative content analysis, theme interviews and Delphi method used in this thesis are explained. The methods are described in the same manner. First, a description of the method in general is provided. Second, the benefits of using the particular method are explained. Third, it is explained in brief how the method is applied here. A more detailed description of the use of the methods is provided in the articles.

4.3.1 Qualitative content analysis

Content analysis covers multiple ways of analysing texts. However, some general definitions exist. For example, content analysis typically refers to the process of making replicable and valid conclusions from the analysis of a given text (Krippendorff 2004). Julien (2008) describes it as a 'process of categorizing qualitative textual data into clusters of similar entities, or conceptual categories, to identify consistent patterns and relationships between variables or themes.' Content analysis can

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[18] Percentage is calculated from the total number of mills, as UPM-Kymmene has also started to apply EMAS registration to mills outside Europe.

be applied both quantitatively and qualitatively (Krippendorff 2004; Hsieh & Shannon 2005; Stack 2005). Quantitative content analysis focuses on the statistical analysis of the text or, as Neuendorf (2002) calls it a systematic and objective quantitative summary of a given text, whereas qualitative content analysis focuses on understanding the text. Hsieh and Shannon (2005, 1278) call it 'the subjective interpretation of the content of text'.

Hsieh and Shannon (2005) categorise qualitative content analysis into three types (see Table 16). First, there is **conventional content analysis**, where the aim is to describe the phenomenon. The researcher reads the data, and codes arise from it. This approach is typically used when there is no previous theory to apply. In **directed content analysis**, the researcher can use existing theory to create the codes beforehand. This approach allows the researcher to validate the theory. The third type, according to Hsieh and Shannon (2005), is called **summative content analysis**. In this, the researcher focuses only on one or a few keywords. Typically, keyword occurrences are first calculated, but then the actual focus is on the context in which the keyword(s) are used.

Table 16. Types of qualitative content analysis based on Hsieh and Shannon (2005)

Types of qualitative content analysis	Description	Application in this research
Conventional content analysis	Aim is to describe the phenomenon Categories arise from the data No previous theory exists	Articles II and III (Article IV)
Directed content analysis	Previous theory exists Aim is to test the previous theory	Article I
Summative content analysis	Counting the use of certain terms and explaining the context used	Not applied in this research

The selection of the qualitative content analysis as a method in this research was natural, as the topic of the research is environmental reporting. Content analysis is typically used as a method when documents are analysed. Qualitative content analysis was selected since the aim here is to understand the reporting practices of the Finnish forest industry rather than just to summarise it with statistics.

In the first article (Article I), the analysis was directed content analysis according to Hsieh and Shannon (2005). The topic of the analysis was the use of the concept of eco-efficiency. Here, 10 years (1998–2007) of reports were analysed. The coding scheme was made according to the previous literature on eco-efficiency. Eco-efficiency is an interesting concept to study in an industrial context. Companies often report the specific emissions (i.e., emissions relative to the amount of production), as companies are often able to make improvements in those. From the environment

point of view, the reduction in specific emissions is not enough if the absolute emissions increase due to the increase in the amounts of production (the so-called rebound effect).

In the following two articles (Articles II and III), the content analysis was applied as conventional content analysis. These two articles focus on the environmental performance reporting, that is, the reporting of environmental indicators. Theories and practical guidelines for environmental performance reporting do exist. However, the aim of this analysis was not to see how the companies apply theories or guidelines but to get their view of the whole of environmental performance reporting. Therefore, the coding and the categories were distilled from the data.

4.3.2   Theme interviews

Research interviews are a common way to gather research material. There are multiple ways to categorise them. For example, Gubrium and Holstein (2001), in their book, divide interview types into five categories: survey, qualitative, in-depth, the life story and focus group interviewing. However, quite often interviews are divided into structured and unstructured interviews (Tiittula & Ruusuvuori 2009). Structured interviews resemble a survey (Singleton & Straits 2001), where each interviewee is asked exactly the same questions with options in exactly the same order (Hirsjärvi et al. 2001; Koskinen et al. 2005; Tiittula & Ruusuvuori 2009; Eriksson & Kovalainen 2013). Unstructured interviews, on the other hand, bring to mind normal discussion where both the interviewer and the interviewee can bring new topics to the conversation (Hirsjärvi et al. 2001; Tiittula & Ruusuvuori 2009). Koskinen et al. (2005) call these deep interviews and describe the interviewer's role as understanding and supporting the interviewee's logic. Eriksson and Kovalainen (2013) emphasise the narrative nature of the unstructured interviews and, literally, the end result would be a narrative. Other concepts used in this regard are open interview, informal interview, and uncontrolled or narrative interview (Hirsjärvi et al. 2001; Eriksson & Kovalainen 2013). The in-between type of interviews are called partly structured (also focus interviews and theme interviews) (Hirsjärvi et al. 2001; Tiittula & Ruusuvuori 2009; Eriksson & Kovalainen 2013) or semi-structured interviews (Gillham 2005).

In this thesis, the concept of theme interviews is used, as it best describes the process of thematising the research material. Koskinen et al. (2005) and Eriksson and Kovalainen (2013) point out that theme interviews are the most common interview method used in business studies. Similarly, Hirsjärvi et al. (2001) state that in qualitative research in general, interviews are the most common research method. In each interview, the same themes are covered but not necessarily with the exact same questions or in the same order (Tiittula & Ruusuvuori 2009). For this flexibility of

allowing one to dig deeper into a phenomenon, Gillham (2005) names these types of interviews as the most important way of collecting research data.

Another way to classify interviews would be to use Silverman's (2014) categorisation of positivist, emotionalist and constructionist interviews. In the positivist approach, which Eriksson and Kovalainen (2013) call naturalist or realist, the researcher is interested in the facts that the interviewee is able to provide. Eriksson and Kovalainen's (2013, 79) example is to study organisational change with questions of 'who were involved and in which ways'. Then, in the emotionalist approach, quite evidently the researcher is interested in the emotions, feelings and perceptions of the interviewee (Silverman 2014; Eriksson & Kovalainen 2013). Last, in the constructionist approach, the interviewer is interested in how the interviewee constructs the meanings of the research topic during the interview (Silverman 2014; Eriksson & Kovalainen 2013). The current research applied the constructionist approach, as the interest was in how the interviewees understand the measurement of the environmental impacts of the forest industry.

In this research, the theme interviews were conducted in order to find out the current measuring and reporting practices in the Finnish forest industry. The interviews were conducted with 11 experts broadly from the forest industry and research community. Four experts represented the forest industry. Nine experts were researchers with the following variation: three from economics and one each from forest industry research, environmental policy research and environmental management research. One expert identified himself as an expert in environmental reporting. There were four interview themes:

1. Area of expertise (How would you describe your area of expertise?)

2. Environmental impacts and their measurement (e.g., what kind of environmental impacts does the forest industry cause? What kind of positive environmental impacts does the forest industry cause? How should the environmental impact measurement be developed?)

3. Eco-efficiency as an indicator of corporate impacts (e.g., how do you define eco-efficiency? How can eco-efficiency be applied in the Finnish forest industry? On which occasions is eco-efficiency a good indicator?)

4. The feasibility of the environmental information (How can the environmental impact data be used in corporate decision-making? How do you yourself use the corporate environmental impact data?)

The interview questions are listed in Appendix 1 of this research. The interviews served as background material for the Delphi study. The interviews lasted between

35 and 85 minutes, and all the interviews were transcribed by the author, which resulted in around 100 pages of transcribed text.

4.3.3   Delphi study

The Delphi[19] method aims to gather expert knowledge in the form of opinions or judgments of the topic's future possibilities, the likelihood of realisation and desirability (Mitroff & Turoff 2002; Kuusi 2003; Bell 2009). In the current research, the Delphi method was applied in order to gather expert opinions of the futures of environmental reporting in the Finnish forest industry.

A characteristic of the method is that the expert knowledge is gathered from a structured group communication process (Linstone & Turoff 2002) or, as Turoff and Hiltz (1996, 2) call it, 'Delphi is a communication structure aimed at producing detailed critical examination and discussion'. In other words, the focus is on the selected experts and their knowledge, not on gathering a statistically representative sample of participants (Seppälä 1985). The opinions are not just a group of expert opinions but, as Peltola (2007) explains, ones that the experts themselves peer review in the process.

The features that define Delphi as its own method are as follows: the anonymity of the experts (Woudenberg 1991; Masini 1993; Turoff & Hiltz 1996; Tapio 2002b; Kuusi 2003; Bell 2009; Linstone & Turoff 2011), the iteration of the arguments (Seppälä 1985; Woudenberg 1991; Masini 1993; Tapio 2002b; Linstone & Turoff 2011) and feedback to the participants (Woudenberg 1991; Masini 1993; Tapio 2002b). The experts give their arguments anonymously, although the experts are selected to participate in the panel because of their expertise. Anonymity allows that experts are treated equally (Peltola 2007). The status of the expert does not affect the estimation of the opinion; only the content of the response matters (Peltola 2007). Iteration means that at least two rounds are used for the gathering of and optionally revising the arguments. The multiple rounds give the experts time to develop their answers. Between the rounds, the researchers give feedback to the experts; e.g., the experts can see their own responses compared to other responses. As in futures research in general, the aim of the Delphi method is not to reveal the future of the topic but to collect ideas of the topic, raise discussion and create change (Seppälä 1985).

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[19]   The roots of the name evidently lead to ancient Greece and to the oracles who 'worked' in the place called Delphi. The name Delphi has by-the-letter roots to the dolphin, to which the god Apollo changed himself to lurk the first oracles into the temple (Kuusi 2003). For a more detailed description of the origin, see Marchais-Roubelat and Roubelat (2011).

The Delphi method was developed in the 1950s at the US RAND Corporation by Gordon, Helmer and Dalkey (Woudenberg 1991; Linstone & Turoff 2011). In the beginning, the aim of the method was to reach a consensus among the experts on the subject matter (e.g., Dalkey & Helmer 1963; Masini 1993; Wilenius & Tirkkonen 1997), the so-called Classical Delphi. However, Woudenberg (1991), for example, heavily criticises the requirement for consensus, as he shows that it really does not increase the reliability of the Delphi studies. Wilenius and Tirkkonen (1997) add that the consensus-based Delphi method loses information, as the interest is only on the one consensus idea. Besides using Delphi to study the futures of a topic, the opinion change or opinion persistence can be studied. This was done in a study by Makkonen et al. (2016) where they noticed that extreme opinions did not change between rounds. However, their experts also included a group of consensus-seeking experts that changed their opinions between the rounds.

