LAPPEENRANTA-LAHTI UNIVERSITY OF TECHNOLOGY LUT
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International Marketing Management

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EXPLORING SUSTAINABILITY COMMUNICATIONS ON TWITTER WITH TOPIC MODELING FROM A STAKEHOLDER PERSPECTIVE: EVIDENCE FROM THE FINNISH MARKETS

Examiners: Associate Professor Anssi Tarkiainen
Assistant Professor Jenni Sipilä

ABSTRACT

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Exploring sustainability communications on Twitter with topic modeling from a stakeholder perspective: Evidence from the Finnish markets

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The demand for sustainability is increasing and companies are operating in an environment where their actions are constantly scrutinized by various stakeholders. It is widely acknowledged that companies should integrate sustainability to their strategies, operations and communications. To improve the efficiency of sustainability communications, stakeholder expectations should be incorporated into the communications. Social media provides a platform for stakeholders to engage with companies and demonstrate their approval for messages.

This mixed method thesis examines the sustainability communications on Twitter of large, listed companies in Finland. The aim is to identify which sustainability topics the companies address on social media. In addition, a stakeholder approach is taken to examine how efficiently the companies address their stakeholders' expectations in their tweets. Furthermore, this thesis investigates which topics the stakeholders engage most with and whether these topics match their expectations. The data consists of organic tweets from 2019 of 25 companies as well as data gathered from the companies' materiality assessments to represent the stakeholder expectations. The research questions are approached with topic modeling method, a statistical text mining technique used to identify latent semantic themes in text data.

The findings offer new insights to prior knowledge and indicate that companies in Finland communicate more about sustainability topics than non-sustainability topics with an emphasis on environmental topics. Building on prior research, new topics identified are circular economy, sustainable food and packaging, forestry and biodiversity, sustainable aviation, sustainable pulp and paper, and sustainable building. Furthermore, the findings indicate that the companies address stakeholder expectations excellently in terms of environmental topics, but poorly in terms of social topics. In addition, the results indicate that the stakeholders engage more with sustainability related topics, especially environmental topics, on Twitter than non-sustainability related topics. Around half of the topics with the highest engagement are also identified to be stakeholder expectations.

TIIVISTELMÄ

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International Marketing Management -Maisteriohjelma

Iina Järvi

Tutkielma vastuullisuusviestinnästä Twitterissä: aihemallinnus sidosryhmien näkökulmasta Suomen markkinoilla

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Kysyntä vastuullisuudelle ja kestävyydelle on kasvussa, ja yritykset toimivat ympäristössä, jossa erinäiset sidosryhmät tarkastelevat niiden toimia jatkuvasti. On yleisesti tiedossa, että yritysten pitäisi integroida kestävyys strategioihinsa, operaatioihinsa sekä viestintäänsä. Viestinnän vaikuttavuutta voi parantaa ottamalla huomioon sidosryhmien odotukset viestinnän suunnittelussa. Sosiaalinen media puolestaan tarjoaa sidosryhmille alustan yritysten kanssa kommunikointiin sekä hyväksyntänsä osoittamiseen.

Tässä monimenetelmällisessä tutkielmassa tutkitaan isojen pörssiyhtiöiden vastuullisuusviestintää Twitterissä. Tavoitteena on tunnistaa vastuullisuuteen liittyviä aiheita, joista yritykset viestivät sosiaalisessa mediassa. Lisäksi tutkielmassa arvioidaan viestinnän vaikuttavuutta tarkastelemalla sidosryhmien odotuksiin vastaamista yritysten Twitter-viestinnässä. Tavoitteena on myös tunnistaa aiheita, jotka ovat sidosryhmien suosiossa ja vertailla näitä aiheita sidosryhmien odotuksiin. Tutkielman aineisto koostuu 25 yrityksen twiiteistä vuodelta 2019 sekä yritysten olennaisuusanalyyseistä kerätyistä teemoista, jotka kuvaavat sidosryhmien odotuksia. Tutkimuskysymyksiä lähestytään tilastolliseen ryhmittelyyn perustuvalla aihemallinnusmenetelmällä. Aihemallinnus on tekstinlouhintatekniikka, jolla voidaan tunnistaa piileviä semanttisia aiheita tekstiaineistosta.

Tutkielman tulokset tarjoavat uusia, paikoin poikkeavia löydöksiä olemassa olevan tiedon lisäksi. Tulokset viittaavat siihen, että Suomessa yritykset viestivät enemmän vastuullisuuteen liittyvistä kuin muista aiheista painottaen ympäristöaiheita. Aiempien tutkimusten löydösten lisäksi uusia tunnistettuja aiheita ovat kiertotalous, vastuullinen ruoka ja pakkaaminen, metsänhoito ja luonnon monimuotoisuus, kestävä ilmailu, kestävästi tuotettu sellu ja paperi sekä vastuullinen rakentaminen. Lisäksi tulokset viittaavat siihen, että yritykset vastaavat sidosryhmien odotuksiin erinomaisesti ympäristöaiheiden viestinnässä, mutta heikosti yhteiskunnallisten aiheiden suhteen. Tulokset tuovat myös esille sidosryhmien suosivan vastuullisuuteen, varsinkin ympäristöaiheisiin, liittyviä teemoja enemmän kuin muita aiheita. Noin puolet suosituimmista teemoista ovat tulosten mukaan myös sidosryhmien odotusten mukaisia teemoja.

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Helsinki, 15 February 2021,

Iina Järvi

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LIST OF SYMBOLS AND ABBREVIATIONS

API	Application Programming Interface
B2B	Business-to-Business
B2C	Business-to-Consumer
CEO	Chief Executive Officer
CO2	Carbon Dioxide
CSR	Corporate Social Responsibility
EK	Confederation of Finnish Industries
eWOM	Electronic Word of Mouth
GHG	Greenhouse Gas
GMO	Gene-Modified Organism
GRI	Global Reporting Initiative
IIRC	International Integrated Reporting Council
LDA	Latent Dirichlet Allocation
LOHAS	Lifestyle of Health and Sustainability
MNE	Multinational Enterprise
NFRD	Non-financial Reporting Directive
NGO	Non-Governmental Organization
PR	Public Relations
PSI	Product Stewardship Institute
SDG	Sustainable Development Goal
SME	Small- and Medium-sized Enterprise
SNS	Social Networking Service
WCED	World Commission on Environment and Development
WHO	World Health Organization

1 INTRODUCTION

Today, businesses are operating in an increasingly critical environment where their actions, and lack of actions, are scrutinized by different stakeholders (Frankental 2001), while digitalization and social media have empowered stakeholders with information and the means to point out irresponsible behavior (Lyon & Montgomery 2013). Thus, it is widely recognized that companies should engage in sustainability efforts and communications (Du, Bhattacharya & Sen 2010). According to a special Eurobarometer survey, 94 % of the respondents state that protecting the environment is important to them, while 80 % believe that large companies and industries are not doing enough to protect it (European Commission 2020). As the demand for sustainability is increasing globally, companies are responding to the demand by integrating sustainability to their strategies and marketing communications (Schmuck, Matthes & Naderer 2018).

During the past decade sustainability, or corporate social responsibility (CSR), has been recognized as a megatrend (Lubin & Esty 2010) and it also plays a role in marketing and communications research. As sustainability has increased its importance, the concept of sustainability marketing has evolved, yet the core idea of integrating sustainability into companies' marketing efforts remains the same (Dangelico & Vocalelli 2017). Sustainability represents a new marketing paradigm and a shift from anthropocentric thinking to biocentric (Achrol & Kotler 2012) and is one of the most important issues in today's marketing (Fodness 2015).

Nowadays, consumers are choosing products not only based on functional and emotional criteria, but also based on how responsible companies are, which represents the concept of Marketing 3.0. Business-to-business (B2B) companies also feel pressure for sustainability from their distributors and customers. (Kotler 2011). While companies have the responsibility to maintain economic growth, they must also consider the economic, environmental and social influence of the business on the external stakeholders (Dahlsrud 2008). By integrating sustainability in their marketing efforts, companies are able to build relations with stakeholders, enhance their societal image and promote sustainable consumption (Signitzer & Prexl 2008). Achrol & Kotler (2012) argue that while marketing drives the economy through consumption, marketing is also responsible for the harmful side-

effects such as the ecological consequences of overconsumption. The many benefits of sustainability and CSR communications have been studied throughout the last decades (e.g., Du et al. 2010) as have the challenges including consumer scepticism (e.g., Dawkins 2004) and greenwashing (e.g., Jahdi & Acikdilli 2009).

Yet, further information is needed in terms of the sustainability communications practices of companies especially from the perspective of their various stakeholders. This thesis explores 25 large companies listed on Nasdaq Helsinki stock exchange and their 2019 sustainability and CSR communications on the social media platform Twitter with a text mining approach. The aim is to identify which sustainability issues are being addressed by the companies and how effective the communications are in terms of meeting the stakeholder expectations stated in the materiality assessments. This thesis aims to also identify topics that the stakeholders engage most with in terms of favorite counts.

Furthermore, this thesis aims to provide up-to-date knowledge about the sustainability communications practices in the Finnish markets and shed light on the trends in sustainability issues the companies are addressing. By identifying the most communicated and popular issues in terms of stakeholder reactions, this thesis can provide practical contributions for companies. Moreover, this thesis addresses an important research gap by taking the stakeholder perspective to study whether the companies utilize the identified material topics effectively to communicate about their sustainability efforts to their stakeholders. In addition, the material topics compared with the most popular topics in the Twitter posts help to ascertain whether there is a connection between the expected issues and the actual engagement.

1.1 Literature review

Research on sustainability marketing was first introduced in 1990 by Peattie (1990) and Prothero (1990), while environmentalism has been around since the 1970s. Traditionally, marketing and environmentalism have been considered to be far from each other as marketing has been seen as an activity with a purpose of getting consumers to consume more while environmentalism encourages to consume less. (Peattie 1990). The thinking has come a long way from the 1970s, when Friedman (1970) argued that "*the social responsibility of*

business is to increase its profits". With the rise of green consumerism, marketing strategies had to start responding to new green demands (Prothero 1990). According to Peattie (1990) the consumers' environmental concerns should be matched with the products' and production processes' environmental performance in green marketing. To predict the future concerns, new scientific evidence announcements about environmental damage should be followed as environmental groups tend to adopt the issue, followed by the media and finally by the public.

There are a few broad sustainability marketing research streams that have been explored in literature, one covering individual consumer concerns, behavior and practices (McDonagh & Prothero 2014). This stream focuses on topics such as consumer values, environmentally conscious behavior, sustainable consumption (Alexander & Ussher 2012; Lim 2017) and the role of the individual consumer (Assadourian 2010; Kilbourne, Beckmann & Thelen 2002). The second stream covers sustainability marketing from the perspective of environmental laws, regulations and policies (McDonagh & Prothero 2014). The focus areas include topics such as consumer laws (Wilhelmsson 1998), eco-labeling (Borin, Cerf & Krishnan 2011), and the role of social marketing policies (Shang, Basil & Wymer 2010) as the environmental laws, regulations and policies have increased during the last few decades.

Another stream explored focuses on organizational sustainability strategies and sustainable business practices, yet marketing communications studied from the sustainability perspective have been rather scarce during the recent decades despite the media attention (McDonagh & Prothero 2014). Chang (2011) and Do Paço & Reis (2012) study the effect of green communications and advertising on consumers' buying behavior while Kärnä, Hansen & Juslin (2003) study the integration of environmental issues into marketing planning in four European countries. In addition, one stream has focused on reframing sustainability through institutional, societal and systems perspectives as well as from the viewpoint of marketing ideology and how it contradicts with environmental issues (McDonagh & Prothero 2014). Moreover, the relationship between marketing and the environment has been addressed often during the last few decades, for example by Kotler (2011) and Prothero, McDonagh & Dobscha (2010).

Furthermore, the very definition of sustainability marketing has been researched along with consumption's role in the traditional purpose of marketing, yet further research is needed (McDonagh & Prothero 2014). For example, Gordon, Carrigan & Hastings (2011) argue that sustainable marketing consists of green marketing, social marketing and critical marketing, while Praude & Bormane (2013) define sustainable marketing as "*the process of creation, communication, and delivery of consumption values to the consumer with a view to meet their needs and observe the requirements of environment preservation without jeopardizing the possibilities of meeting the needs of future generations*". Lee (2017) proposes that sustainability marketing communications can be defined as the company's marketing communication activity that aims to promote sustainability while seeking economic growth and environmental wellbeing in a marketing campaign. In addition, McDonagh and Prothero (2014) argue that current sustainability marketing practices should be studied further to support the existing literature and further research. Furthermore, Lee (2017) argues that further research is needed for studying how companies communicate about sustainability issues to the public and how integrated sustainability is in their marketing communications.