Therefore, different types of Delphi applications have been developed (see Table 17; see also Turoff 2009; Hasson & Keeney 2011). Decision Delphi focuses on creating a future by helping in decision-making (Rauch 1979). Policy Delphi focuses on policy-making by gathering the pro and cons of arguments (Turoff 1970). Policy Delphi has been developed further by Kuusi (1999) and Tapio (2002a; 2002b). Kuusi's (1999) Argument Delphi focuses on creating relevant arguments on the study topic, whereas Tapio's (2002a; 2002b) Disaggregative Policy Delphi aims to create scenarios based on the Delphi responses. Then, in Steinert's (2009) application, the aim is to gather a variety of opinions, and for that reason the application is called Dissensus Delphi. Furthermore, the aim of a Delphi study can be to solve certain problems (Problem Solving Delphi) or to extrapolate trends (Trend Delphi) in the future (Turoff 2009). Di Zio and Pacinelli (2011) applied the Delphi method for finding a suitable location (Spatial Delphi) for a new building. The current application is Classical Delphi, as the aim was to reach a consensus on the topic.

In this study, the Delphi method was selected due to its possibility to effectively gather expert views on the research topic. Delphi was considered as being a more time-effective method to gather the expert opinions than interviews. The anonymity of the method was an important feature in the current research, as I wanted to keep the opinions of each expert equal. Furthermore, I did not want for the experts themselves to dismiss a comment or option based on the background of that expert. Iteration in the current research was vital, as the first round had a list of multiple and different environmental aspects and impacts which the experts then narrowed down to a manageable number of aspects and impacts during the next rounds. Iteration and feedback were also applied by using the comments of the rounds and the interviews as sources of additional aspects for the experts to evaluate. In addition, Delphi methods and different rounds were better suited for the purpose of this study than just conducting a survey of experts.

Table 17. Examples of Delphi study types

Delphi type	Aim
Classical Delphi (Dalkey & Helmer 1963)	To research 'the most reliable consensus' among the experts
Decision Delphi (Rauch 1979)	'To prepare, assist and make decisions'
Policy Delphi (Turoff 1970; see also de Loë 2016)	To collect pro and con arguments of certain policy options
Argument Delphi (Kuusi 1999)	To produce relevant (factual) arguments on a specific single issue
Disaggregative Policy Delphi (Tapio 2002a; 2002b)	To create scenarios from expert views
Dissensus Delphi (Steinert 2009)	To gather a large variety of expert opinions on a topic
Problem Solving Delphi (Turoff 2009)	'To state the problem and request solution options'
Spatial Delphi (Di Zio & Pacinelli 2011)	To gather opinions of a certain spatial location
Trend Delphi (Turoff 2009)	To project a trend to the future

In this research, the Delphi method had three rounds. The rounds were executed as web-based surveys. The three rounds had three distinct topics, which piled on the previous rounds and previous literature on the topic. In general, the topic of the Delphi survey was the measurement and reporting of environmental aspects and impacts of the Finnish forest industry. The topic of the first round was the measurement of environmental aspects and impacts in the Finnish forest industry. The topic of the second round was the measurement of eco-efficiency in the Finnish forest industry. The topic of the third round was to evaluate the future of corporate environmental reporting in the Finnish forest industry.

The experts were selected for the panel based on their recognised expertise in the area of the current thesis. The expertise of the selected experts is presented in Table 18, covering areas of research (environmental, economics and forest), forest industry, authorities and environmental NGOs. In each round of Delphi, the experts were able to label themselves using five categories, namely expert, researcher, forest industry, authority and environmental NGO (see Table 19 for details). In this question, the participants were able to select multiple identifiers. In each round, the majority of the participants labelled themselves as experts. The researchers were the second-largest group.

Table 18. The expertise of the selected experts

Expertise	Number of selected experts (N = 62)
Environmental research or expert	14
Forest (industry) research	13
Forest industry	16
Economics research	8
Authority	6
Environmental NGO	5

Table 19. The background of the participating experts

Background	First-round experts (N = 19)	Second-round experts (N = 17)	Third-round experts (N = 18)
Expert	11	11	10
Researcher	5	7	5
Forest industry	5	3	2
Authority	1	1	1
Environmental NGO	2	2	2

The Delphi method was used to investigate the alternative futures of environmental reporting in the Finnish forest industry. I was interested in the possible futures of the topic and especially the preferable and probable futures of environmental reporting.

5   Summary of the publications

This research consists of five original research papers. A short description of the papers is presented in the following. The research papers are included as an appendix to this thesis.

I. Defining eco-efficiency: Case study on the Finnish forest industry
Koskela, M. – Vehmas, J.
Business Strategy and the Environment, 2012; Vol. 21 (8): 546–566.

The first article presented the definitions of eco-efficiency from the literature. The literature definitions were used as criteria to analyse the environmental reporting of the three case companies. The material for this article was the environmental reports (or equivalents) from 1998–2007. The literature definitions of eco-efficiency were divided into five groups. The case companies seldom used the concept of eco-efficiency in their reports. They, however, had improved the different areas of eco-efficiency. The article argued that eco-efficiency was a popular academic concept but not so much of a practical concept.

The first article was a joint article by the author and the second supervisor of the thesis. The material was gathered and analysed by the author. The main responsibility for the writing of the paper was the author's. The second supervisor commended on the content and structure of the article and wrote about the operationalisation of eco-efficiency and other similar concepts.

II. Environmental impacts and aspects in the Finnish forest industry: What kind of picture do the environmental reports provide?
Mäkelä, M.
Forest Policy and Economics, 2017; Vol. 80: 178–191.

The aim of the second article was to find out what kind of picture the environmental reports give on the performance of the Finnish forest industry. The article concentrated on the numeric information that the companies report for their environ-

mental performance. The data for this article were gathered from the corporate environmental reports (or equivalents) from the three Finnish forest industry companies from 1998–2012. The results showed that the forest industry reports on its environmental performance a lot. However, the majority of the indicators focused on inputs, especially energy, needed for production, and on outputs, namely emissions and waste, caused by the production. A very limited number of indicators focused on the actual environmental impacts or on the supply chain view.

III. Trends in environmental performance indicator reporting in the Finnish forest industry

Mäkelä, M.
Journal of Cleaner Production, 2017; Vol. 142: 1333–1346.

The aim of the third article was to review the trends of environmental performance reporting in the Finnish forest industry. Similar to the second article, the third article focused on numerical environmental information in the reports. The data for this article were gathered from the corporate environmental reports (or equivalents) from the three Finnish forest industry companies from 1998–2012. The analysis revealed seven major trends in the 15 years of reporting. Companies reported on many indicators. The mass of indicators consisted of input and output indicators. Multiple themes were often reported, such as energy, wood, air emissions, waste and water emissions. The number of indicators was decreasing. Only a few themes (land issues and management indicators) were less often reported. The reporting of background and management indicators was fragmented. Inside the themes, there were variations on what has been reported over the years.

IV. Expert views on environmental impacts and their measurement in the forest industry

Koskela, M.
Journal of Cleaner Production, 2011; Vol. 19 (12): 1365–1376.

The third article assessed the expert views on environmental impacts and their measurement in the forest industry. The material for this article was gathered from the theme interviews with 11 experts. The interviews revealed that the experts actually discussed environmental aspects and not environmental impacts. Experts thought that the traditional emission measurement was a well-measured issue in the Finnish forest industry. Environmental impact measurement was considered to require improvement. Similarly, the measurement of the production chain that is physically outside the boundaries of forest industry mills should be developed.

V. Future of environmental reporting in the Finnish forest industry
Koskela, M.
European Journal of Futures Research, Supplement, 2014; 01/2014.

The fifth article tackled the future of the environmental reporting of the Finnish forest industry with a review of the literature and the expert opinions gathered from the Delphi survey. The article highlighted the probable and preferable futures of environmental reporting. The probable future described the current reporting of the forest industry, i.e., a business-as-usual scenario. The preferable reporting could be called a wish list of the reporting. For example, the development of reporting on transportation, the use of water and the development of a supply-chain view on reporting were emphasised.

6 Results and their interpretation

6.1 Summary of the results

The results of this thesis are presented in the five articles that are reported in the appendix of this thesis. The research papers provide the answers to the three sub-research questions of past, present and future environmental reporting. This section summarised the results to the first two sub-questions. The first question deals with the past reporting practices of the forest industry and the second question with current success factors and development areas. The last sub-question addresses the future possibilities for reporting, and the answer to it has been discussed in Section 7.1. The main results can be summarised in following three statements (see also Table 20). First, this study showed that the Finnish forest industry is eco-efficient in environmental management with good results in decreasing the environmental aspects. Second, the Finnish forest industry has succeeded in environmental reporting. Third, despite the long tradition and good results, this study showed that environmental reporting has room for improvement in the future.

First, although the focus of this study was on one tool of environmental management, namely environmental reporting, the study showed that the Finnish forest industry has been eco-efficient in environmental management. For example, the interviewed experts highlighted that the Finnish forest industry has received good results by transforming itself from a highly polluting industry to a relatively clean industry (Article IV). This is visible in many of the waterworks near forest industry sites (Article IV). According to the experts (Article IV) and the review of the reports (Articles II and III), the industry seems to be very good at measuring the environmental aspects of their own production. Environmental aspects are a part of companies' activities, products or services that interact with the environment (ISO 2002; Regulation EC No 1221/2009). Most of the environmental performance indicators that the companies report address the inputs (e.g., energy) needed for the production and the outputs (e.g., emissions) caused by the production (Article II). Furthermore, the analysis of eco-efficiency reporting showed that these companies have made numerous eco-efficiency improvements in the processes (Article I).

Table 20. Summary of the main results

Key themes of the results	Sub-theme	Source	Future considerations
1. Eco-efficient environmental management	1.1 The Finnish forest industry has improved its environmental performance.	Articles I, IV	Compared to the 1990s, the Finnish forest industry has improved its environmental performance. However, currently the pace of improvement has decreased or even stopped. The future emphasis should be on decreasing the environmental impacts even further.
	1.2 The industry is good at measuring the environmental aspects of its own sites.	Articles II, III, IV	Since the industry is good at measuring the environmental performance of its own sites, this knowledge could be translated into the measurement of environmental performance of the supply chain. (See also Sub-theme 3.2 in the current Table.)
	1.3 The Finnish forest industry has made multiple and different eco-efficiency improvements.	Article I	The Finnish forest industry has made several eco-efficiency improvements. They, for example, have improved both their material and energy intensity. Surely it is important to make future eco-efficiency improvements. From the environmental point of view, however, eco-efficiency improvements are not sufficient if and when the absolute environmental impacts remain large.
	1.4 They apply the different environmental management tools extensively.	Article IV	The Finnish forest industry has improved its environmental performance already for years by applying different environmental management tools. Needless to say, the companies need to continue to use the tools in the future as well and further develop them in order to keep up the continuous improvement of the process.
2. Success in environmental reporting	2.1 Finnish forest industry companies were pioneers in environmental reporting, starting the practice in the 1990s.	Articles I, II, III (V)	In Finland, the forest industry companies have been among the first companies in publishing environmental reports. Today the companies could be the ones to start to innovate the reporting and publish reports that take the current weaknesses into consideration. (See Theme 3 in the current Table.)
	2.2 Their reports contain a great deal of environmental information, especially focusing on environmental aspects.	Articles I, II, III (V)	The forest industry companies report a lot of environmental information. The reporting focuses on the reporting of environmental aspects, such as emissions to air and water, energy and use of wood. Especially if a person reads reports from multiple years, the reader

			gets a wide picture of the environmental performance of the company. So far, the environmental reporting has been a success story for the industry. However, as the thesis pointed out major weaknesses in the reporting (see Theme 3 in the current Table), future success is possible by further developing the reporting.
3. Weaknesses in environmental reporting	3.1 The environmental reports contain a decreasing number of environmental indicators.	Article III	The analysis showed that the companies are reporting less on their environmental performance. One needs to make sure that the current reporting meets the needs of the stakeholders.
	3.2 The environmental reports have only a small focus on the environmental performance of the supply chain.	Articles II, III, IV, V	Only a part of the environmental impacts of the forest industry results from their own sites. For this reason, the environmental reporting should cover the whole supply chain, from the forests to the waste management phase.
	3.3 Companies report very little on the actual environmental impacts.	Articles II, III, IV, V	The majority of the environmental data reported environmental aspects and not the actual environmental impacts. The future reports should give a truthful picture of the environmental impacts that the industry is causing.
	3.4 Besides environmental issues, companies need to report about issues of social responsibility.	Articles III, IV	In the future, it would be better to analyse the sustainability reporting of the industry and not just focus on the environmental reporting. The social issues are equally important to the forest industry companies as the environmental issues.
	3.5 The content of the reports focuses on the reporting of past and present practices.	Articles I, II, III	By definition, environmental reports should contain information on the past, present and future environmental activities and performance. The current research showed that these companies report on past and present activities and performance, but the future focus is neglected.

Second, the Finnish forest industry has been proactive in environmental reporting. The forest industry companies were among the first companies to start publishing environmental reports in Finland, from the 1990s onward. The reasons for reporting most likely have included the tightening national environmental regulations and the rising environmental demands of international customers. The analysis of the environmental reports easily covered 10 to 15 years (Articles I, II and III). The analysis of the environmental performance indicators showed that the companies publish a lot of environmental data (Articles II and III). In particular, the reporting focuses on environmental aspects such as energy and emissions to air and water. Fifteen years of reports contained over 2,000 mentions of environmental performance indicators (Articles II and III).

Third, although the industry has a long tradition of environmental management and has received good results with it, this study showed that regarding environmental reporting, improvements are needed. The trend analysis of the environmental performance reporting showed that there is actually a decreasing trend of environmental performance reporting (Article III). In other words, despite the long tradition and evidently working reporting processes inside companies, for some reason the companies have started to report less on environmental issues. In addition to this decrease, this study showed that there are three topic areas in which reporting should be improved. The report analysis and the experts showed that the forest industry companies measure and report little about the supply chain (Articles III and IV). As mentioned earlier, the Finnish forest industry is good at measuring their own performance (Article II). Yet they seem to be reluctant to provide data, for example, on the performance of their suppliers and the transportation needed (Articles II and III).

Similarly, it was shown that the forest industry mainly focused on measuring and reporting on the environmental aspects and not on the actual environmental impacts caused by the production (Articles II and III). Environmental impacts are typically understood as any change in the environment, positive or negative, wholly or partially caused by the company (ISO 2002; Regulation EC No 1221/2009). For example, the analysis of the environmental performance indicators showed that the companies reported on only three environmental impacts (acidification, eutrophication and climate change) during the years and lately report mainly on climate change (Article II). Apart from those, the forest industry should at least report on biodiversity.

Somewhat surprisingly, the social responsibility of the company was named especially by the experts as an area for future improvements (Article IV). This is surprising, as often in definitions social responsibility is not seen as a part of environmental reporting but an area of its own. Therefore, the social sustainability was defined as out of scope in the current thesis. On the other hand, the rise of social aspects is understandable, as there is more discussion of the wider sustainability aspects,

which include both environmental and social aspects. Moreover, the emphasis on social responsibility can be reasoned with the news of mill disclosures during the times of the interviews.

Furthermore, the current research showed that the forest industry companies report a lot of their past and present practices. In order to efficiently manage the environmental aspects and impact of the operations, one would need to have a future focus. Relying on the past trends makes the management reactive and not proactive.

6.2 Long tradition in environmental management

This research showed that the Finnish forest industry has a long tradition in environmental management. For example, the different tools have been applied for decades (Article IV). This was often mentioned by the experts interviewed in this research. They mentioned, for example, the environmental management systems that the companies have. This is verified in this research, as the three companies studied had ISO 14001 certifications for 80 to 100 per cent of their sites worldwide. In addition, the experts highlighted the use of forest certificates. The forest certifications are widely applied by the three companies: the FSC certification rate is over 92 per cent at each company, whereas the PEFC certification rate is between 74 and 100 per cent. Other tools that the interviewees mentioned were, for example, lifecycle analysis, product certificates, data collection systems and the use of many indicators.

The research material gives the impression that the forest industry has received environmentally good results (Article IV). This was especially emphasised by the interviewees. It was often mentioned by them that the forest industry used to be one of the worst polluters in the 1960s and 1970s in Finland, but the current situation is much better. For example, the quality of waterworks around the mills has improved. The good track record is highlighted by the statistics provided by the FFIF. These statistics show up to an 85 per cent of reduction in the rates (in absolute amounts) for certain environmental aspects over 20 years.

Also, the interviewees mentioned that one of the success factors of the forest industry is that they are able to keep their emissions below the environmental permit requirements (Article IV). One of the reasons behind this is that the industry has good relations with the environmental authorities, as the interviewees mentioned.

Similarly, the good environmental performance was visible in eco-efficiency improvements made by the studied companies. The eco-efficiency improvements made by the industry were highlighted by the interviewees (Article IV). The review of the eco-efficiency reporting revealed that although the actual concept was seldom used by the companies, several eco-efficiency actions were taken (Article I). In the eco-efficiency reporting review, first the literature definitions of eco-efficiency were identified and then these were compared to the companies' reporting. For example,

the following eco-efficiency improvements were often used by the companies (Article I):

- **reducing material intensity** by creating lightweight products;

- **reducing energy intensity** by improving the energy efficiency of the production;

- **reducing toxic dispersion** by minimising the toxic waste;

- **enhancing recyclability** by using recovered pulp;

- **maximising the sustainable use of renewable resources** by using the renewable raw material (i.e., wood); and

- **reducing environmental impact** by proving a significant amount of information about the efforts for improvements in environmental aspects.

A clear success factor of the forest industry in the past seems to be the environmental aspects measurement of their own sites. Many of the results of this thesis emphasise this. For example, this was mentioned many times by the interviewed experts (Article IV). They mentioned, for instance, the traditional emission measurement as a well-measured aspect. They said that forest industry companies are good at measuring the water-related emissions at their own sites due to the longstanding requirements for this leading to well-established practices (as it is required of them by the water permit requirements). In addition, they highlighted that this measurement is done on a monthly or quarterly basis, which brings continuity to this process. This view is supported by the reviews of environmental performance indicators (Articles II and III). They showed that the companies mainly reported about the water and air emissions that their production caused. Furthermore, the interviewees mentioned that the companies are good at measuring the energy-related aspects of their production (Article IV). Moreover, this was visible in the environmental indicator reviews (Articles II and III): energy indicators were the most commonly reported indicators by the forest industry companies. The environmental performance reviews showed that the majority (almost 88 per cent) of the indicators that the companies reported addressed the activities of their own sites.

One of the environmental management tools that the forest industry companies use especially well is environmental reporting. Its success will be discussed in the next section.

6.3   Success in environmental reporting

The Finnish forest industry has a long tradition of environmental reporting. In the environmental reporting review articles, 10–15 years of environmental reporting

was analysed (Articles I, II and III). The first company to start to publish environmental reports was the former Metsä-Serla (which is currently a part of the Metsä Group) in 1992. The interviewed experts named the environmental reports as a success factor for the industry.

The research articles of environmental performance review showed that the companies report a lot of environmental information in the reports (Articles II and III). As was mentioned above, different eco-efficiency improvements are covered in the reports. In addition, other environmental aspects are often reported. The reports typically contained 50–100 environmental indicators per report. This equals over 2,000 indicators in total over 15 years of reporting. The reported indicators were categorised into five different groups (upstream process indicators, input indicators, corporate environmental management indicators, output indicators and environmental impact indicators), and inside the groups into 20 different themes (such as forest, land issues, energy, air emissions, eutrophication). This means two things. First, a wide range of topics of environmental management are covered with these indicators. Second, by reading the 15 years of reports, the reader is able to get a wide picture of the environmental performance of the studied companies, starting from the forests and ranging to waste or recycling.