Research has also focused on different communication strategies, especially on the stakeholder information, and involvement or interacting strategies (Cho, Furey & Mohr 2017; Morsing & Schultz 2006). It is argued that in addition to informing stakeholders about the companies' sustainability and CSR efforts, companies should also aim to interact with the stakeholders and engage in an interacting strategy (Morsing 2006). Furthermore, the research highlights the importance of two-way communication and continuous dialogue with the stakeholders as it helps to identify and respond to the changing stakeholder expectations (Morsing & Schultz 2006). However, in practice companies adopt the informing strategy more often than the interacting strategy (Cho et al. 2017) and it is argued that there is a lot of untapped potential in communicating about CSR through social media channels given that they can be used to foster dialogue (Kent & Taylor 2016).

In the recent years, many have focused on researching sustainability communications in an online and digital context (Abitbol & Lee 2017; Kent & Taylor 2016; Lee 2017) as companies have increasingly started to use websites and social media as tools in their sustainability communications (Grigore, Stancu & McQueen 2018). Others have studied the role of company web sites or annual reports, while some have focused on sustainability

communications on social media. Moreno & Capriotti (2009) study the role of company web sites in CSR communications and find that the internet has become an essential instrument in CSR communications. Furthermore, Etter (2013) argues that the CSR related messages should be analyzed further to identify which CSR topics are being addressed by the companies.

Prior research has mainly studied sustainable marketing communications from the company perspective rather than the perspective of stakeholders (Lee 2017). Different stakeholders, such as investors or the society, have different expectations towards companies' CSR activities (Cho et al. 2017). Moreover, Fodness (2015) argues that sustainability marketing is challenging as different stakeholders have different expectations regarding the communications. In addition, research about CSR communications that investigates consumers' expectations and reactions towards the communications is still rather scarce (Podnar 2008). Moreover, research about the efficiency of companies' day-to-day communication on social media is limited (Ye & Cheong 2017). Cho et al. (2017) find that over 80 % of companies Facebook postings are about non-CSR related communications among sampled Fortune 500 companies, and that the public has a greater tendency to engage with non-CSR messages than CSR messages. Etter (2013) finds similar results for Twitter, as around 15 % of companies' tweets are about CSR related issues, and the level of stakeholder interaction is significantly higher for non-CSR related tweets.

1.2 Research questions

This thesis aims to fill the gaps identified in the literature review and support existing literature by studying the sustainability communications practices on Twitter among large companies on the Finnish markets. The aim is to identify which sustainability topics are addressed by the 25 analyzed companies and how the sustainability marketing communications are implemented from the stakeholder perspective. The companies, their industries and the number of their Twitter followers are presented in appendix 1. Thus, the main research question is as follows:

RQ: How do large, listed companies in Finland implement sustainability marketing communications on Twitter?

And the first sub-question is as follows:

SQ1: Which sustainability topics or themes are being communicated on Twitter?

In addition, this thesis focuses on sustainability communications from the perspective of stakeholders and aims to find whether the topics in the communications are similar to the topics identified in the materiality assessments of the companies. The materiality assessments are used to identify stakeholder expectations towards companies' sustainability activities and communications. The level of the companies' fulfillment of stakeholder expectations is used to find out how effective the sustainability communications are. Thus, the second sub-question is as follows:

SQ2: How effective is the communication in terms of meeting the stakeholder expectations?

This thesis aims also to identify with which topics the stakeholders engage most with on Twitter and whether they engage most with the same topics they find important in the materiality assessments. The stakeholder engagement in social media is examined to identify the most popular topics and then compared to the results in the second sub-question. Thus, the third sub-question is as follows:

SQ3: Which sustainability topics the stakeholders engage most with and do the topics match their expectations?

The three sub-questions support the main research question, and their results are used to answer the main research question about the implementation of sustainability marketing communications. The effectiveness of the communications is evaluated by how well the companies address the stakeholder expectations while also examining which topics the stakeholders engage most with to see if there is a connection between their expectations and the topics they engage with.

1.3 Theoretical framework and key concepts

The theoretical framework in this thesis is built around the studied phenomenon and research problem of the implementation and effectiveness of sustainability marketing communications on Twitter. The theoretical framework consists of the relevant concepts and theories used in this thesis, the context of the research, the studied phenomenon, as well as their relationships to each other and linkage to the topic of the thesis. The framework is illustrated in figure 1 below.

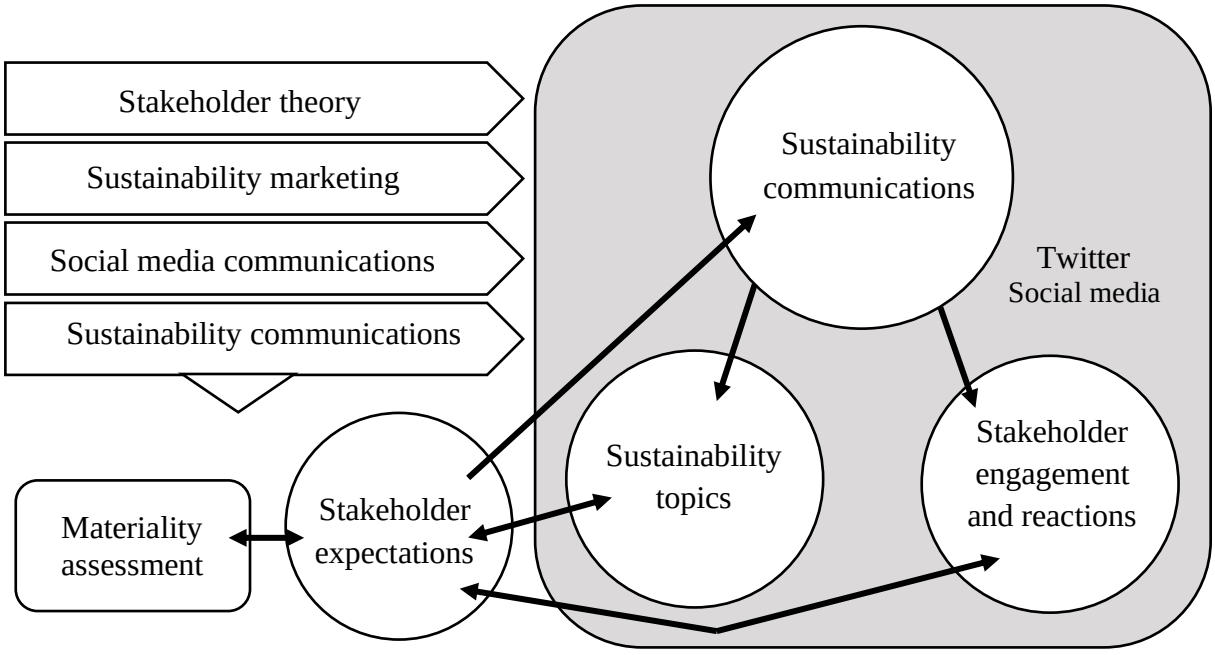

Figure 1. Theoretical framework of the thesis

The figure presents the relevant theories and concepts: sustainability and CSR communications, sustainability marketing, social media communications and stakeholder theory and materiality. The relevant concepts are defined later in this chapter. The theoretical concepts provide a comprehensive theoretical foundation for studying the topic. The context in this research is the social media channel Twitter, and more specifically the studied companies' posts in Twitter from the calendar year 2019. Within the context, the main research question and the three sub-questions are presented as the analysis focuses on the sustainability communications on Twitter. The aim is to identify the sustainability topics that are communicated as well as the stakeholder engagement and reactions through popularity

metrics, specifically favorite counts. The stakeholder expectations are gathered from the materiality assessments from the corporate reports or websites, which is why they are presented outside the context of Twitter.

In the figure, the arrows represent the relationships between the aspects of the framework. This thesis aims to find out whether stakeholder expectations are being responded to in the companies' sustainability communications on Twitter, and whether the measured stakeholder engagement and reactions match the expectations in the materiality assessments. In order to determine whether companies communicate according to the stakeholder expectations, the topics that are communicated are first identified and then compared to the expectations. Furthermore, the engagement levels and emerging topics can help identify popular topics among stakeholders. Next, the key concepts are defined.

Perhaps the most known definition of **sustainability** is by the World Commission on Environment and Development (WCED) in 1987: "*development that meets the needs of the present without compromising the ability of future generations to meet their needs*". According to Elkington's (1997) triple bottom line approach, instead of focusing merely on profits, companies should also focus on environmental and social concerns. Thus, there should be three bottom lines: profit, people and planet, which refer to the three dimensions of sustainability: economic, social and environmental sustainability. The concept of **Corporate Social Responsibility** also refers to companies finding a balance between the three dimensions so that none of the three thrives at the expense of the other dimensions (Bergmans 2006). Thus, the concepts of sustainability and CSR are used interchangeably in this thesis. Corporate sustainability communications refer to companies communicating about different economic, social and environmental sustainability issues that should be integrated to the company's strategy and agenda (Signitzer & Prexl 2008).

Social media can be defined as an online communication platform or a channel designed for networking as well as creating and sharing content generated by the users of the platform. Social media allows companies to engage directly with the end-consumers in a timely, low-cost and effective way. (Kaplan and Haenlein 2010). This thesis focuses on the social media channel Twitter, which is a platform for self-expression, networking, sharing and discovering content in real time (Twitter 2020). In Twitter, the users send messages or posts

called *tweets* that are up to 280 characters long (Clement 2020) and it is one of the leading social networks in the world with its 326 million active users (Kemp 2020).

Stakeholder is defined by Freeman (1984) as any group or individual who can affect and/or is affected by the activity of a company. The stakeholder perspective means that companies are also accountable to external and internal stakeholders instead of merely the owner of the company. Companies have different stakeholders, such as employees, consumers, customers, shareholders, society, competitors, legislators and interest groups. The stakeholders have different needs and expectations, and companies should aim to manage them all as stakeholder relationships are crucial in sustainability efforts. Stakeholder engagement refers to involving stakeholder in various activities such as having dialogue or disclosing sustainability information to them. (Sloan 2009). In this thesis, stakeholder engagement and reactions will be examined through favorite counts (likes) in the tweets.

Material topics are topics identified by companies that can have a substantial environmental, social or economic impact or topics that can significantly affect the decisions of stakeholders. The materiality assessments are conducted by companies often together with relevant stakeholders through for example interviews or surveys. The material topics identified can be illustrated with a materiality matrix. In the matrix the material topics are positioned across two dimensions: the effect on stakeholder decisions and the significance of the sustainability impacts. (GRI 2020a). The two dimensions can also be interpreted as the importance to stakeholders and the importance to the company. In this thesis, the material topics are gathered from each of the companies' websites or recent corporate reports such as sustainability reports or annual reports. Moreover, the material topics are used as a proxy for stakeholder expectations.

1.4 Delimitations and research methodology

The main research problem in this thesis is the implementation and effectiveness of sustainability marketing communications of 25 large, listed companies in Finland on the social media platform Twitter. Thus, this thesis does not include small- and medium-sized enterprises (SMEs), unlisted large companies or companies from other countries. The main research question is supported by three sub-questions that cover the sustainability topics that

are being communicated by the studied companies and the effectiveness of the communication in terms of stakeholder expectations. In addition, the most popular topics from the stakeholder perspective are examined. Other aspects of sustainability communications are not examined in this thesis. The data in this thesis consists of Twitter posts of 25 large, listed companies from the calendar year 2019. The posts are collected from January 2019 to December 2019 to allow for a comprehensive picture of corporate communications and to take into account any seasonal changes in the communications. Thus, other communication channels and years are excluded. The reason for not using the most recent data from the spring and summer of 2020 is to exclude any changes in the communications caused by the global pandemic. The Twitter data is collected with RStudio. The other data set consists of the materiality assessments of the companies and it is manually collected from the companies' websites and corporate reports.

Both of the data sets are analyzed in RStudio by using a text mining technique topic modeling. Text mining is used to identify the most common sustainability topics and themes in the corporate communications, the most common themes among the companies' material topics and the most popular topics. Text mining is a rather new method used to analyze social and environmental disclosure, but it has been used in the recent years for example by Aureli, Medei, Supino & Travaglini (2016) to analyze sustainability reports. The internet and social media networks provide large sets of data that can be analyzed with text mining tools to identify patterns and trends. In topic modeling, Latent Dirichlet Allocation (LDA) is a method for identifying concealed topics in data based on co-occurrence patterns of terms. Thus, LDA generates topics where the terms in the dataset most probably occur with each other. (Aggarwal & Zhai 2012)

The number of favorite counts for each post will be used as popularity metrics to measure stakeholder engagement as has been done in prior research (such as Cho et al. 2017; Swani, Milne, Brown, Assaf & Donthu 2016). To better represent the data, a favorite count-to-follower ratio is used to identify the most popular tweets from the data. The most popular content will be compared to the stakeholder expectations to study whether the stakeholder engagement and reactions match the expectations and material topics. The degree of how well companies are responding to stakeholder expectations will be used to evaluate the

effectiveness of the communications in this thesis. Research methodology is further discussed in chapter 3.

1.5 Structure of the thesis

The structure of the thesis is described in this chapter. The thesis begins with an introduction to the topic with the background and literature chapters and description of the research questions. The theoretical framework is then presented, and key concepts are defined. The delimitations of this thesis are described, and a brief description of the research methodology follows. The description of the structure of the thesis will conclude the introduction chapter. The theoretical background consists of one main chapter of sustainability and CSR communications and six subheadings of corporate sustainability and CSR efforts, sustainability content in corporate messages, sustainability marketing, communicating sustainability on social media, stakeholder theory including stakeholder expectations and stakeholder engagement on social media, as well as the effectiveness of communications.

Then, the research design and methods are explained to include the research context, data collection and analysis methods used in this thesis. The reliability and validity of the thesis are also discussed. Next, the research findings are presented and analyzed for each research question. This is followed by discussion and conclusions that include the theoretical and practical contributions and implications of the thesis and its findings. The final chapter presents answer to the research questions. Finally, the various limitations of the thesis are discussed and suggestions for future research are presented.

2 SUSTAINABILITY AND CSR COMMUNICATIONS

Today, companies operate in an environment where their actions are critically scrutinized by various stakeholders (Frankental 2001). Thus, it is widely recognized that companies should engage in corporate sustainability communications (Du et al. 2010). This chapter discusses sustainability communications, relevant legislation and reporting standards as well as the challenges related to the topic. Next sub-chapters address companies' sustainability activities, the sustainability content in companies' communications, sustainability from the marketing perspective and in social media, the stakeholder theory, expectations and engagement on social media and finally the effectiveness of sustainability communications.

Corporate sustainability and CSR communications refer to companies communicating about different economic, social and environmental sustainability issues (Signitzer & Prexl 2008). CSR communications can also be used by companies with an aim to persuade customers, by trying to influence their purchase decisions by promoting a CSR issue related to the product, service or company (McWilliams, Siegel, and Wright 2006). Sustainability issues are disclosed through many channels, such as websites, corporate reporting (Morsing & Schultz 2006) and social media (Kent & Taylor 2016). Podnar (2008) argues that corporate CSR communications is a process, illustrated in figure 2, where stakeholder expectations are taken into consideration, CSR policy is articulated and different communication tools are utilized to disclose transparent and honest information about the company's integration of sustainability concerns, business operations and stakeholder interaction.

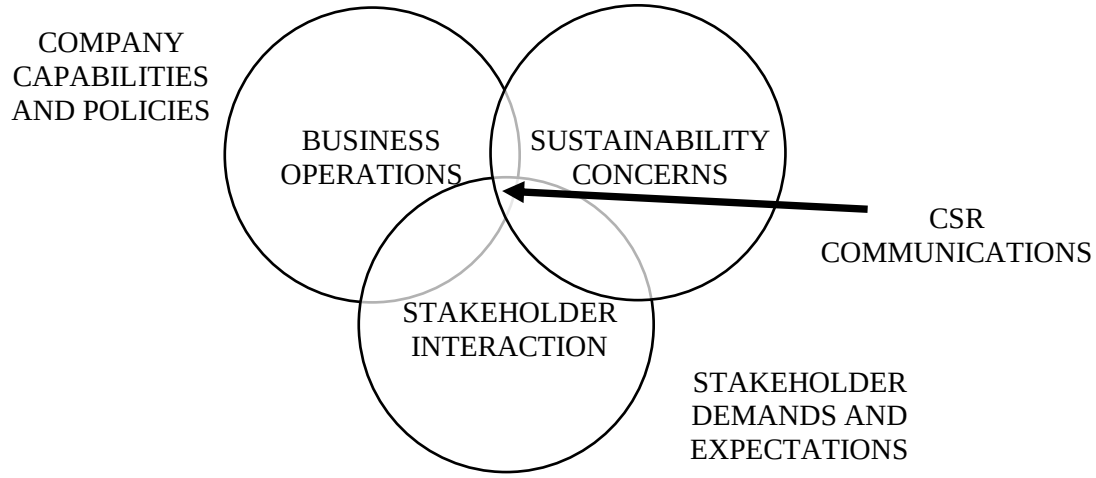

Figure 2. CSR communications (Podnar 2008)

In their CSR communications, companies can engage in information or interaction strategies meaning that they merely disclose information to their stakeholders or aim to interact with them in the process (Morsing 2006). Morsing (2006) argues that when informing stakeholders about CSR efforts, companies should present sustainability issues as a shared concern between the company and the stakeholders and link the issue to the company's core business. This is also supported by Abitbol & Lee (2017) who study messages and their stakeholder engagement on CSR-dedicated Facebook pages and find that messages congruent with the company's core business and industry are the most engaging.

Some stakeholders, such as investors or non-governmental organizations (NGO), expect to see evidence about the sustainability efforts to include indicators, targets, trends and benchmarks along with case studies. To overcome barriers in communication, companies should avoid using sustainability jargon and aim to include relevant information that fits well to the corporate strategy and explain the issues' impact on the bottom line. (Dawkins 2004). Furthermore, Morsing (2006) argues that the CSR communications strategy should be in line with the corporate strategy and the messages should demonstrate how the company supports the sustainability issue and with what results. In addition, stakeholders appreciate companies' compliance of reporting standards such as Global Reporting Initiative (GRI) (Dawkins 2004).

There are rules, regulations and standards related to sustainability disclosure on national, European and international levels. In the EU, the non-financial reporting directive (NFRD, or the Directive 2014/95/EU) requires large companies to report about social, environmental and economic information in order for stakeholders to properly evaluate the companies' non-financial performance. The directive applies to large public-interest companies that employ more than 500 employees and requires them to publish information about environmental protection, social responsibility and employee wellbeing, human rights, anti-corruption and bribery as well as diversity on the companies' boards. (European Commission 2014). Since 2016 in Finland an Accounting Act amendment (1376/2016) based on the EU directive has required large public-interest companies with more than 500 employees and a turnover of over 40 million EUR or balance sheet total of more than 20 million EUR to report about corporate social responsibility issues. The legislation is flexible in terms of the format and particular information or figures, but the topics are the same as in the EU directive. (Ministry

of Economic Affairs and Employment of Finland 2016). All of the 25 companies analyzed in this thesis are required by law to disclose CSR issues. According to KPMG (2020), 84 % of Finnish companies include sustainability information in their annual reports today compared to 54 % in 2017.

While the EU directive and Finnish national legislation are flexible in terms of how the information is disclosed, there are various sustainability reporting standards that guide companies in reporting, such as the GRI. The GRI framework is the most popular reporting framework (KPMG 2017) and it is also the first and most widely adopted global standards for sustainability reporting. GRI is an independent organization that provides the standards that are continuously developed together with multiple stakeholders. (GRI 2020b) The standards guide companies in disclosing a wide range of sustainability topics such as biodiversity, anti-corruption, health and safety. Companies choose the most relevant, material topics based on the economic, environmental and social impacts and the topics that are of importance to their stakeholders. (GRI 2017). In addition to sustainability reporting, companies are increasingly adopting integrated reporting to respond to the demand for transparent and reliable information about financial performance and sustainability efforts (Frias-Aceituno, Rodríguez-Ariza & Garcia-Sánchez 2014). Integrated reporting combines financial and sustainability information into one report and the International Integrated Reporting Council (IIRC) provides a framework for companies. However, the IIRC standards have not yet been adopted on a global scale. (IIRC 2020)

While more and more companies are engaging in sustainability efforts and communications, there are also various challenges related to communicating the corporate responsibility efforts to the stakeholders (Dawkins 2004). Public scepticism towards corporate sustainability messages is a challenge as some believe that sustainability communications are merely an attempt to hide unethical or irresponsible activities (Christensen, Morsing & Thyssen 2011). Moreover, corporate social responsibility should not only be used for public relations (PR) purposes (Frankental 2001) or greenwashing where the communications do not reflect the actions of the company (Elving, Golob, Podnar, Ellerup-Nielsen & Thomson 2015). Furthermore, the public cynicism is often related to the companies' motives for the responsibility efforts especially when the public perceives that the selfish motives trump the altruistic ones (Dawkins 2004). Corporate credibility can be increased by addressing

sustainability issues that fit to the brand and core business (Abitbol & Lee 2017; Dawkins 2004; Morsing 2006). However, it seems that today people are accepting that sustainability efforts can stem from both extrinsic and intrinsic motives, meaning that it is increasingly acceptable for companies to be driven to sustainability by profits in addition to ethical reasons. It is emphasized that being deceptive about the motives causes further scepticism and negative reactions from the public. (Du et al. 2010)

The differences in sustainability communications between B2C and B2B companies have also been researched during the last decades. It seems that B2C companies are driven to improve their sustainability performance by the greater amount of attention paid to their activities by the society. B2B companies, however, have less visibility on the markets in terms of the end-consumers. (Bowen 2000; Haddock-Fraser & Fraser 2008). Moreover, Haddock-Fraser & Tourelle (2010) find that the companies closer to the end-consumer are significantly more active in environmental measures and sustainability management, such as reporting, compared to B2B companies, which highlights the importance of consumers' demands.

2.1 Corporate sustainability and CSR efforts

In today's world, corporate sustainability and CSR are increasingly important topics from the societal, environmental and business perspectives. In the fall of 2019, the prestigious business and economics newspaper *Financial Times* called for a reset on capitalism proposing that corporations share a fundamental commitment to all their stakeholders instead of merely the shareholders (Wolf 2019). Companies are indeed increasingly implementing various CSR and sustainability efforts such as improved employee conditions or recycling in their operations globally (Tench & Jones 2015). Dyllick & Muff (2015) define a truly sustainable business as "*a business that shifts its perspective from seeking to minimize its negative impacts to understanding how it can create a significant positive impact in critical and relevant areas for society and the planet*." This is done by turning sustainability challenges such as climate change, poverty or migration into business opportunities. A more common approach to determine the sustainability of a company is to assess its economic, environmental and social performance (Figge & Hahn 2004).

The concept of corporate social responsibility has been around for decades denoting that companies have responsibilities beyond the legal obligations to the society it operates in (Brønn & Vrioni 2001). Today, the concept has evolved to recognize the impact a company can have on its external stakeholders (Tench & Jones 2015). Indeed, a responsible company acknowledges its existence and position in the society and how its activities affect or can affect its various stakeholders such as the environment (Brønn & Vrioni 2001). It is widely recognized that sustainability has and will have a significant impact on how businesses operate (Dyllick & Muff 2015). Environmental, social and economic sustainability, also known as the triple bottom line of profit, people and planet (Elkington 1997) should all be focused on by companies and no dimension should thrive at the expense of the others (Bergmans 2006). The three dimensions in their ideal balance are illustrated in figure 3, where sustainability occurs at the intersection.