The companies report on both their own production and that of the suppliers (Articles II and III). The companies report both the environmental aspects and the caused environmental impacts. Companies report on what they need in order to produce their products, such as energy, raw materials (such as wood, fibre, chemicals) and water. Moreover, they report on the unwanted environmental aspects that come as an end result of the production (such as air and water emissions, waste and wastewater). They report what happens in the chain before the production starts at their own sites; for example, they report on the transportation needed and the forest management practices. The companies report on the environmental management practices and the associated costs. Finally, companies publish indicators of the environmental impacts caused.

Companies use multiple and different units of measurement when they publish the indicator results (Article II). Most often the results are shown in absolute figures with units such as tonnes, joules, kilometres and cubic metres. It was somewhat typical that companies presented the results either as indexes (i.e., development is shown in relation to a certain year) or as figures of specific emissions or as specific energy consumption, where the amounts of, for example, emissions or energy consumption are presented in relation to the amount of production. In addition, the companies presented some environmental information in monetary terms.

Despite the long tradition of environmental reporting, this thesis found weaknesses in the current reporting practices. These are discussed in the following section.

6.4   Weaknesses in environmental reporting

The environmental reports of the forest industry companies can be described as a success story, but they still have room for improvement. The main problems of the reporting include the decreasing amount of environmental information disclosed and what is actually being reported. These are discussed in detail in the following.

The environmental performance review that focused on describing the past reporting trends showed that the companies are currently actually reporting less than they used to (Article III). The peak of reporting was between 2003 and 2005. One explanation for the decrease could be that environmental issues are now reported inside annual reports or sustainability reports, which seems to decrease the number of pages devoted to environmental issues. The reason can hardly be that environmental issues are less important nowadays.

Content-wise, the reports have several shortcomings (Articles II and III). As mentioned above, the majority of the reporting focuses on the environmental aspects of the forest industry's own sites (88 per cent). The actions of the supply chain that happen before the forest industry sites are very seldom discussed; only 5 per cent of the indicators address the upstream processes, such as forestry, land use issues, suppliers and transportation. Forestry and land use issues are of vital importance to the companies, as forest companies themselves own very few forests. The majority of the wood they need for production is bought from forest owners. As there are many occasions that the wood supply conditions are less than acceptable,[20] more attention would need to be paid to this topic. The minor role of transportation is somewhat of a surprise here. All the studied companies operate in many countries and continents and their products are sold worldwide. This means that they require transportation of the raw materials to the mills and transportation of the products to customers.

An important content shortcoming is the lack of information on the environmental impacts that the emissions and other aspects of the industry cause (Articles II and III). Only about 7 per cent of the indicators addressed the actual environmental impacts that the companies are causing. Recently, this reporting consists almost exclusively of climate change information (e.g., the amounts of CO_2 emissions and emission allowances). Previously, the companies also reported about acidification and eutrophication. This means that companies have reported only three environmental impacts with numeric indicators. However, previous studies have identified that forest industry companies are linked with several other environmental impacts.

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[20]   Especially, Stora Enso has been accused of inappropriate actions regarding land issues in China (e.g., Hänninen 2013, Ping & Nielsen 2010, Vartiala & Lampela 2013) and Brazil, and about labour conditions in India (Vartiala & Lampela 2013).

One important environmental impact of the forest industry is caused by logging and forestry practices that affect the loss of biodiversity and the role of carbon sinks. In Finland, the most important cause of threatened species is forestry, which causes the lack of decayed and old trees (Hyvärinen et al. 2019). Regarding the role of carbon sinks, there is currently a discussion in Finland about the role of the Finnish forests. The two opposite ends of the discussion are (1) whether the forests should be preserved as carbon sinks, and (2) how much (more) the forest and energy industry can fell the forests in order to produce their products. The carbon sink approach is promoted by the environmental NGOs but also by environmental researchers (e.g., Seppälä et al. 2015; BIOS 2017; Seppälä et al. 2017). Then again, the industrial use of forest is argued with environmental aspects, as wood is a renewable source of both energy and raw material. The problem of measuring environmental impacts was also raised by the interviewed experts, as they thought that forest industry companies should focus more on the actual impacts that the industry is causing.

The most surprising result of this thesis was the rise in awareness of social responsibility. Even though the interviews focused on the environmental impacts, the interviewed experts discussed often and at length that the forest industry would need to focus on the social responsibility of their actions (Article IV). The interviewees' reasoning for this was that environmental issues were considered to be rather well managed in the forest industry. Another reason for this might be the time when the interviews were conducted (the spring and early summer of 2009). Around that time, the majority of news items about the Finnish forest industry related to the closing of the mills in Finland due to outsourcing the production to foreign countries. This thesis does not take a stand on the content and level of social sustainability reporting in the Finnish forest industry as this was not in the scope of the thesis. In general level, the author is aware that the Finnish forest industry companies do report also on their social performance.

The last weakness of the reports deals with the lack of futures focus in the reports. The idea in this thesis was that, first, for the researcher to take a look at how the companies have previously reported on their environmental performance, and then for the researcher to make recommendations on the improvement of reporting in the future. At the same time, the companies themselves could use the reporting as a tool for future improvements. Currently, the reporting focuses on the descriptions of past and current activities and performance. A future focus could easily be added here. The graphs that currently show the development of certain emissions for a decade could have a target for the next five years. This would make the environmental report a tool towards the preferable future.

7 Discussion and conclusions

This chapter draws the work together. First, the thesis results are converted to futures images. Second, the results are reflected based on the research questions. Third, the limitations of the current research are considered. Fourth, ideas of further research are reflected. Fifth and last, the theoretical conclusions of the thesis are presented.

7.1 The futures of environmental reporting in the Finnish forest industry

The thesis results are here discussed in the form of alternative futures images. The images are created based on the theory of Dator's four generic futures (Dator 2002; 2009; see Section 2.5). This approach was selected for two main reasons. First, it gives a framework for creating four distinct futures images. Second, I wanted to try applying Dator's approach, originating from a large-scale societal growth perspective, to describe changes in the more specific context of forest industry and its environmental reporting. The futures images do not address a particular year but depict at least 20 years in the futures, as they also describe the change in the role of the forest industry in Finnish society.

Dator's four archetypes are continuation, transformation, limits and collapse (see Section 2.5). The futures images created based on these are summarised in Table 21. The collapse image, 'End of the Forest Industry', would mean that the forest industry will face difficulties and its significance in the Finnish economy will fade. This would result in no need for the environmental reporting. The limits-and-discipline image, 'Strong Sustainability Focus', is based on the limitation of the industry by strict sustainability regulation. Strict environmental reporting, covering the whole production chain, will be required and regulated by the law. The continuation image, 'Survival of the Forest Giant', would mean that the forest industry will survive mainly with the strong demand of current products. Regarding environmental reporting, this means that the current reporting practices are continued in a business-as-usual manner. In the transformation image, 'Renewal of the Industry', the majority of the production is based on new products that, for example, replace plastics. The forest industry will be able to use the renewable raw material as a success factor.

Due to the transformation of the whole industry, the environmental reporting practices have also been transformed into high-quality reporting, meaning that the environmental reporting covers the lifecycle of the industry. The content of these futures images is discussed in detail in the following. In addition, their probability based on this research is evaluated.

The first image, 'End of the Forest Industry', means that the forest industry will lose its significance in Finnish society and economics. Two major drivers will cause the change. Due to digitalisation, the demand for the traditional forest industry products will decrease significantly. The forests will be generally protected because of climate change mitigation. This change will cause the forest industry to cease reporting on environmental issues, as their environmental impacts will have significantly decreased. This image is not really supported by the thesis. Although the forest industry seems to still be somewhat struggling in finding its futures path, it seems to be innovative in developing new products. Similarly, although there are discussions of the role of (Finnish) forests in relation to climate change mitigation, the complete protection of all Finnish forests is highly unlikely at the moment.

'Strong Sustainability Focus' is the name of the second futures image. In this image, the operations will be limited by strong sustainability regulations. Business operations will be allowed in general, as long as they meet the regulations – both national regulations and international agreements. One of the requirements is sustainability reporting, which includes environmental reporting. Companies see sustainability reporting as an important tool for managing sustainability impacts. The second futures image is indirectly supported by the thesis. For example, the previous literature often raised mandatory environmental reporting as a solution to the current quality problems. Currently, there is an EU directive in force that requires sustainability reporting from certain large, private companies. In addition, I do not really see it as likely that the environmental and social regulations guiding companies will loosen in the near future.

The third image ('Survival of the Forest Giant') means the business-as-usual approach where the current development continues. The forest industry will have a strong stance in the market. The traditional forest industry products will maintain a stable demand. However, the forest industry will be able to develop new products. Regarding environmental reporting, companies will continue the current approach, where the amount of environmental information published is limited. The current thesis supports this image. Currently, it seems that in the near future, the forest industry will still produce the traditional forest industry products (such as paper and board), but more and more new products will be launched. If the industry is not making significant changes in the production or there is no significant change in stakeholder demands, this would mean that the environmental reporting stays more or less at the current level.

Table 21. Futures images of the Finnish forest industry and its environmental reporting

Futures image	Key driver	Development of the forest industry	Implications to environmental reporting
End of the Forest Industry (collapse)	Digitalisation and forest protection	The industry suffers for two reasons. The developments in digitalisation have significantly decreased the demand for forest industry products. Moreover, climate change mitigation demands that the forests are protected as carbon sinks.	As the industry has only a minor role in society, the environmental reporting, due to very low environmental impacts, has been ceased.
Strong Sustainability Focus (limits)	Tight sustainability regulation	Any industrial company, forest industry companies among them, is allowed to operate when they meet the high sustainability requirements set by national law and global agreements. In sustainability, environmental and social requirements are especially important.	Sustainability reporting (including environmental reporting) is an important tool for the companies. Sustainability reporting is required by law.
Survival of the Forest Giant (continuation)	Current development continues	Current development continues in the forest industry. The majority of their production is based on the traditional production (pulp, paper, board and timber products). However, the industry has been able to develop new, promising products.	In reporting, the current trends continue, which means that the amount of environmental information is decreasing.
Renewal of the Industry (transformation)	Circular economy	The forest industry has changed its operating procedures and has created totally new products. The whole approach follows the circular economy approach. Wood-based products are the main substitutes for the current plastic products. The traditional products play only a minor role.	Due to the transformation of the industry, sustainability reporting has been developed as high-quality reporting.