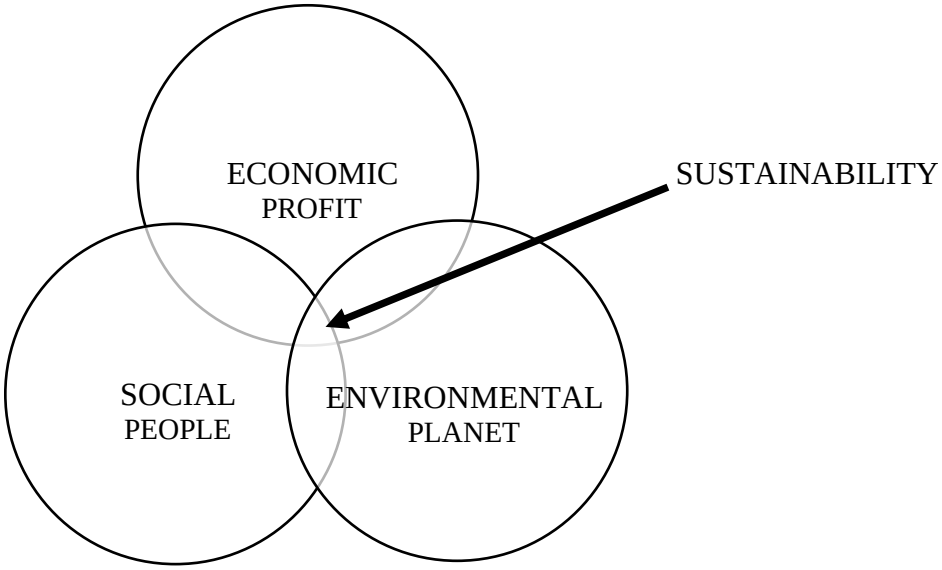

Figure 3. Dimensions of sustainability ideally balanced

In theory, sustainability can be achieved when the three dimensions are balanced. However, in reality the dimensions need to be integrated better as the economic dimension is often trumping the other two (Adams 2006) as illustrated in figure 4 below. This refers to the economic paradigm where companies are driven by economic concerns such as access to low-cost resources in order to achieve profit or other economic shareholder value (Dyllick & Muff 2015). The balancing of the dimensions also depends on the stakeholder expectations and companies' business models, products and services as they can offer

different opportunities in terms of social and environmental impact (Fischer 2020). In addition, there is a large gap between the number of businesses claiming to operate sustainably and the actual impact of these activities in the state of the planet and societies (Dyllick & Muff 2015).

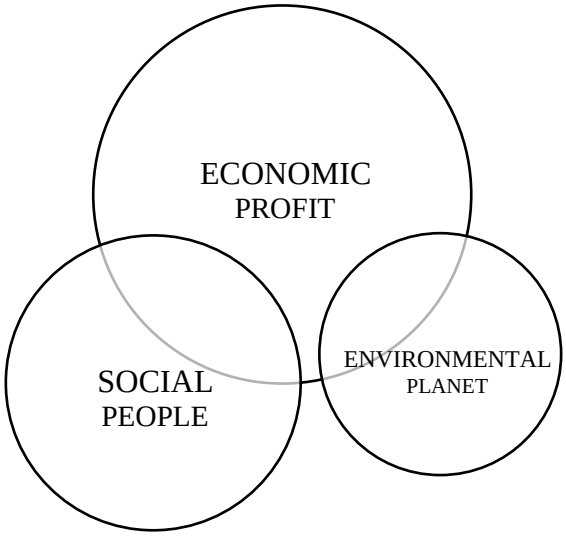

Figure 4. Dimensions of sustainability in reality (Adams 2006)

According to Fischer (2020) the three dimensions can be divided to various sub-dimensions. The economic dimension includes profit generation, financial growth, increase in the number of employees, development of new markets, economic survival and sustaining of business, and addressing the needs of the market (Fischer 2020). The Confederation of Finnish Industries (abbr. EK) states that responsible companies take care of their profitability and competitiveness in the long run so that they are able also to take care of the social and environmental aspects. In addition, the economic dimension refers to the economic impact on the stakeholders in terms of salaries, dividends, income and paying taxes to the society. (EK 2020). The GRI reporting standards include economic standards including topics such as anti-corruption, taxes and procurement practices (GRI 2021). The three dimensions, their sub-dimensions and related topics are presented in table 1 below.

Table 1. Sustainability dimensions, sub-dimensions and related topics (EK 2020; Fischer 2020; GRI 2017 & GRI 2021)

Dimension	Sub-dimensions and topics
Economic	Profit generation, financial growth, increasing number of employees, development of new markets, economic survival and sustaining of business, addressing market needs, profitability, competitiveness, economic impact on stakeholders (salaries, income, dividends, taxes), anti-corruption, procurement practices
Environmental	Energy efficiency, environmentally friendly products and solutions, renewable energy, resource independency, minimizing emissions and water usage, recycling, creating value from waste, efficient use of raw materials and natural resources, protecting water, air and soil, preventing climate change, biodiversity
Social	Ethical actions, public health, improving quality of life and living conditions, better education, supporting local business, social impact on people and society, employee conditions, safety and health, equality, child labor, human rights, socioeconomic compliance

Environmental dimension can be divided to six sub-dimensions that are energy efficiency, environmentally friendly products, using of renewable energy, being resource independent, minimizing greenhouse gas (GHG) emissions and water usage as well as recycling and creating value from waste (Fischer 2020). According to EK (2020) a responsible company acknowledges the environmental impacts of its operations, adheres to legislation and continuously develops its operations to efficiently use energy, raw materials and natural resources, to recycle and decrease the amount of waste, to protect the water, air and soil, to prevent climate change and to offer environmentally friendly solutions to its customers. The GRI reporting standards include also environmental topics such as materials, biodiversity and emissions (GRI 2017). The economic dimension often walks hand in hand with the environmental dimension through cost reductions and enhanced efficiency gained from for example energy savings or cleaner production (Schaltegger, Luedeke-Freund & Hansen 2012). Moreover, Gupta (2018) finds that a company operating in an environmentally friendly manner is rewarded by the market due to cheaper implied cost of equity, indicating a relationship between a company's financial performance and environmentally friendly practices.

The social dimension can be divided to sub-dimensions that are ethical actions, working to enhance public health and getting rid of sources that can damage health, improving quality of life and living conditions in the societies, securing better education and supporting local businesses and trade (Fischer 2020). EK (2020) states that social sustainability refers to the impact a company has on people and societies to include employees, customers, local residents, sub-contractors and NGOs. Social sustainability can be achieved by engaging in dialogue with stakeholders to find out any expectations from the stakeholders, share information and utilize expertise from the stakeholders to find new and better solutions (EK 2020). The GRI reporting standards include several social standards including topics such as employee conditions, employee and customer health and safety, equality, child labor, human rights and socioeconomic compliance (GRI 2021).

Penz & Polsa (2018) find that companies are driven to reduce GHG emissions because of business rationale, environmental responsibility or pressure from stakeholders. Indeed, consumers, employees and other key stakeholders are becoming more likely to favor responsible companies and punish the irresponsible ones (Du et al. 2010), and social media provides a platform for both actions (Hennig-Thurau, Gwinner, Walsh & Gremler 2004; Lyon & Montgomery 2013). Moreover, the benefits of CSR and sustainability for companies are manifold. By acting responsibly, companies are able to enhance their brand image, affect the attitudes and behavior of stakeholders such as consumers and their purchase behavior, strengthen relationships with stakeholders, attract employees and investors, as well as increase positive word of mouth (Du et al. 2010).

2.2 Sustainability content in corporate messages

Consumers are increasingly demanding sustainability from companies (Schmuck et al. 2018) and they also are making purchase decisions based on how responsible the companies are (Kotler 2011) due to their growing concern for the environment and belief that companies are not acting sustainably enough (European Commission 2020). Thus, companies are increasingly changing their way of operating to more sustainable and are communicating about the efforts through various channels. Penz & Polsa (2018) find that companies are driven to communicate about their GHG emission reduction efforts to create awareness among customers, employees and suppliers about the companies' activities, to exchange

information with stakeholders such as NGOs, to provide information about performance indicators to investors and to react to society's concerns.

More and more companies are communicating about sustainability issues and an increasing number of companies are integrating the United Nations (UN) Sustainable Development Goals (SDGs) to their strategies as well as communications (KPMG 2017). In 2020, 72 % of the 250 largest global companies connected their business activities to the SDGs, while in Finland the figure stands at 76 % of top 100 companies (KMPG 2020). The SDGs consist of 17 goals and 169 targets adopted by all UN member states and they provide an action plan for sustainable development for people and the planet. The goals, adopted in 2015, all have a target year of 2030 as stated in the 2030 Agenda for Sustainable Development. (UN 2015). The SDGs consist of all three dimensions of sustainability: environmental, social and economic perspectives. All 17 SDGs are presented in appendix 2. The goals address almost all issues that are relevant to sustainable development (Colglazier 2015), and thus provide a comprehensive image about the various sustainability issues that companies can integrate to their strategies and communications.

According to the UN (2015), the world is facing many challenges in terms of sustainable development as billions of people live in poverty and inequalities related to for example gender and wealth are increasing. There are global threats to health, unemployment, natural disasters and extreme weather conditions, conflicts and violence, terrorism and other humanitarian crises facing the world today. Moreover, environmental degradation such as deforestation and drought, loss of biodiversity and climate change are among the greatest challenges as are the many consequences of climate change to include ocean acidification and global warming. The SDGs address these sustainability challenges and aim to tackle them. It is widely recognized that the private sector plays an important role in achieving the SDGs (Ike, Donovan, Topple & Masli 2019). Furthermore, van Zanten & van Tulder (2018) find that European and North American multinational enterprises (MNE) contribute highly to gender equality, decent work and economic growth, responsible consumption and production, climate action, peace, justice and strong institutions as well as partnerships for the goals. However, it was found that MNEs mainly aim to mitigate negative impacts rather than engaging in a more active role.

Nielsen & Thomsen (2007) study corporate annual reports and find that the companies' CSR communications focus on employees, local community, society, environment, corporate governance and accountability, measurement of CSR initiatives as well as business strategy. Zeisel (2020) studies the dynamics of sustainability and the change of CSR topics covered in 2011 compared to 2016 in German companies' CSR reports and finds that some topics are becoming more important while others are decreasing their importance. Furthermore, topics about employee working conditions, data protection, diversity and corporate citizenship have increased substantially while climate protection, alternative fuels and environmental management are among topics that have decreased in their importance.

In addition, Cao, Feng & Wang (2016) study corporate CSR reporting in the U.S. from ten different industries and find that the companies communicate about concerns in all three dimensions of sustainability. In the environmental dimension the companies disclose information about emissions, water, waste, energy, climate change and materials, while the social perspective focuses on employees, customers and community, and more specifically on diversity and inclusion as well as health, safety and customer satisfaction. The economic dimension highlights the job opportunities the companies create in the societies they operate in. Industry- and company-specific topics were also discovered such as oil spills in the oil industry or small business support in the financial industry.

Lee (2017) studies company sustainability marketing communications on Facebook and blogs from a customer-centric perspective and finds that there is a gap between what topics customers see as important and what the companies communicate about. More specifically, customers rate green production and service processes, sustainable means and the use of renewable energy as the most important issues, while the companies communicate more about sustainability promotion, social responsibility for environmental protection and green products and services on Facebook. In their blogs, companies focus on communicating about the use of innovative energy, promotion of sustainability and reducing environmental risks. O'Connor & Schumate (2010) also find that the topic of CSR communications differs between industries, and especially the companies' position in the value chain.

Chae & Park (2018) study sustainability topics in Twitter communications using topic modeling and find that the most popular topics in 2014-2016 with a CSR hashtag (#csr) in

the tweets were company CSR strategy, community charity, climate and energy, supply chains as well as governance related to corporate, environment or social aspects. Altogether they find over 20 CSR topics, for example related to business ethics, CSR awards, human rights, veganism, employee engagement, green initiatives and social business. Saxton, Gomez, Ngoh, Lin & Dietrich (2019) also study CSR messages on Twitter and find eight different CSR categories out of which education, environment, health and wellness as well as community development are among the most communicated topics. Other topics include human rights, labor practices, consumer issues and product development and other CSR topics in general. The sustainability topics discovered in the aforementioned studies are summarized and presented in table 2.

Table 2. Summary of sustainability topics found in prior research

Study	Channel	Sustainability topics
Nielsen & Thomsen (2007)	Corporate reports	Employees, local community, society, environment, corporate governance and accountability, measurement of CSR initiatives and business strategy
Zeisel (2020)	Corporate reports	Employee working conditions, data protection, diversity and corporate citizenship
Cao, Feng & Wang (2016)	Corporate reports	Emissions, water, waste, energy, climate change, materials, employees, customers and community, diversity, inclusion, health, safety, customer satisfaction, jobs
Lee (2017)	Facebook and blogs	Sustainability promotion, social responsibility for environmental protection, green products and services, the use of innovative energy and the reduction of environmental risks
Chae & Park (2018)	Twitter	CSR strategy, community charity, climate, energy, water, waste, supply chains, governance, green initiatives, health, employee engagement, veganism, philanthropy, public benefit, social business, business ethics, CSR awards
Saxton, Gomez, Ngoh, Lin & Dietrich (2019)	Twitter	Education, environment, health and wellness, community development, human rights, labor practices, consumer issues, product development and other CSR topics

Some companies communicate more about sustainability on social media than others and many have found that companies are mainly communicating about non-CSR related topics. For example, Cho et al. (2017) find that on Facebook 80 % of posts by the studied Fortune 500 companies address a topic not related to sustainability. In addition, Etter (2013) finds that 85 % of corporate tweets address a non-CSR topic on general corporate Twitter accounts while 71 % of tweets of accounts focusing on CSR are about CSR topics. This is supported by Saxton et al. (2019), who find that 67 % of the tweets on CSR-focused Twitter accounts address a sustainability topic.