The fourth and last futures image is called 'Renewal of the Industry'. In this transformation image, both the whole industry and its environmental reporting have transformed to a completely different stage in comparison to the current situation. The industry has succeeded in the renewal process. The industry does not any more

rely on the traditional products but has developed totally new products. The present biorefineries are an example of this shift, as they produce, for example, biodiesel. Currently, the forest industry works to develop products to replace controversial plastics. Furthermore, wood-based textile applications exist, and wood could serve as a raw material in food production, medicine and cosmetics. The forest industry, as its raw material base is renewable, is able to apply the circular economy approach fully. The transformation of the industry has enabled it to make radical changes in its environmental reporting. As the circular economy and sustainability are important for the industry, environmental reporting is now of high quality. Environmental reporting is real-time reporting via company's webpages. Key information is still summarised in a report, but the webpage application allows a stakeholder to search for the information that is most relevant to her/himself via a data management tool. High-quality reporting would require much more thorough reporting than today – including the reporting of both environmental aspects and impacts, but also the reporting from a lifecycle and supply chain perspective. In addition, the reporting should be at the mill level and not only at the corporate level, as it mainly is today. The mill-level reporting is important, as many of the environmental impacts that the industry causes are local. This fourth futures image is only indirectly supported by this research. Real-time and comprehensive reporting is rather far from the current reporting practices. However, this is what the current research suggests in order for the forest industry to better reflect the environmental aspects and impacts of its processes and operations. When it comes to the future products of the industry, the fact is that the forest industry desperately needs new products in order to succeed in the future.

The above four futures images, although they deal with the futures of environmental reporting in the Finnish forest industry, take into account the structural changes in the industry and society that could explain the changes in the environmental reporting practices. In the fifth research article, I created two futures images (a probable future and preferable future) for environmental reporting. The probable future was a business-as-usual approach in reporting and resamples here the reporting description in the image 'Survival of the Forest Giant'. The preferable future in the fifth article can be also called a wish list of environmental reporting, and it bears similar aspects to the environmental reporting in 'Renewal of the Industry'.

7.2   Discussion of the results

This thesis had one main research question and three sub-questions. In this section, the results will be discussed first from the point of view of the sub-questions and lastly from point point of view of the main research question. The discussion of the sub-questions focuses on was the thesis able to answer them. The main research

question is discussed from the point of view of the development needs of environmental reporting.

The first sub-research question asked 'how have the Finnish forest industry companies reported their environmental performance?' The thesis was able to provide an answer to this question. The results showed that Finnish forest industry companies report a lot of their environmental performance. The companies focus on reporting of the environmental aspects.

The second sub-research question addressed both 'the well-measured environmental performance' and 'the insufficiently measured environmental performance in the Finnish forest industry. The results to these two parts are presented in detail in Sections 6.3 and 6.4. Shortly, one can conclude that the environmental aspects of own production are typically well-measured, while the environmental impacts from the point of view of the supply-chain are insuffienciently measured. Also, the second sub-question can be considered answered.

The last sub-question focused on the alternative futures of environmental reporting in the Finnish forest industry. In the previous section (Section 7.1), the alternative futures of Finnish forest industry are covered including aspects of the environmental reporting. In the futures images, the role of environmental reporting differs from non-reporting to high quality and real-time reporting. The thesis was also able to answer the third sub-question.

The main research question of this study asked, 'How should the environmental reports of the Finnish forest industry be developed in order to give the reader a more comprehensive description of the environmental aspects and impacts its processes and operations are causing?' As was mentioned in the section 2.4, values are important in the futures research. In the current research, the value of the environment, the nature, has been the main value. In the end, the environment sets the boundaries to all our operations. This has directed the whole focus of the thesis on the environmental sustainability and especially on environmental reporting. Furthermore, this guided the formulation of the main research question, which directly implies that there are development needs in the current reporting style. In the following, the development needs are discussed further.

The reporting should be developed toward 'high-quality' reporting. This means reporting both environmental impacts and aspects from the overall operations. That would mean that the companies report more comprehensively than they currently do on the environmental actions that happen before and after their own processes. The forest industry companies already collect this kind of data. For example, Finnish forest industry companies have the chain-of-custody certifications that trace the fibre back to the forests. In addition, the companies have codes of conduct for the suppliers. These codes require certain types of sustainability performance from the suppliers. Currently, the environmental aspects of their own production are well-measured

and reported, so basically not many improvements can be offered for that area. The only remark about this is that environmental aspects should be reported similarly for years in order to make it easier for the reader to see the trend of development. The other way to show the development trend would be to provide, in each report, long data series of each indicator.

The second main weakness of the current reporting is its almost exclusive emphasis on environmental aspects (i.e., organisations' processes, products or services that cause the environmental impacts) instead of the actual environmental impacts. Currently, the reports do not really reflect on the environmental impacts the companies are causing, such as eutrophication, oxygen depletion in the water bodies, acidification and the impacts of logging and forestry on biodiversity and carbon sinks. This is addressed only indirectly. It requires knowledge from the reader to be able to connect the currently reported environmental aspects to environmental impacts. Presently, the companies report on three environmental impacts (i.e., acidification, eutrophication and climate change) but focus on climate change. This simplifies the facts too much. This connects with the fact that companies focus on reporting the performance of their own sites. For example, biodiversity impacts happen in forests that are not typically owned by the companies.

The critics of the current environmental reporting practices and the content of the reports can be summarised into four main areas: (1) the reports do not reflect the whole performance; (2) the content of the reports does not meet stakeholders' expectations of knowledge (e.g., Azzone et al. 1997; Deegan & Rankin 1999; Hammond & Miles 2004); (3) companies merely tend to report positive news (Adams & Frost 2008; Spence 2009); and (4) reports suffer from quality problems (Hopkinson et al. 1999; Dragomir 2012).

These criticisms were variously addressed in the current research. Stakeholders' expectations of reporting were only indirectly addressed. One would expect that the stakeholders want to receive a comprehensive picture of the companies' environmental aspects and impacts from reading a report. Current reports do not meet this requirement, and therefore I have given suggestions for how to improve the content of the reports. Meanwhile, I recognise that the readers of the reports might have other types of knowledge interests, which are or are not met with the current reports. However, the stakeholders' knowledge interests or expectations were beyond the scope of the current research.

In addition, the critics of the reporting say that the reports do not reflect the whole performance of the company. In the previous studies, this has become evident when the image received from the report is compared to that of external sources (e.g., Niskanen & Nieminen 2001; Cho et al. 2018). This criticism is only partly covered in the current research. The picture of the environmental reports is not compared to any external sources. However, as mentioned already many times, the forest industry

companies tend to report only on their environmental aspects. In that sense, the reporting can hardly be described as reflecting the whole performance.

Previous studies have showed that companies tend to report only on their positive achievements. Similar to the previously mentioned criticisms, this aspect is only partly touched upon in the current research. I did not analyse the environmental reporting in such detail that I would have noticed, for example, would the companies report only on such environmental aspects in which the development is favourable for the company?

The last main criticism of environmental reporting practices related to the quality problems in reporting. The analysis of environmental performance reporting showed that companies had over 2,000 mentions of environmental indicators. This relates to the quality issue, as a large number of indicators makes the comparison of different companies more difficult. Similarly, the environmental performance reviews showed that the companies used multiple and different units of measurements for the same topic indicators. Different units of measurement make it at least difficult if not impossible to compare different companies' environmental performance.

In academic research, there is a general aim at open access. For example, research results are encouraged to be published as open access publications where the readers would not need to pay for reading the research. This approach quite evidently is not applied in a business context. Surely, some of the companies' data is confidential, as it creates a competitive advantage for the company. Nevertheless, I would encourage companies to consider whether the environmental data could be such that the companies would grant open access. There are foreign companies (foreign here means companies that do not have headquarters in Finland) that offer a tool on their websites through which one can download the environmental data as Excel spreadsheets, such as German energy company RWE, German car manufacturer Daimler and German automotive and industrial supplier Schaeffler. Similarly, the environmental data should be open at different levels of the operations. Summary data at the corporate level does not give a true picture of the environmental impacts that the company is causing. For example, the same amount of harmful emissions to water causes a different level of environmental impacts when released into the ocean in comparison to a small lake. In other words, the environmental data should be published at the site level as well.

7.3 Limitations of the current research

The current research has some limitations. First, the experts interviewed were purposively selected, and not all invited experts participated in the Delphi panel. Second, the whole Finnish forest industry has changed since the current research began in early 2007. Third, the topic of the current research is the Finnish forest industry;

however, the data have been collected mainly from the three biggest companies. Fourth, the review of past environmental reporting did not cover the whole environmental reporting of the industry. Fifth, the long time span taken to complete the thesis evidently affects the results of the thesis. These limitations are discussed in detail in the following.

I selected the experts for the study purposively according to the principles of qualitative research. I wanted to interview persons that I thought have knowledge either of the forest industry or of environmental management. Therefore, my experts had expertise in various fields of research (such as economics, forest industry, environmental management and environmental policy), forest industry and environmental reporting. Surely, a different set of experts might have given me different ideas about the environmental reporting in the Finnish forest industry. In the results, I mainly focused on the elements about which experts had a shared opinion, i.e., issues that many of the experts talked about. On the other hand, on some occasions I highlighted the variety of views, for example when the experts named and talked about the many different environmental management tools that the industry is using. The same applies in the Delphi panel. I invited a large pool of experts to participate. However, only a subset of the invited experts participated. With a different set of participating experts, the results could have been different. Nevertheless, as my target was to get answers from researchers of environmental management, forest (industry) and economics, and representatives of the forest industry, authority and NGOs, in all rounds member(s) of each group participated. However, their views were a bit biased towards the researchers, and more responses from members of the forest industry would have been welcomed. Two groups of potential readers of the environmental reports were not covered in my research, namely the customers and analysts.