2.3 Sustainability marketing

Sustainability is one of the most important and topical issues in companies' marketing efforts, (Fodness 2015) and as the importance increases, sustainability marketing is evolving and becoming more integrated (Dangelico & Vocalelli 2017). Consumers are becoming more aware of and interested in responsible consumption which leads to companies feeling the pressure for sustainability (Kotler 2011). Moreover, sustainability has clear financial benefits for businesses as the Business & Sustainable Development Commission (2017) estimates that sustainable business opportunities could be worth up to 12 trillion US dollars. Sustainability marketing often focuses on either the environmental dimension or the social dimension of sustainability which can be referred to as green marketing and social or cause-related marketing (Kumar & Christodoulopoulou 2014). Social and cause-related marketing refer to marketing efforts that promote products or services along with a social matter or a dimension (Webb & Mohr 1998), while Dangelico & Vocalelli (2017) define green marketing as marketing that has environmental sustainability as a goal after consumer satisfaction and profitability of the company.

There are various ways to integrate sustainability into marketing. Kotler (2011) argues that in sustainable marketing the four Ps (product, price, place and promotion) also known as the marketing mix should be reinvented so that in terms of designing products, companies would have to consider the materials, sourcing and carbon footprint more carefully. In addition, do Paço, Alves, Shiel & Filho (2014) find that in green products, sustainable packaging is consumers' most requested characteristic. In terms of price, environmentally friendly customers can be willing to pay more for sustainable products, but companies also have to

take into account the possible costs of new regulations (Kotler 2011) as well as the cost of more expensive high-quality materials and production costs (Peattie & Crane 2005).

When it comes to place, local production is often preferred, and the sustainability of distributors should be assessed as well (Kotler 2011). In the green marketing mix, the role of efficient reverse logistics is also emphasized (Lee & Lam 2012). Finally, the commitment to sustainability as well as the companies' sustainability efforts should be communicated in advertisements, product labeling and other promotion methods (Kotler 2011). In green advertisement, companies should promote sustainable lifestyle and ecological benefits of the products, provide sufficient and understandable information as well as enhance the sustainable brand image (D'souza, Mehdi, Lamb & Peretiatko 2007). Adapted green four Ps are presented in figure 5 below.

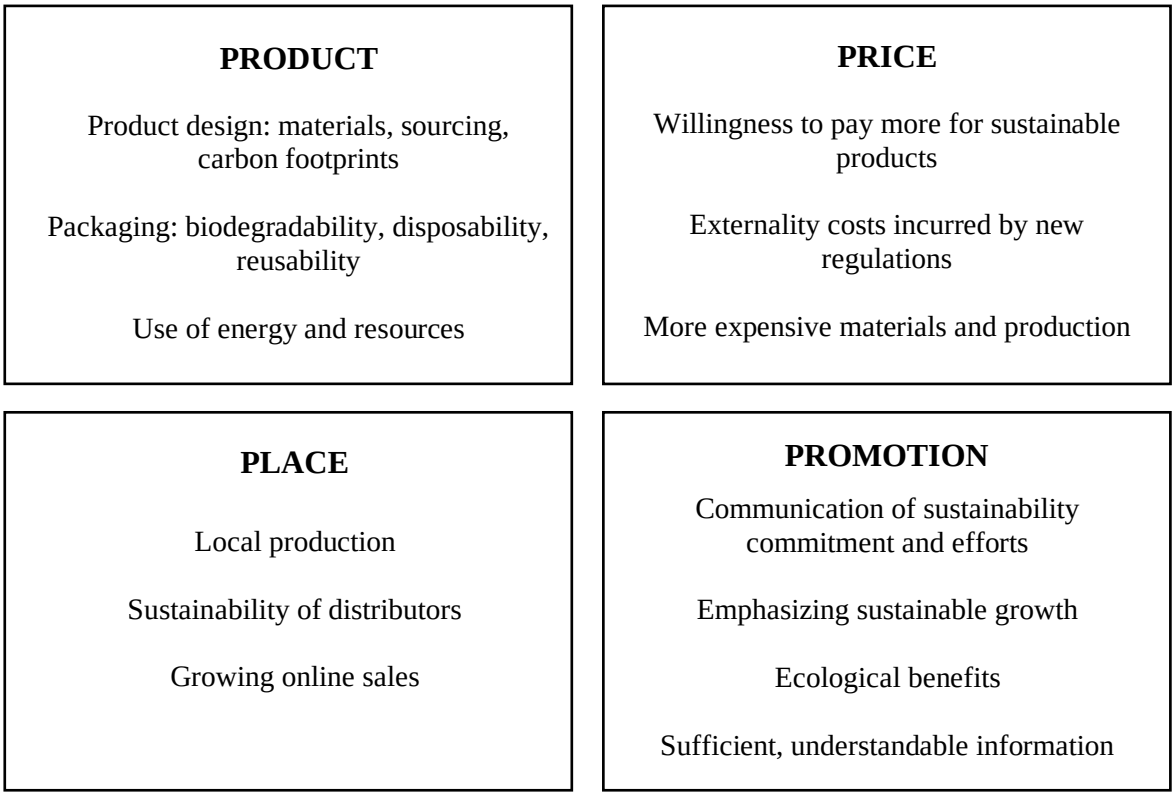

Figure 5. Green four Ps adapted from do Paço et al. (2014), D'souza et al. (2007), Kotler (2011) & Peattie & Crane (2005)

Baldassare & Campo (2016) argue that there are four types of companies in terms of transparency in communicating sustainability efforts. They argue that there are companies that do not engage in sustainability efforts nor understand its importance strategically,

companies that utilize sustainability opportunistically in their marketing and appear to be sustainable rather than actually being sustainable. On the other hand, there are companies that are highly committed to sustainability initiatives, but do not utilize it in their marketing efforts, and finally companies that see sustainability as a competitive advantage and are highly committed to it in their operations, strategy and marketing efforts. (Baldassare & Campo 2016). Moreover, companies that communicate about their sustainability initiatives are able to further build their brand equity (De Chiara 2016). Indeed, many companies have integrated sustainability as a core value in their brand positioning (Werther & Chandler 2005). For example, eco-labeling can be used to differentiate products and to promote the products' value to the environment (De Chiara 2016).

The changes in the world we live in have also required for marketing to evolve first from the product-centric Marketing 1.0 to consumer-centric Marketing 2.0 and finally to Marketing 3.0 where responsibility is emphasized alongside profitability. More specifically, Marketing 3.0 is driven by sustainable values and the new wave of technology, and it aims to provide solutions for humans and the society at large. (Kotler, Kartajaya & Setiawan 2010). The pool of customers interested in environmental and social responsibility is growing, and for example the Lifestyle of Health and Sustainability (LOHAS) consumers take into account the ecological, societal and personal outcomes of their purchase decisions (Pícha & Navrátil 2019). Sustainability also has an impact on B2B companies as their various stakeholders are increasingly demanding responsible practices (Kotler 2011). Thus, sustainability has become an important marketing tool (Baldassare & Campo 2016).

2.4 Communicating sustainability on social media

Social media is an online platform, or a channel designed for communicating and networking. The users of social media can create and share their own content in the platforms and companies are also using social media to connect and engage with their customers and other stakeholders. (Kaplan & Haenlein 2010). The internet and digitalization have enabled consumers to increasingly use social media platforms for networking (Correa, Hinsley & de Zúñiga 2010) as well as for building relationships with companies and brands (Confos & Davis 2016). Today, 3.96 billion people are using different social media sites such as Facebook, Twitter and LinkedIn (Kemp 2020). Twitter has 326 million active users (Kemp

2020) out of which roughly 0,9 million users are in Finland (DNA & Nepa 2019), adding up to approximately 21 % of the population. Given the popularity of social media among consumers, it has great potential as a communication channel for companies (Kvasnicková, Pilar, Margarisová & Kvasnicka 2020). This thesis focuses on Twitter, which is a social media platform for self-expression, networking, sharing and discovering content in real time using short messages called *tweets* (Twitter 2020).

Companies are increasingly adopting different social media channels as a part of their communication methods when communicating to their internal and external stakeholders (Reilly & Hynan 2014). Social media also allows companies to engage with their stakeholders on a new level as it makes two-way communication possible (Kent & Taylor 2016). In addition, sustainability efforts are increasingly integrated in companies' social media communications (Choi, Cho, Ko, Kim, Kim & Sarkees 2019). Furthermore, Podnar (2008) argues that communications play a fundamental role in companies' CSR strategies, and social media offers another way of communicating to the stakeholders.

Today, social media is a standard tool for corporate communication globally (Kim 2019; Kvasnicková et al. 2020). Given its ability to foster interaction and dialogue with stakeholders (Kent & Taylor 2016), social media differs from traditional CSR communication channels such as corporate reports or websites (Kvasnicková et al. 2020). In addition, in comparison to other channels, sustainability messages on social media receive better visibility and exposure and can help companies to maximize the value from their sustainability efforts (Benitez, Ruiz, Castillo & Llorens 2020). Moreover, social media enables companies to share information swiftly with a low cost and to respond to stakeholder questions, thus helping them build a reputation (Ye & Cheong 2017).

Social networking services (SNS) are a type of social media that for example Twitter is, where users can make connections with each other, express themselves and also promote themselves professionally (van Dijck 2013). SNSs are widely adopted strategic marketing tools by companies as they allow for consumers to participate in the conversation and communication while also encouraging purchasing (Chae & Ko 2016). Thus, SNSs help companies to create additional value by engaging with their stakeholders (Lin, Featherman & Sarker 2017). Moreover, SNSs enable both marketing communications created by the

companies and the communication between customers to occur at the same time (Weisfeld-Spolter, Sussan & Gould 2014). eWOM (electronic word of mouth) refers to a negative or positive statement made by a prospect, customer or former customer about a company or their product or service which is publicly available online for anyone (Hennig-Thurau et al. 2004). SNSs accommodate customer communication and eWOM, and according to Bickart & Schindler (2001) eWOM influences consumers' interest in products more than marketing communications initiated by companies. Thus, the interaction in SNSs should be given attention to as social media users can speak for the companies and promote their messages, but they can also criticize companies and their activities online.

While social media offers benefits to companies, there are also challenges due to the interactive nature of the communications. Online, individual users can create and share content without filtering or fact-checking and might reach an audience as large as a globally influential newspaper (Alcott & Gentzkow 2017). The content created by the users can then affect how others react to or perceive the messages, or even their purchase intentions (Colliander 2019; Erkan & Evans 2016). The challenge lies in that companies cannot control consumers' messages and what they share, when and how often (Mangold & Faulds 2009). Negative comments online can lead to damaged corporate reputation (Jones, Temperley & Lima 2009). In addition, social media trends are changing fast and need constant updating. When communicating on social media it is important to choose a platform based on where the company's customers or other stakeholders are and to have a coherent message throughout the channels. Moreover, companies should be active and engage in open and honest conversation with the users about topics that the users find interesting and valuable. (Kaplan & Haenlein 2010)

In terms of CSR and sustainability, social media has made it easier for users to point out irresponsible corporate activity (Tench & Jones 2015). Moreover, Lyon & Montgomery (2013) argue that social media will reduce corporate greenwashing as consumers and activists are more empowered with information and have the means to punish companies for their wrongdoings. In addition, companies with a mixture of some success in environmental efforts along with some failures should thoroughly consider whether to promote the achievements and withhold information about the failures as they risk claims of greenwashing (Lyon & Montgomery 2013). Moreover, Eberle, Berens & Li (2013) find that

negative comments online about corporate CSR have a greater effect on damaging corporate reputation than positive comments have on enhancing it. Thus, online activity should be monitored closely, and CSR efforts should be communicated effectively and convincingly.

Yet, communicating CSR and sustainability matters on social media is necessary for companies in today's world (Tench & Jones 2015). Indeed, social media also provides opportunities for disclosing sustainability information and allows positive messages to be posted by the users. The content created by the social media users can even provide valuable insights that can be used in the companies CSR strategies (Kvasnicková et al. 2020). Companies that engage in CSR efforts and communicate about the efforts on SNSs are more likely to achieve a responsible reputation through the quickly spreading and positive eWOM (Fatma, Ruiz, Khan & Rahman 2020). This is supported by Dutot, Lacalle Galvez & Versailles (2015) who find that communicating CSR on social media has a positive effect on companies' reputation on the internet. It is argued by Lyon & Montgomery (2013) that green companies use social media more to communicate about their environmental performance than others as they face less backlash and scepticism.

Consumers are becoming more willing to support companies with environmental efforts that are perceived by consumers to be initiated by a real concern for the environment. Companies can then use social media to communicate about the efforts to create a loyal and engaged customer base. (Kesavan, Bernacchi & Mascarenhas 2013). Moreover, Eberle et al. (2013) find that communicating CSR in an interactive channel such as social media can lead to higher credibility of the message and stronger identification with the company, thus indicating that utilizing social media to communicate CSR efforts can lead to enhanced corporate reputation and positive word of mouth. In comparison, companies' CSR efforts communicated through traditional channels can be seen as self-promotion and not credible as the content is created and shared by the company itself (Groza, Pronschinske & Walker 2011).

2.5 Stakeholder theory

As mentioned before, stakeholders can be defined as any group or individual who can affect and/or is affected by the activity of a company (Freeman 1984). The stakeholder perspective

means that companies are also accountable to external and internal stakeholders instead of merely the shareholders of the company. Companies have different stakeholders, such as employees, consumers, customers, shareholders, society, competitors, legislators and interest groups. The stakeholders have different needs and expectations, and companies should aim to manage them all as stakeholder relationships are crucial in sustainability efforts. (Sloan 2009). However, as companies' resources are finite, the stakeholders and their needs should be prioritized as part of the stakeholder management (Louche & Baeten 2006).

Stakeholder engagement refers to involving stakeholders in various activities such as having dialogue or disclosing sustainability information to them (Sloan 2009). Dialogue with stakeholders is an important part of the stakeholder management, building relationships, and in understanding the stakeholders' expectations and concerns (Louche & Baeten 2006). Communicating about CSR and sustainability issues to the stakeholders is a part of the stakeholder management (Crane & Glozer 2016). Furthermore, the stakeholder concerns and expectations should be taken into account in the sustainability communications (Dawkins 2004).

2.5.1 Stakeholder expectations

Stakeholders are increasingly expecting companies to engage in sustainability activities and expect communication about the engagement (Beckmann, Morsing & Reisch 2006). It is argued by Morsing & Schultz (2006) that companies should respond to the expectations in the CSR communications. According to Dawkins (2004) it is essential for companies to align companies' sustainability communications with stakeholder concerns to reach the reputational benefits of CSR. Indeed, Sweeney & Coughlan (2008) find that companies' communications about CSR are aligned with the key stakeholder expectations. Furthermore, by understanding the sustainability concerns of the stakeholders and integrating them to the sustainability communications, companies can show their commitment to the stakeholder expectations and needs (Lee 2017). However, it is a challenge for the companies as different stakeholders have different expectations, information needs, and they respond differently to the communications (Dawkins 2004). Sweeney & Coughlan (2008) find that companies in different industries disclose CSR information to different stakeholder audiences prioritizing some over others as Louche & Baeten (2006) argue that should be done.

Stakeholder engagement is seen as essential in CSR activities and the activities should be designed to meet the stakeholder expectations (Abitbol & Lee 2017). Traditionally, stakeholders have paid negative attention to particular industries producing for example tobacco, alcohol or weapons, but today the expectations are continuously shifting and include expectations regarding for example child labor, sweatshops or gene-modified organisms (GMO) (Morsing & Schultz 2006). The expectations of stakeholders are enlarged by the concerns of the public and the governments, and today environmental topics such as climate change and pollution are also a cause of concern for stakeholders (Lubin & Esty 2010). Thus, the stakeholder expectations should be frequently updated, and the CSR communications strategy should be updated accordingly. (Morsing & Schultz 2006). This is supported by Louche & Baeten (2006) who argue that stakeholder management should be an on-going process.

The different stakeholder expectations are often taken into account in planning the CSR activities, but the same expectations are sometimes not seen in the company communications, leaving the stakeholders dissatisfied with the information (Dawkins 2004) and the companies with a failed attempt to communicate about their CSR efforts effectively (Lewis 2003). Thus, the CSR communications should be planned to satisfy the expectations of each stakeholder (O'Connor & Schumate 2010). The process of taking the different stakeholder expectations into account in the planning of CSR communications is illustrated in figure 6 below. The stakeholders express their various expectations towards the company's CSR activities, the company conducts a materiality assessment, identifies material topics that turn to actual activities and are then communicated to the stakeholders.

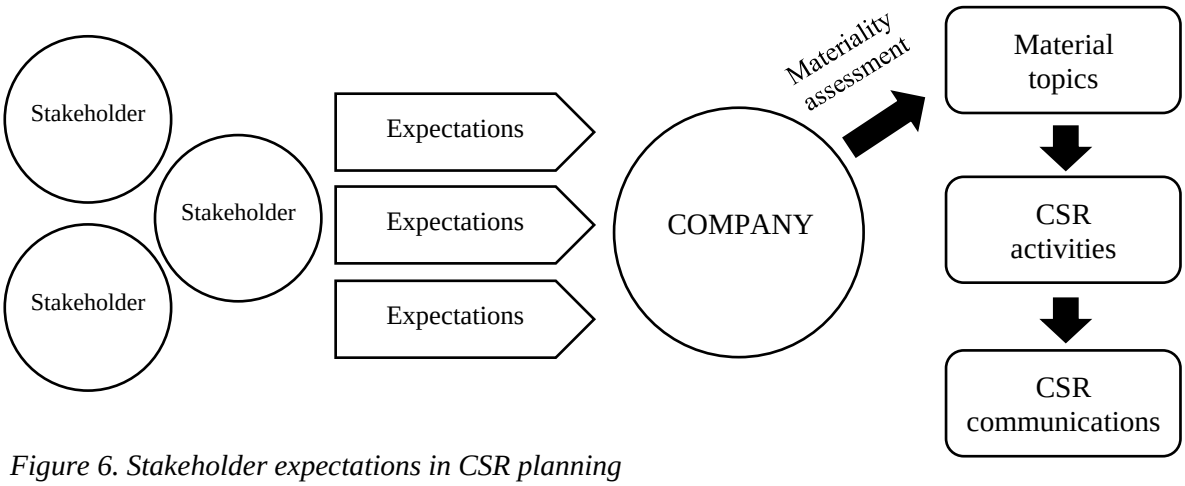

Figure 6. Stakeholder expectations in CSR planning

Materiality is one of the most important principles for companies when communicating about their sustainability efforts as it helps to identify topics that correspond to the stakeholder needs and expectations (Torelli, Balluchi & Furlotti 2020). Material topics refer to topics that can significantly affect the decisions and assessment of stakeholders and topics that reflect a company's substantial environmental, social or economic impacts. Companies conduct a materiality assessment that can be illustrated with a materiality matrix that shows how the material topics are positioned across two dimensions: the effect on stakeholder decisions and the significance of the sustainability impacts. (GRI 2020a). An example of the materiality matrix is presented in figure 7 below, where the topics are positioned according to the level of stakeholder concern and the significance of the sustainability impact. The six material topics in the example are equal employment, human rights, product safety and quality, resource efficiency, sustainable raw materials and profitability.

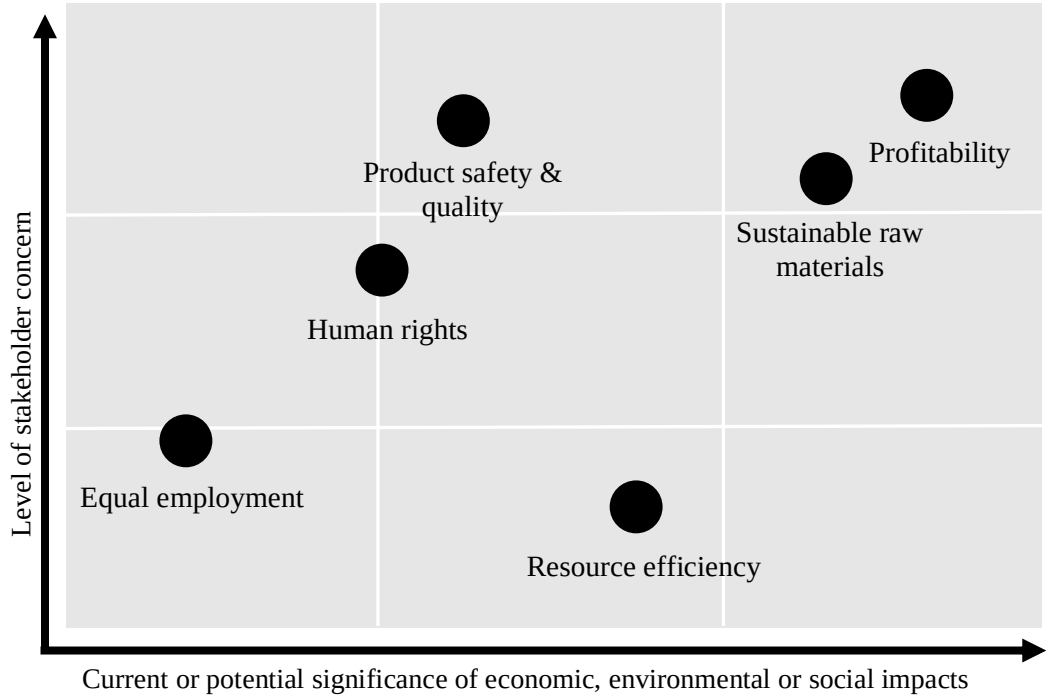

Figure 7. An example of a materiality matrix

The prioritized topics should be covered more comprehensively in the sustainability reporting (Calabrese, Costa, Ghiron & Menichini 2019). Torelli et al. (2020) study the application of materiality in sustainability reports and find that 89 % of the Italian companies studied apply the materiality principle in their sustainability reporting. It is argued that without applying the materiality principle in the sustainability communications, companies are unable to properly target their stakeholders. Thus, the materiality assessment can also

improve the effectiveness of sustainability communications (Calabrese et al. 2019). Furthermore, Fasan & Mio (2017) argue that the materiality assessment is an important tool for stakeholder engagement.

2.5.2 Stakeholder engagement in social media

Stakeholder engagement can be defined as corporate activities that involve stakeholders, such as customers, employees or shareholders. These engagement activities can vary from dialogue, employee training, disclosure of information to community support. In addition, stakeholder engagement can be defined as commitments and policies to stakeholders such as different policies for human rights, or the outcomes of the company's performance. (Sloan 2009). Stakeholder engagement and dialogue is an integral part of planning corporate sustainability activities (Abitbol & Lee 2017). Today, social media and the internet play an important role as a tool for stakeholder engagement (Manetti & Bellucci 2016).

Moreover, in social media, the stakeholder engagement can happen and be measured through *likes*, *shares* and *comments* (Abitbol & Lee 2017), and the audience engagement can also be used to measure the effectiveness of the marketing communications in the social media tools (Curran and Lennon 2011). *Likes* are the easiest and lowest level of engagement, whereas the *share* tool allows the user to voluntarily share the message to their own social group, and the *comments* represent the highest level of engagement due to the effort it requires from the user (Cho, Schweikart & Haase 2014). Manetti & Bellucci (2016) find that Facebook is used by over 29 % of the studied companies as a channel for stakeholder engagement, while Twitter is used by over 22 % and YouTube by almost 10 %. In figure 8, the process of stakeholder engagement in social media is illustrated. First, the company discloses information to the stakeholders and the stakeholders can respond with their reaction through the different tools in social media such as *likes*, *shares* and *comments* or in Twitter with *favorite counts*, *retweets* and *replies*.

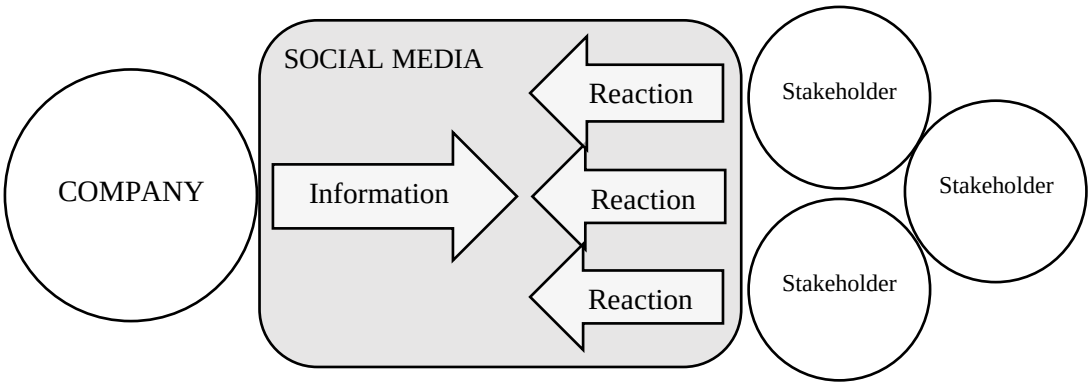

Figure 8. Stakeholder engagement in social media

The stakeholder engagement can shed light on how stakeholders evaluate companies' sustainability activities. Abitbol & Lee (2017) find that CSR messages congruent with the company's core business and industry are the most engaging. They also find that several topics are important to stakeholders and while there are differences between industries, there are also topics that are engaging stakeholders regardless of the industry. Jonhson, Redlbacher & Schaltegger (2018) study the differences in stakeholder engagement between B2C and B2B companies and find that there are no major differences in the level of engagement in terms of the customer segment. On the other hand, Cho et al. (2017) find that on Facebook, messages that do not contain CSR topics are significantly more engaging in terms of *likes*, *comments* and *shares* compared to messages with CSR topics. This finding is supported by Etter (2013), who finds that on Twitter, the level of stakeholder interaction is significantly higher for tweets related to non-CSR issues than for CSR related tweets.