The forest industry has changed during the time of this study. I started working with this topic in early 2007. At that time, the Finnish forest industry was often the topic of news with their layoffs and mill closures in Finland. This has changed. Lately, the forest industry has been investing in Finland. According to the FFIF (2019), the industry invested in 2016 and 2017 over 800 million euros per year, when the level of investments was around or below 600 million per year for the previous seven years. In addition, in 2017, the number of employees increased in the forest industry for the first time in years,[21] and the industry was the second most active in hiring out of all the manufacturing industries in Finland (FFIF 2019). In 2017, the biggest forest industry investment ever in Finland, the bioproduct mill in Äänekoski

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[21] There has been a decreasing trend in the number of employees in the forest industry from the 1970s onwards. Only in 1981, 1989 and 2001 has the number of employees been larger than in the previous year. (LUKE 2019.)

in central Finland, began its production (Ruoho 2017). The investment totalled 1.2 billion euros (Ruoho 2017). After these large investments, the investment boom seemed to take a gap year. In 2018, the forest industry's investments were estimated to be 420 million euros (Kyytsönen 2018). The one thing that has not changed during the writing of the thesis is the need for change in the industry. The industry still relies on the traditional products of the industry, i.e., paper, pulp, board and wood products. At least, the FFIF (2019) reports forest industry production amounts in these product groups only. The Äänekoski bioproduct mill could be a sign of the new direction for the industry, but regardless of its size, it is still only one mill.

How do these changes affect the environmental reporting in the industry? If the production is not moving from Finland to other countries, it should mean that the collection of environmental data is easy, as the forest industry was recognised for being good at measuring the performance of its own sites. On the other hand, if the industry moves in a new direction (such as the bioproduct mills) where the previous knowledge of the measuring of environmental aspects would not apply, it does not automatically mean that environmental performance will be easily measured in the future as well.

The context of this research was the Finnish forest industry. However, the data were mainly collected from the three biggest Finnish forest industry companies due to the best availability of the data. The majority of the rest of the forest industry companies are much smaller than the companies studied here, and they do not publish environmental reports or have not published them for many years. Therefore, one cannot really generalise (and it has not even been the aim of the current research) the results of this study to the whole Finnish forest industry.

The review of past environmental reporting did not cover the whole environmental reporting of the Finnish forest industry. The review was targeted to two topics, which were eco-efficiency reporting and environmental performance indicator reporting. To limit the content analysis to certain themes is along with the principles of qualitative content analysis. The quantitative content analyses have analysed the whole reporting but in this thesis, the focus was to gain a deeper understanding of a few issues.

The long time span taken to complete the thesis evidently affects the results of the thesis. The expert interviews were conducted in spring and early summer 2009. The last research articles were published in 2017. This introductory essay was written in 2017–2019. The long time span naturally affected the results of the thesis. The content analysis of the environmental reports is not that much affected by the time. However, there are more recent reports available for analysis. The time lapse between writing the introductory essay and conducting the interviews and organizing the Delphi panel has some effect on the results. Both the interviews and Delphi panel represent the situation when organized and the situation would have been different

if they were organized at some other time. On the other hand, in the interviews the majority of questions related with the environmental impacts that the forest industry is causing and the impacts have stayed more or less the same over the last years. Surely, the thesis would have been a more compact and coherent whole if it were completed during a more shorter time period.

7.4 Ideas for further research

This research offers ideas and suggestions for further research. First, this study showed that the amount of environmental reporting is decreasing in the Finnish forest industry. Therefore, it would be interesting to study whether this is the case in the global forest industry and in other business sectors as well.

Second, the current research revealed that the Finnish forest industry reports mainly about environmental aspects and not that much about environmental impacts. Similarly, as with the first point above, it would be interesting to research the global forest industry companies and see whether they focus in their reports only on environmental aspects. The same applies for other industries as well.

Third, this study discovered that the Finnish forest industry companies concentrate on reporting only on their sites and not so much on the supply chain perspective. This would be an interesting research area in industries that have a (long) supply chain in order to operate. Examples of such industries are electronics, clothing and shipbuilding.

Fourth, the most recent environmental report analysed in this study was from 2012. Currently, there would be seven more recent reports to evaluate. Especially, the trend analysis should be updated to see which of the identified trends still exist today.

Fifth, this study focused on environmental reporting practices. Here it was understood that the environmental report would be the main result of these practices. In spite of that, the companies publish a great deal more environmental data. For example, alongside the environmental or sustainability report, often the annual reports contain some environmental information. Typically, the corporate webpages include a section of environmental data, which, along with the actual webpage, can contain reports of certain environmental issues. Therefore, if the target would be to research the whole of environmental reporting or better environmental communication, these wider sources should be taken into account. Yet another source of environmental communication are the various social media channels that companies use.

Sixth, the previous criticisms of environmental reporting could be addressed directly in the forest industry as well. The stakeholders' expectations of the environmental reporting should be studied, and then the report contents should be compared to those. The corporate picture of environmental performance should be compared

to that of external sources. Niskanen and Nieminen (2001) compared the corporate reporting to newspaper items and found that companies' reporting tends to be more positive than the newspaper reporting. One could now update this comparison and focus only on the forest industry.

A seventh suggestion relates to widening the research topic from environmental reporting to sustainability reporting. The current research gives a rather comprehensive picture of the environmental reporting practices in the Finnish forest industry. But nowadays companies put time and effort into the reporting of the wider sustainability issues, which include, in addition to environmental issues, also economic and social issues. For example, it would be interesting to see if the decreasing trend in environmental reporting is visible in social responsibility reporting as well. In addition, in sustainable development the fourth area of sustainability is the cultural sustainability. However, in corporate context the cultural sustainability is seldom discussed. Nevertheless, the cultural aspects are important in corporations. Organizational cultures affect the how companies manage sustainability issues. In addition, the different cultural contexts, countries and continents, where the companies operate, affect as well.

Eight suggestion of this research focused on the whole industry. As mentioned already, the Finnish forest industry is currently in need of a major change. Section 2.6 reviewed the previous studies of the futures of the Finnish forest industry. However, as the current situation shows that a new direction has not been found yet, there is still the need for futures research in the forest industry. The evident need is to combine the efforts of researchers and the industry in order to find future avenues for profitable business.

Ninth suggestion refers to the methodological choices of studing environmental and sustainability reporting in the future. The current research as many previous studies focused on the content of the reports. Often in these studies, the research question is 'what is in the report?' Not so much is devoted to discussing what has not been reported. Furthermore, more focus should also be devoted to the perceptions of the readers of the reports. In addition, an interesting aspect would be to study the views of the preparers of the reports. Why certain aspects are reported and while others are not reported?

A tenth and last suggestion regarding futures research is that this study showed that more research on futures images is needed. As stated in the theoretical background of this thesis, the concept of futures images is essential for futures research. However, after many searches, I have not been able to find many studies where the researchers would report the process of how futures images are created and describe the content of these images. Yet there are theoretical models, such as the one by Dator that was applied here and one by Polak, which ease the process of creating futures images.

7.5 Theoretical conclusions

The aim of this thesis was to study the environmental reporting in the Finnish forest industry. The thesis studied the past, present and alternative futures of reporting. The theoretical part of the current thesis reviewed the characteristics of futures research and environmental reporting. In the following, the theoretical contributions of the thesis will be discussed.

One characteristic of futures research is that values have a strong role. Values had a strong role in the current research as well. The starting point of the study was the assumption that there would be a development need in the current reporting practices. The values of the researcher have guided the process. On the other hand, the values link to the concept of alternative futures and futures images. Some of the alternative futures and futures images are preferable to others, and the preference always relates to the values of the person or group of persons making the judgment. I personally prefer (or value) either the futures image of the 'Strong Sustainability Focus' or the 'Renewal of the Industry' as a target for the future. In both, the forest industry has a strong economic role in the society, but also in both, sustainability is valued. In addition, the environmental reporting practices have evolved in both as well, in the first due to the legislation and in the second as a voluntary practice. In the Delphi panel, the experts were rating the probable and preferable futures of environmental reporting in the Finnish forest industry. The experts' values especially guided the selection of the preferable future. The preferable reporting was seen to include a more through reporting of environmental impacts throughout the supply chain than in the probable reporting.

Futures research is often seen as instrumental, as the aim of the research is to change something (e.g., Mannermaa 1998; 2003). This can be applied from both the technical and emancipatory knowledge interest perspectives. From the technical knowledge interest point of view, this thesis recognises that there is a development need in the environmental reporting practices. The thesis acknowledges that the industry has been rather transparent in publishing the environmental data in the past. This is the point where the emancipatory knowledge interest steps in, as it focuses on the preferable future and on new ways of doing things. Therefore, in the future it is not enough for the Finnish forest industry just to publish some data, but in order to get the competitive advantage of sustainability, the environmental reports should report on both environmental aspects and impacts and from the lifecycle and supply chain perspectives.

The futures images of environmental reporting were created here with the help of Dator's archetypes. Alternative futures and futures images have other categorisations that would have been applied here as well (such as Voros (2017) and Polak (1973)). Voros's (2017) categorisation has seven alternative futures. The futures images created here can all be labelled as possible, as with current knowledge they

could happen. However, depending on the viewpoint of the evaluator, their desirability differs. In other words, it depends on the values of the evaluator. The 'End of the Forest Industry' image could be, for a member of the forest industry, a preposterous future, as this would mean that the industry is not a big player in the society anymore. For an environmental NGO, the 'Strong Sustainability Focus' image could be a preferable future, as the environmental impacts are strongly governed by the state. Then 'Survival of the Forest Giant' could be generally labelled as probable, as this is the business-as-usual image. Last, the 'Renewal of the Industry' is, at least from the point of view of the industry, a preferable future.

Polak (1973) categorised the futures images based on the influence and essence. The influence could be interpreted in this case as the possibility of the industry to influence futures. The essence, for that matter, could be the external factors affecting the industry. The four futures images created here could fit with Polak's categorisation as well. Polak's influence and essence optimism would be the 'Renewal of the Industry' image where the industry believes in itself and has created new products that are also welcomed by the markets. Influence optimism and essence pessimism would be the 'Survival of the Forest Giant'. Here the industry can influence the course of action by creating new products, but the external factors (such as possible regulation or general opinion) can cause the need for change. Influence pessimism and essence optimism refer to 'Strong Sustainability Focus'. The industry feels that it has lost some of its influence, as the regulations require many sustainability actions from the industry. Polak's influence and essence pessimism would be the 'End of the Forest Industry'. Here the industry has not been able to produce products that would have demand from the customers. In addition, the society is not promoting the industry.