2.6 Effective sustainability communications

Dawkins (2004) argues that to effectively communicate about sustainability, companies must have a clear strategy that takes into account the threats and opportunities to the brand, and the different expectations and needs of the various internal and external stakeholders. Moreover, it is crucial for the effectiveness to communicate in the correct channel to ensure that the message gets through to the correct audience. Erdem & Swait (1998) highlight the role of credibility of companies' claims when communicating about environmental matters. In addition to credibility, detailed and specific information are key to efficacy in CSR communications (Davis 1994). Furthermore, the credibility of sustainability matters communicated by the companies and the companies' motivation, can be questioned by the public which can cause cynicism and reputational harm (Dawkins 2004).

As stated before, stakeholders are increasingly expecting companies to communicate about their sustainability activities (Beckmann et al. 2006). It is widely recognized that companies should take the expectations in to account not only in planning the sustainability activities but in the sustainability communications as well (Abitbol & Lee 2017; Morsing & Schultz 2006). The challenge lies in that different stakeholders have different needs and expectations, and they operate in different channels which means that companies have to prioritize and customize the messages to effectively reach the key stakeholders (Dawkins 2004). The materiality assessment is an important tool in identifying the topics that are important to the stakeholders, and it is argued by Calabrese et al. (2019) that by applying the materiality principle in the communications, the companies are able to better target the stakeholders and thus improve the efficiency of the communications.

In terms of effectiveness on social media, Ye & Cheong (2017) find that companies that receive more engagements (*likes, comments* and *shares*) on Facebook are more efficient in managing their reputation than companies that receive fewer engagements. Social media users can demonstrate their approval for a post by *liking*, *commenting* on or *sharing* it (Choi et al. 2019). Swani et al. (2016) refer to these as popularity metrics as they can be used to measure the popularity of a social media post. The stakeholder engagement measured through the popularity metrics can also be used to measure the effectiveness of the social media communications (Curran and Lennon 2011).

3 RESEARCH DESIGN AND METHODS

This chapter describes the data collection and analysis methods of this exploratory and evaluative mixed-method thesis. This thesis mixes methods by using a quantitative method to analyze qualitative data and the results are qualitatively analyzed and compared. The two data sets are described, and topic modeling is presented as the method for answering the research questions. Finally, the reliability and validity are discussed.

3.1 Research context

The goal of the research is to answer the research questions presented in chapter 1.2. The first sub-question is approached using a text mining technique called topic modeling which allows for discovering hidden themes and trends in text. In this thesis the text data consists of tweets of large, listed companies in Finland. The analyzed companies are listed on the Nasdaq Helsinki Large Cap segment that consists of companies with a share value of over 1 billion EUR (Nasdaq 2020). The other data set used in the second sub-question consists of the recent material topics of the analyzed companies gathered from the company websites, annual reports and sustainability reports.

The second and third sub-questions are also approached using topic modeling. The results of the sub-questions are then used to answer the main research question of how sustainability marketing communications are implemented on Twitter by companies in Finland. The companies analyzed in this thesis are listed on appendix 1 with their industries, Twitter accounts and follower numbers. This thesis aims to provide a comprehensive analysis of the sustainability communications of large, listed companies in Finland and thus companies from different industries are included; basic materials, industrials, financials, telecommunications, consumer goods, utilities, consumer services, oil and gas, technology and health care.

3.2 Data collection and analysis methods

The data used in this thesis is secondary, document-based text-data (Saunders, Lewis & Thornhill 2015) gathered from Twitter and company annual reports, sustainability reports

and websites. Data in the first sub-question consists of the tweets of 25 large, listed companies from 1st of January 2019 to 31st of December 2019. Of the 31 Large Cap companies listed on Nasdaq Helsinki stock exchange, 6 were excluded from the thesis as one was not active on Twitter, one had only recently set up their Twitter account and four only communicated in Finnish. Thus, 25 companies' tweets are analyzed in this thesis. The research strategy in this thesis is documentary research and the secondary data used was originally created for non-research purposes (Saunders et al. 2015) such as marketing or communications. Twitter offers APIs (Application Programming Interface) which researchers can use for data collection.

The data is collected from Twitter using RStudio and the rtweet-package by only including the organic tweets the companies created themselves. Any retweets or tweets where the company is mentioned by another party are excluded as are any paid advertisements. In addition, the data is filtered to exclude tweets that respond to another Twitter user (for example for customer service purposes) to keep the focus in the planned corporate communications. From the organic tweets all URL links are also removed to keep them from appearing in the topic modeling results. As some tweets only contained a URL link, the empty tweets were then removed from the data. For the companies that tweet both in English and Finnish, only tweets in English are included in this thesis.

After filtering the data, 8,376 tweets remain to be analyzed in R. From these tweets, the company names were removed to keep them from distorting the topic modeling results. In R, the tweets are further cleaned from stop words (such as "and"), numbers, punctuation and white space. After the cleaning, some tweets turned out empty or only had emojis in them. Thus, they were removed as they had no informational value in them. Finally, 8,369 tweets are included in the data. After data preprocessing there are 12,703 terms in the data set with a sparsity of 100 % indicating there are no zeros in the document-term-matrix created. Data collection and preprocessing methods are illustrated in figure 9. While testing the data in R, it was noted that some words with no semantical value were among the most frequently used and the algorithm used them to create topics leaving out the more meaningful words. Thus, words *can, will, learn* (as in "learn more here: URL link"), *see* and *read* were removed from the data.

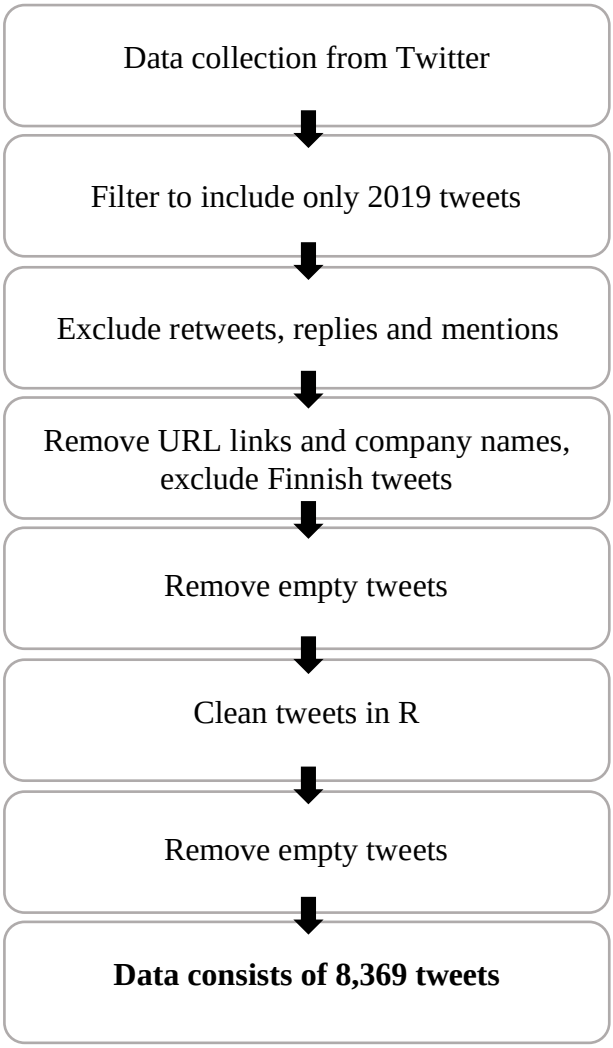

Figure 9. Twitter data collection and preprocessing

The average number of tweets per company is 334.72 ranging from 32 to 1,076 with a total of 8,369 tweets and a median of 227. The total average favorite count is 12.46 ranging from the minimum average of 1.33 favorites to the maximum average of 87.1 favorites and a median of 9.07. The total average retweet count is 3.06 ranging from the minimum average of 0.23 to the maximum average of 19.63 and a median of 2.09. These figures are also presented in table 3 below.

Table 3. Figures from the Twitter data set

	Number of tweets	**Average favorite count per company**	**Average retweet count per company**
Average	334.72	12.46	3.06
Min	32	1.33	0.23
Max	1076	87.1	19.63
Median	227	9.07	2.09

The first sub-question aims to gain new insights about the sustainability communications in terms of identifying topics and thus, the research design is exploratory (Saunders et al. 2015). As the goal of the thesis is to find out how large Finnish companies implement their sustainability communications on Twitter, and more specifically which sustainability themes they are addressing in their communications, the text mining technique topic modeling is an appropriate method for analyzing the data. Moreover, as the dataset is large with 8,369 tweets, manual content analysis is not a suitable method in this thesis though it has been used in previous research by some (such as Manetti & Bellucci 2016) with smaller datasets or research assistants were hired for the manual coding of the data (such as Lee 2017). With big volumes of data, computational text analysis techniques offer a tool for efficient and quick analysis and visualization of the datasets (Chae & Park 2018).

The method used in this thesis to approach the first sub-question is topic modeling which is an unsupervised content analysis technique based on machine-learning. As the first sub-question aims to find the sustainability themes addressed in the tweets, topic modeling can be used to discover latent topics. (Chae & Park 2018). Latent Dirichlet Allocation (LDA) is a mathematical method and algorithm first introduced in machine learning by Blei, Ng and Jordan (2003). It is often used in topic modeling and it can be used to find words that are associated with each topic and at the same time determining the topics that describe the dataset (Silge & Robinson 2020). Words are the only variables in the data that can be observed while the other variables are latent (Blei et al. 2003).

According to Blei et al. (2003) LDA is a generative probabilistic and a three-level hierarchical Bayesian model where the idea is that the text data consists of latent topics that are characterized by words in the data. The bag-of-words assumption (word order is ignored

while word frequency is taken into account) in LDA can also lead to some words being allocated to multiple different topics. The latent structure in topic modeling refers to document-topic distribution, which informs how a document is composed in terms of topics, and topic-term distribution, which provides a set of word lists which each represent a topic (Chae & Park 2018).

LDA identifies hidden topics in data based on the words in the data that most probably occur with each other thus forming a topic (Aggarwal & Zhai 2012). For example, a *climate change* topic has a high probability of consisting of words about climate change such as *pollution* or *global warming* whereas words such as *employee conditions* and *safety* could form a latent topic of *social responsibility*. The word-topic-probability, the beta-value, indicates whether a word is part of a certain latent topic among all the topics within the data (Silge & Robinson 2020).

Typically, the number of words examined per topic is set from five to 20 (Aggarwal & Zhai 2012). The number of topics in this thesis was set to 50 with 15 top words to dive deep to the latent trends in the data and due to the large variety of terms (12,703 terms) in the data and the goal of the analysis. If the number of topics is not known, different number of topics can be tested (Silge & Robinson 2020), which was also done in this thesis with values of 10, 20, 30, 40 and 50. Each of the topics that the topic modeling identified and the words in the topics were manually examined for coherence and exclusivity meaning that a topic is cohesive when the words in the topic are semantically coherent (Chae & Park 2018). Topic exclusivity means that the words forming one topic are unlikely to appear in other topics in the data. Topic coherence and exclusivity indicate a more semantically useful topic. (Roberts, Stewart, Tingley, Lucas, Leder-Luis, Gadarian, Albertson & Rand 2014)

When examining the results of the LDA, some top terms were manually checked to see what their context was and why they were allocated to a certain topic. For example, in one topic, the topic consists of words related to circular economy and podcasts. By examining the tweets, it was found out that circular economy podcasts had been communicated by one company along with other sustainability and non-sustainability related podcasts. For each of the word lists, the words with the highest beta-value are taken into account when forming the topic and assigning a label for the topic. Some topics out of 50 did not form a

semantically coherent topic and they were excluded from further analysis. The 38 semantically coherent topics were analyzed in terms of whether they are related to sustainability or not and finally, 18 topics remained. The 18 sustainability topics that were identified are further analyzed and discussed in chapters 4.1 and 5.