Regarding environmental management and environmental reporting, the theoretical contribution relates to the application of futures research methods. As was shown in Section 4, environmental reporting has been studied relatively often, but the majority of the studies have focused on describing and analysing the past reporting of companies or industries. The future of reporting is typically addressed only in the conclusions of the meta-analysis by pointing out new research topics of the less studied areas. Futures research offers a proactive approach to environmental reporting, such as in this research, by offering futures images of the possible future states. The futures images then provide the opportunity to decide in which direction we want to develop environmental reporting in the future.

Abbreviations

AOX	adsorbable organic halides
AR	annual report
BOD	biological oxygen demand
CEO	chief executive officer
CER	corporate environmental report
CO_2	carbon dioxide
COD	chemical oxygen demand
CSR	corporate social responsibility
CSRR	corporate social responsibility report
EMAS	the Eco-Management and Audit Scheme
EU	European Union
FFIF	Finnish Forest Industries Federation
FSC	Forest Stewardship Council
IR	integrated reporting
ISO	International Organization for Standardization
N	nitrogen
NA	not available
NGO	non-governmental organisation
NO_x	nitrogen oxides
P	phosphorus
PEFC	Programme for the Endorsement of Forest Certification
PESTEC	political, economic, social, technology, environment, cultural
SO_2	sulphur dioxide
SWOT	strengths, weaknesses, opportunities, threats
TSS	total suspended solids

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Appendices

Appendix 1. Interview questions

Area of expertise

How would you describe your area of expertise?

Environmental impacts and their measurement

What kind of environmental impacts does the forest industry cause? Which of these are significant environmental impacts?

What are the most efficient ways to decrease the environmental impacts?

What kind of positive environmental impacts does the forest industry cause?

What other kind of impacts (economic, social) does the forest industry cause?

Why is it important to measure the environmental impacts?

What kinds of good practices does the forest industry have in measuring environmental impacts?

What kinds of deficiencies does the forest industry have in measuring environmental impacts?

What good practices do other industrial sectors have? How could these be applied in the forest industry?

What is the role of different stakeholders (other companies, researchers, authorities) in developing environmental impact measurement?

How should the environmental impact measurement be developed?

Eco-efficiency as an indicator of corporate impacts

How do you define eco-efficiency?

How can eco-efficiency be applied in the Finnish forest industry?

Eco-efficiency can be defined as a ratio of corporate environmental impacts on economic performance. How should the environmental impacts be measured? How should the economic performance be measured?

Another way to define eco-efficiency would be to call it productivity of natural resources. What would this mean in the forest industry?

In what circumstances is eco-efficiency a good indicator?

In what circumstances is eco-efficiency a poor indicator?

Internal feasibility of the environmental information

How can the data on environmental impacts be utilised in corporate decision-making?

How should the data be developed in order to utilise it better in corporate decision-making?

Which impacts should the companies report?

External feasibility of the environmental information

How do you yourself use the published environmental impact data?

How should the data be developed in order for you to utilise it better?

Appendix 2. Delphi questionnaire

First round – Measuring environmental impacts and aspects in the forest industry

Choose the options that you think are the most suitable. You can also add your own options. After each section, there is an open field where you comment on the section or complete your answer to a question.

Which environmental aspects should the forest industry measure?

1) Wood-based raw materials
- Wood
- Pulp
- Recovered pulp
- Other, what?

2) Other raw materials
- Minerals
- Pigments
- Binders
- Fillers
- Starch
- Other, what?

3) Energy
- Electricity production
- Heat production
- Fossil fuels
- Renewable fuels
- Other, what?

4) Water
- Process water
- Other, what?

5) Emissions
- Emissions to water
- Emissions to air
- Solid waste
- Other, what?

6) Transportation of
- Raw materials
- Fuels
- Waste
- Products
- Employees
- Other, what?

7) Other environmental aspect

8) Your comments about environmental aspects in the forest industry

How should environmental aspects be measured in the forest industry (indicator and unit of measurement)?

9) Wood-based raw materials
- Wood
- Pulp
- Recovered pulp
- Other, what?

10) Other raw materials
- Minerals
- Pigments
- Binders
- Fillers
- Starch
- Other, what?

11) Energy
- Electricity production
- Heat production
- Fossil fuels
- Renewable fuels
- Other, what?

12) Water
- Process water
- Other, what?

13) Emissions
- Emissions to water
- Emissions to air
- Solid waste
- Other, what?

14) Transportation of
- Raw materials
- Fuels
- Waste
- Products
- Employees
- Other, what?

15) Other environmental aspect

16) Your comments about measuring environmental aspects in the forest industry

What are the current problems in measuring environmental aspects in the forest industry?

17) Wood-based raw materials
- Wood
- Pulp
- Recovered pulp
- Other, what?

18) Other raw materials
- Minerals
- Pigments
- Binders
- Fillers
- Starch
- Other, what?

19) Energy
- Electricity production
- Heat production
- Fossil fuels
- Renewable fuels
- Other, what?

20) Water
- Process water
- Other, what?

21) Emissions
- Emissions to water
- Emissions to air
- Solid waste
- Other, what?

22) Transportation of
- Raw materials
- Fuels
- Waste
- Products
- Employees
- Other, what?

23) Other environmental aspect

24) Your comments about the current problems in measuring environmental aspects in the forest industry

25) Which environmental aspects should be measured at the corporate level and which at the mill level? Mention a maximum of five most important at each level.

Mill level
1.
2.
3.
4.
5.

Corporate level
1.
2.
3.
4.
5.

26) How would it be possible to rank the corporations/mills according to the environmental aspect?

27) Your comments about environmental aspects and their measurement in the forest industry in general

28) Which environmental impacts should the forest industry measure?
- Acidification (effects on forests, water works, and constructions)
- Climate change
- Contamination of ground water
- Contamination of soil
- Effects on cultural heritage (especially cultures of native people)
- Effects on landscape (e.g., logging, new mills)
- Effects on recreational use
- Environmental effects of chemical use (e.g., ecotoxicity, bioaccumulation)
- Environmental noise
- Eutrophication
- Health effects of chemical use
- Health effects of environmental impacts
- Loss of biodiversity
- Monocultures in forest plantations
- Overuse of renewable resources
- Oxygen depletion in water bodies
- Ozone depletion
- Smell
- State of the Baltic Sea
- Tropospheric ozone formation
- Use of fossil fuels
- Use of unrenewable resources
- Other, which?

29) Your comments on the environmental impacts in the forest industry

30) How should environmental impacts be measured in the forest industry (indicator and unit of measurement)?
- Acidification (effects on forests, water works, and constructions)
- Climate change
- Contamination of ground water
- Contamination of soil
- Effects on cultural heritage (especially cultures of native people)
- Effects on landscape (e.g., logging, new mills)
- Effects on recreational use
- Environmental effects of chemical use (e.g., ecotoxicity, bioaccumulation)
- Environmental noise
- Eutrophication
- Health effects of chemical use
- Health effects of environmental impacts
- Loss of biodiversity
- Monocultures in forest plantations
- Overuse of renewable resources
- Oxygen depletion in water bodies
- Ozone depletion
- Smell
- State of the Baltic Sea
- Tropospheric ozone formation
- Use of fossil fuels
- Use of unrenewable resources
- Other, which?

31) Your comments on measuring environmental impacts in the forest industry.

32) What are the current problems in measuring environmental impacts in the forest industry?
- Acidification (effects on forests, water works, and constructions)
- Climate change
- Contamination of ground water
- Contamination of soil
- Effects on cultural heritage (especially cultures of native people)
- Effects on landscape (e.g., logging, new mills)
- Effects on recreational use
- Environmental effects of chemical use (e.g., ecotoxicity, bioaccumulation)
- Environmental noise
- Eutrophication
- Health effects of chemical use
- Health effects on environmental impacts
- Loss of biodiversity
- Monocultures in forest plantations
- Overuse of renewable resources
- Oxygen depletion in water bodies
- Ozone depletion
- Smell
- State of the Baltic Sea
- Tropospheric ozone formation
- Use of fossil fuels
- Use of unrenewable resources
- Other, which?

33) Which environmental impacts should be measured at the corporate level and which at the mill level? Mention a maximum of five most important at each level.

Mill level
1.
2.
3.
4.
5.

Corporate level
1.
2.
3.
4.
5.

34) How would it be possible to rank the corporations/mills according to the environmental impacts?

35) Your comments about environmental impacts and their measurement in the forest industry in general.

36) How would you describe your expertise from the point of view of measuring environmental impacts and aspects in forest industry? You can describe your expertise with environmental impacts, environmental aspects, measurement and/or the forest industry.

37) Which of the following best describe your background? You can specify after the options.
- Expert
- Researcher
- Representative of the forest industry
- Representative of the authorities
- Representative of an NGO
- Other, which?

38) Can your name be listed as a participating expert in the Delphi panel? The names will be published if each expert allows.

39) Your comments about the survey in general.

Second round – Measuring eco-efficiency

1. Measuring eco-efficiency

In my study, I define eco-efficiency as a ratio of environmental and economic impacts. Both the environmental and economic impacts can be understood in various ways. I have listed some options below. Please state your opinion of those.

1.1 Environmental impacts can be seen as the inputs needed for the production. Which of the below mentioned inputs should be taken into consideration as the forest industry's environmental impacts? You can also add your own choices.
- Consumption of water
- Consumption of energy
- Consumption of raw materials
- Other, which?

1.2 Environmental impacts can be seen as emission groups caused by production. Which of the below mentioned emission groups should be taken into consideration as the forest industry's environmental impacts? You can also add your own choices.
- Emissions to air
- Emissions to water
- Solid waste
- Other, which?

1.3 Environmental impacts can be seen as emissions caused by production. Which of the below mentioned emissions should be taken into consideration as the forest industry's environmental impacts? You can also add your own choices.

- Particles
- SO_2
- NO_2
- CO_2 (fossil)
- CO_2 (renewable)
- CO_2 (total)
- COD
- BOD
- AOX
- Phosphorus
- Nitrogen
- Solid particles
- Other, which?

1.4 Environmental impacts can be seen as the environmental impacts resulting from the production. Which of the following impacts should be considered as the forest industry's environmental impacts? You can also add your own choices.

- Acidification
- Climate change
- Contamination of ground water
- Contamination of soil
- Effects on recreational use
- Environmental impacts of chemical use
- Environmental noise
- Eutrophication
- Loss of biodiversity
- Monocultures in tree plantations
- Oxygen depletion in water bodies
- Ozone depletion
- Smell
- Use of fossil fuels
- Use of unrenewable natural resources
- Other, which?

1.5 Which of the abovementioned groups would best describe the environmental impacts of the forest industry?

- Inputs
- Emission groups (emissions to air, emissions to water, solid waste)
- Separate emissions (e.g., SO_2, CO_2, BOD)
- Environmental impacts (e.g., loss of biodiversity, smell)

1.6 What would be another way to measure the environmental impacts of the forest industry?

2. Measuring the economic impacts

2.1 How can the economic impact of the forest industry be measured? You can also add choices.

- Turnover
- Value added
- Amount of production
- Profit
- ROI (Return on investment)
- ROCE (Return on capital employed)
- ROE (Return on equity)
- ROS (Return on sales)
- Number of employees
- Other, which?

2.2 Which would best describe the economic impact of the forest industry?

- Turnover
- Value added
- Amount of production
- Profit
- ROI (Return on investment)
- ROCE (Return on capital employed)
- ROE (Return on equity)
- ROS (Return on sales)
- Number of employees
- Other, which?

3. Feasibility of the eco-efficiency indicator results

3.1 On which occasions would measuring eco-efficiency would be a good indicator?

- Comparing products of the same product group
- Comparing corporations of the same industry
- Comparing mills of the same industry
- Internal benchmarking (identifying good and bad performers inside a company)
- Reporting environmental aspects publicly
- A relative figure is in general more informative than a (large) absolute figure

3.2 On which other occasions would eco-efficiency be a good indicator?

3.3 Why is eco-efficiency not a good indicator?
- Eco-efficiency does not take the social impacts into consideration.
- Eco-efficiency does not take the location of the mill into consideration. The location affects the size of the environmental impact.
- Combining the different environmental impacts would require large expertise.
- Different actors count the environmental impacts differently.
- Absolute figures (e.g., total emissions, energy consumption) describe the environmental impacts better than the relative figures (e.g., emissions in relation to production).

3.4 What other difficulties there are in using eco-efficiency as a performance indicator?

4. Background information

4.1 How would you describe your expertise from the point of view of measuring environmental impacts and aspects in the forest industry? You can describe your expertise of environmental impacts, environmental aspects, measurement and/or the forest industry.

4.2 Which of the following best describe your background? You can specify after the options.
- Expert
- Researcher
- Representative of the forest industry
- Representative of the authorities
- Representative of an NGO
- Other

4.3 Can your name be listed as a participating expert in the Delphi? The names will be published if each expert allows.

4.4 Your comments about the survey in general.

Round three – Reporting environmental impacts and aspects in the forest industry in 2030

The topic of this survey is the reporting of environmental aspects and impacts in the forest industry in 2030. The questions evaluate both probable and preferable futures. One cannot foretell the futures, but as an expert you surely have insights regarding what most likely is going to happen in 20 years and/or what you would like to happen in 20 years.

I will use in the survey the concept of environmental aspects and impact. I define them according to the ISO 14000 series. Environmental aspects are the parts of the organisation, products or services that interact with nature. An environmental impact is any change to the nature, be it beneficial or harmful that is partly or totally caused by the organisation, its products or services.

What will be reported in 2030?

1) On which environmental aspects will the forest industry companies report in 2030?

	Probably will be reported	Preferably will be reported
Wood		
Recovered fibre		
Electricity production		
Heat production		
Fossil fuels		
Renewable fuels		
Process water		
Cooling water		
Emissions to water		
Emissions to air		
Solid waste		
Transportation of raw material		
Transportation of products		

2) Which other environmental aspects will probably be reported in the forest industry in 2030?

3) Which other environmental aspects will preferably be reported in the forest industry in 2030?

4) On which environmental impacts will the forest industry companies report in 2030?

	Probably will be reported	Preferably will be reported
Loss of biodiversity		
Use of fossil fuels		
Smell		
Acidification		
Oxygen depletion in water bodies		
Climate change		
Environmental impacts of chemical use		
Contamination of soil		
Eutrophication		
Overconsumption of renewable natural resources		
Consumption of unrenewable natural resources		
Environmental noise		

5) Which other environmental impacts will probably be reported by the forest industry in 2030?

6) Which other environmental impacts will preferably be reported by the forest industry in 2030?

To whom will be reported in 2030?

7) To which stakeholders will the forest industry companies report their environmental aspects and impacts in 2030?

	Probably will be reported	Preferably will be reported
Customers		
Employees		
Consumers		
Neighbours		
Owners		
Students		
Financers		
Media		
Other companies of the industry		
Companies of the supply chain		
Researchers		
Insurance companies		
Authorities		
Environmental NGOs		
Managers of the company		

8) To which other stakeholders will the companies probably report?

9) To which other stakeholders will the companies preferably report?

Indicators in the reports in 2030

10) Environmental aspects will be reported with absolute figures.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

11) Environmental aspects will be reported with relative figures (in relation to, e.g., the amount of production).

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

12) Corporate environmental impacts can be summarised into one indicator.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

13) Corporate environmental impacts will be presented with multiple indicators.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

14) Corporate environmental impacts will be illustrated with examples from everyday life (e.g., electricity consumption equals the consumption of N electricity heated detached houses or CO_2 emissions equal to N flights to Thailand.)

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

15) The environmental impacts will be presented in relations to the caused environmental impacts.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

The topics of the forest industry's reports in 2030

16) Companies report precisely on the environmental aspects at the mill level.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

17) Companies report precisely on the environmental aspects at the corporate level.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

18) Companies report precisely on the environmental aspects at the supply chain level.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

19) Companies report precisely on the environmental impacts at the mill level.

not probable at all   1 2 3 4 5 6 7   extremely probable
not preferable at all   1 2 3 4 5 6 7   extremely preferable

20) Companies report precisely on the environmental impacts at the corporate level.

not probable at all   1 2 3 4 5 6 7   extremely probable
not preferable at all   1 2 3 4 5 6 7   extremely preferable

21) Companies report precisely on the environmental impacts at the supply chain level.

not probable at all   1 2 3 4 5 6 7   extremely probable
not preferable at all   1 2 3 4 5 6 7   extremely preferable

Content of the forest industry reports in 2030

22) The environmental aspects of different companies are easy to compare.

not probable at all   1 2 3 4 5 6 7   extremely probable
not preferable at all   1 2 3 4 5 6 7   extremely preferable

23) Significant environmental aspects are reported with long data series.

not probable at all   1 2 3 4 5 6 7   extremely probable
not preferable at all   1 2 3 4 5 6 7   extremely preferable

24) The environmental impacts of different companies are easy to compare.

not probable at all   1 2 3 4 5 6 7   extremely probable
not preferable at all   1 2 3 4 5 6 7   extremely preferable

25) Significant environmental impacts are reported with long data series.

not probable at all   1 2 3 4 5 6 7   extremely probable
not preferable at all   1 2 3 4 5 6 7   extremely preferable

26) Companies report on the effects of structural changes in environmental impacts.

not probable at all	1 2 3 4 5 6 7	extremely probable
not preferable at all	1 2 3 4 5 6 7	extremely preferable

27) Reporting of environmental aspects and impacts fulfils the current requirements of financial reporting.

not probable at all	1 2 3 4 5 6 7	extremely probable
not preferable at all	1 2 3 4 5 6 7	extremely preferable

28) Companies only report on their positive environmental impacts.

not probable at all	1 2 3 4 5 6 7	extremely probable
not preferable at all	1 2 3 4 5 6 7	extremely preferable

29) Companies report on both their positive and negative environmental impacts.

not probable at all	1 2 3 4 5 6 7	extremely probable
not preferable at all	1 2 3 4 5 6 7	extremely preferable

30) Companies only report on their negative environmental impacts.

not probable at all	1 2 3 4 5 6 7	extremely probable
not preferable at all	1 2 3 4 5 6 7	extremely preferable

31) Which other significant aspects are there in relation to the content of forest industry reporting in 2030?

Forest industry, stakeholders and reporting in 2030

32) The reports are verified by an external, independent party.

not probable at all	1 2 3 4 5 6 7	extremely probable
not preferable at all	1 2 3 4 5 6 7	extremely preferable

33) The knowledge of external stakeholders is utilised in the environmental reporting.

not probable at all	1 2 3 4 5 6 7	extremely probable
not preferable at all	1 2 3 4 5 6 7	extremely preferable

34) External stakeholders actively take part in reporting the environmental aspects and impacts.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

35) Environmental aspects and impacts are reported in one report, which fulfils the requirements of all stakeholders.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

36) Environmental aspects and impacts are reported to different stakeholders in different propositions.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

37) The reporting of environmental aspects and impacts is regulated by law.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

38) The reporting of environmental aspects and impacts is standardised in the forest industry.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

39) Which other significant aspects relate to reporting and stakeholders in the forest industry in 2030?

The reporting schedule of forest industry companies in 2030

40) The reporting of environmental aspects and impacts is in real-time (e.g., daily or weekly updated statistics).

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

41) The reporting of environmental aspects and impacts happens quarterly.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

42) Companies publish data on environmental aspects and impacts yearly.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

43) Companies publish a wide report on environmental aspects and impacts less than once a year.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

44) Companies do not publish information on their environmental aspects and impacts.

| not probable at all | 1 2 3 4 5 6 7 | extremely probable |
| not preferable at all | 1 2 3 4 5 6 7 | extremely preferable |

45) What other significant aspects relate to the schedule of the forest industry reporting in 2030?

Background information

46) How would you describe your expertise from the point of view of measuring environmental impacts and aspects in the forest industry? You can describe your expertise in environmental impacts, environmental aspects, measurement and/or the forest industry.

47) Which of the following best describe your background? You can specify after the options.
- Expert
- Researcher
- Representative of the forest industry
- Representative of the authorities
- Representative of an NGO
- Other

48) Can your name be listed as a participating expert in the Delphi panel? The names will be published if each expert allows.

49) Your comments about the survey in general.

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