As this thesis also aims to assess the effectiveness of the sustainability communications by making comparisons between the stakeholder expectations and communicated topics the research purpose in the second sub-question is also evaluative (Saunders et al. 2015). In the second sub-question, the materiality assessments of the companies are used to reflect the expectations of the stakeholders. The materiality assessments were manually collected from the 25 companies' sustainability or annual reports or websites. All of the companies have recently conducted a materiality assessment. The material topics gathered from the assessments form the data set for the second sub-questions which aims to examine how well the topics that companies address in their Twitter communications match the expectations of their stakeholders in terms of material topics. The data consists of 262 material topics that were analyzed in R using the same topic modeling technique as in the first sub-question. The number of material topics per company varies from 4 to 20 topics, with an average of 10,5 and a median of 9.

Because the data set is quite small, the number of topics was set to 25 with 10 top words. In comparison to the data set that consists of tweets, the material topic data set is simpler with fewer words in total and also fewer words with no semantical value. Still, the data set was cleaned in R to remove stop words, numbers, punctuation and white space. The LDA results of the second sub-question were also manually checked and analyzed by looking at the top words with the highest beta-value. Of the 25 topics the algorithm created, 20 were found to be semantically coherent. These 20 inherently sustainability related themes were then compared to the 18 sustainability topics discovered from the Twitter communications to find out how well the companies address the stakeholders' expectations. The results are analyzed in chapter 4.2.

Finally, the exploratory third sub-question aims to examine the tweets with the highest engagement in terms of favorite counts and determine which topics are the most popular among stakeholders. The favorite counts (likes*)* are used as they represent the easiest and

lowest level of engagement (Cho et al. 2014) and therefore are likely to lead to the highest numbers. Moreover, the aim is to find out whether the stakeholders engage most with the topics they perceive as important in the materiality assessments. The same Twitter data is used as in the first sub-question, however, only 20 % of it are included in this analysis. The 8,369 tweets and their respective favorite counts were adjusted by dividing the favorite counts by the companies' number of followers to get the favorite count-to-follower ratios for each tweet. By adjusting the favorite counts, the data is more diverse as the data consists of more companies and the number of tweets per company is spread more evenly. If the favorite counts were not adjusted, the data would not represent all the analyzed companies well. For example, by merely examining 10 % of the tweets with the highest favorite counts, one company would represent 65 % of the tweets. The adjusted favorite count represents the percentage of how many of the companies' followers have engaged with the tweet via liking it. However, it should also be taken into consideration that one does not have to follow someone on Twitter to be able to like a tweet.

Once the favorite counts were adjusted, the data was filtered to only include 20 % of the tweets with the highest favorite count-to-follower ratio. 20 % was chosen as it represents only the most popular tweets, yet it includes more companies than only examining for example the top 10 %. The ratios vary from the lowest of 0.0017 to the highest of 0.09 with the average of 0.0058 and median of 0.0042. The data set includes 1,679 tweets. The tweet with the highest ratio has an unadjusted favorite count of 761 while the tweet with the lowest ratio a favorite count of 26. By including 20 % of the tweets, 96 % of the companies are included in the data. Thus, only one company with significantly more followers than the others was excluded.

After the data was collected, topic modeling was used to identify latent themes in the data to discover which topics receive the highest engagement on Twitter. The data was cleaned in R and analyzed with 30 topics and 10 top words because of the size of the data. The LDA results were then analyzed in a similar manner as before by examining the beta-values and by assigning labels to the topics. 23 semantically coherent topics were discovered out of which 15 are related to sustainability. These 15 themes were then compared to the 20 material topic themes identified before. The results are analyzed in chapter 4.3.

3.3 Reliability and validity

Reliability and validity in research refer to whether the research design can be replicated with consistent findings, the methods used in the research are appropriate, the analysis of results is accurate and whether the findings can be generalized. The consistency of research can be enhanced by transparent reporting of the research process and by being methodologically rigorous. (Saunders et al. 2015). Thus, this thesis aims to carefully describe the research process, especially in terms of the analysis of the data and the LDA results to enhance the reliability.

In qualitative studies, the data often consists of small samples, which limits the generalizability of the findings (Saunders et al. 2015). However, in this mixed-method thesis, the sample size of the qualitative data is rather large which enhances the generalizability of the findings and, thus the validity of the research. Moreover, as the data set is large it can only be processed using computational techniques and thus, topic modeling was chosen as an appropriate method in this thesis. Text mining has been used by some to analyze sustainability disclosure before and given its strong reliance on algorithms and machine learning it is argued to enhance the reliability of the research (Aureli 2017).

Still, also in computational approaches there is a need for human interpretation which can cause bias or human errors (Indulska, Hovorka & Recker 2012), partly because text mining does not take context into account (Aureli 2017). Human interpretation is used as objectively and accurately as possible also in this thesis when analyzing the LDA results and research findings to enhance the validity. RStudio was chosen to process the data as it is well suited for data mining purposes given its different packages and possibilities as well as the software's reputation for reliability, accuracy and robustness (Ohri 2013).

4 RESEARCH FINDINGS

This chapter presents the findings of this thesis. To answer to the main research problem presented in this thesis, the sub-questions are first examined. The first sub-question is introduced first with findings that present which sustainability topics the companies address in their tweets in 2019. The second sub-question follows and examines how effective the communications are in terms of stakeholder expectations. Finally, the third sub-question examines which topics the stakeholders engage most with and whether they are similar to the stakeholder expectations. The sub-questions are approached with topic modeling and qualitative analysis of the results.

4.1 Sustainability topics in corporate Twitter communications

The first sub-question examines the sustainability themes the 25 analyzed companies address in their Twitter communications. This is studied through topic modeling in RStudio with the LDA algorithm. The LDA algorithm can be used to identify hidden trends and themes in text data (Aggarwal & Zhai 2012) and in this thesis it is used to identify themes in corporate tweets through terms and their probability of occurring together in a theme. The number of topics was set to 50 with 15 top words. Each of the topics and the words were manually examined for coherence and exclusivity. For example, in one topic the top words are *gas, electricity* and *oil* thus forming a topic of *energy*. The energy topic is also exclusive as the top words do not appear in other topics in the data. The energy topic, however, is not analyzed further as there are no words in the topic related to sustainability.

Out of the 50 topics that were created with the algorithm, 38 (76 %) semantically coherent topics were found. Thus, 12 topics are excluded as no clear topics could be formed. As the words forming a topic are words with high overall frequency in the data (Roberts et al. 2014), some of the words in the topics do not have semantical value (such as *one, high* or *year)* though a few words (such as *learn, see, will* and *can*) with no informational value were removed during the testing of the data. Thus, only words with semantical value are considered to form a topic. After reviewing the top words in each topic, relevant labels were assigned to each topic. For example, in one topic words such as *circular* and *economi(-y),* occurred, thus the topic was labeled as “Circular economy”. Moreover, as the goal is to

identify topics related to sustainability, other topics that form a topic not related to sustainability (such as car racing or energy) are excluded from further analysis. A complete list of the semantically coherent topics not related to sustainability, and therefore not analyzed further in this thesis, can be found in appendix 3. A total of 18 sustainability related topics can be identified, adding up to 47 % of the semantically coherent topics. The identified topics are re-numbered here from 1 to 18 for better clarity and are presented with their beta-values in appendix 4.

Table 4. Identified sustainability topics communicated on Twitter and their categories

Category	**Topics**
Environmental (67 %, 12 topics)	T1 Circular economy
	T2 Sustainable food and packaging
	T3 Forestry & biodiversity
	T4 Sustainable aviation
	T5 Transition to renewable energy
	T6 Wastewater treatment
	T7 Renewable fuel
	T8 Sustainability solutions & environmental problems
	T9 Plastic waste & renewable materials
	T10 Emission reduction
	T11 Sustainable pulp and paper
	T12 Sustainable building
Social (22 %, 4 topics)	T13 Sustainable water solutions
	T14 Employee engagement
	T15 Safety & technology
	T16 Community support
General (11 %, 2 topics)	T17 Sustainability awards
	T18 Sustainable customers, partners and practices

Out of the 18 topics, 12 (67 %) represent an environmental sustainability theme, while four (22 %) address a social theme and two (11 %) topics represent a general sustainability theme. The topics are placed to the three categories based on the sustainability dimension they represent. Some topics represent more than one dimension but are only placed in one

category for clarity and based on the most relevant dimension. The topics and their categories are presented in table 4. Furthermore, by reviewing the topics and the top words it can be noted that some topics and words occur repeatedly, thus decreasing their exclusivity. For example, topics 5 and 7 have a similar theme related to renewable fuel and energy indicating that renewable energy is commonly addressed in the corporate communications. Next, the identified topics are further analyzed.

The first topic, T1, consists of top words such as *circular, economi(-y), live* and *podcast*. The top words indicate a clear topic of circular economy which is a concept used to describe an economy where continuous production of new is replaced with reusing, recycling, repairing and remanufacturing which would lead to significant reduction of greenhouse gas emissions (Stahel 2016). The words *live* and *podcast* also indicate that the companies are communicating about doing podcasts. By examining the tweets with the word *podcast*, it can be concluded that the companies have various sustainability related podcasts such as climate change and circular economy podcasts which explains why the words appear in this topic.

The second sustainability topic, T2, forms a topic of sustainable food and packaging with the top words being *food, sustain(-able, -ability)* and *packag(-e, -ing)*. Food production and processing represent severe environmental and social challenges such as changes in land use, reduction of biodiversity, over-fertilization leading to aquatic eutrophication, global warming, water shortages as well as malnourishment and famine as the global population keeps growing and food production is not keeping up. Thus, food production is one of the most important sustainability challenges to be addressed. (Boye & Arcand 2012). As for sustainable packaging or packages, do Paço et al. (2014) find that in green products, sustainable packaging is consumers' most requested characteristic which is why it is not surprising that the companies communicate about sustainable packaging. The other words that appear in the topic also support the top words with words such as *product, recyl(-e, -ing), cleaner* and *materi(-al)*. The words together indicate that the topic has to do with sustainable food, products and sustainable packaging and materials.

Topic 3 of forestry and biodiversity consists of top words such as *forest* and *biodivers(-ity)*. This topic could be expected to emerge as the forest industry plays an important role in Finland's economy and three of the analyzed companies operate in the industry. Moreover,

substantial investments are used to ensure the sustainability of the forest operations (Ministry of Agriculture and Forestry of Finland 2021a). In addition, the protection of biodiversity in Finnish forests is fundamental in the industry practices (Ministry of Agriculture and Forestry of Finland 2021b). According to KPMG (2020), 40 % of companies in forestry and paper industry report of the risk of biodiversity loss. Topic 4 represents sustainable aviation and renewable fuel with top words as *aviat(-ion), sustain, renew, flylowcarb* (fly low carb(-on), a hashtag), and *fuel*. It is widely acknowledged that the aviation industry contributes to greenhouse gas emissions and thus climate change (Miyoshi & Merkert 2015). As the demand for aviation is expected to grow fast along with the GHG emissions (Gudmundsson & Anger 2012), sustainable aviation is an important environmental issue to be addressed.

Topic 5 represents the future of energy and transition to renewable energy with top words such as *energi(-y), future(-e)* and *transit*. Topic 7 forms a similar theme of renewable fuel and innovations with top words as *sustain(-able, -ability), renew(-able), innov(-ate, -ation)* and *diesel* (a fuel). Renewable energy represents a crucial sustainability issue to be addressed and it emerges in multiple topics in the Finnish companies' communications. Moreover, Danish, Bin, Bo & Zhaohua (2017) find that energy from non-renewable sources is one of the main causes for carbon dioxide (CO2) emissions and thus renewable energy plays an important role in reducing emissions.

Topic 6 refers to sustainable wastewater treatment with top words as *treatment, sustain(-able, -ability)* and *measur(-e, -ement)*. In the topic also appear words such as *wastewat(-er), method, increas(-e)* and *oper(-ation, -ate)*. By examining the tweets with the word *treatment*, it can be concluded that the companies communicate largely about sustainable wastewater treatment. Wastewater treatment technologies incorporate various environmental, social and economic sustainability issues in terms of for example energy use, affordability and impact on the local community (Muga & Mihelcic 2008). By examining the tweets with the word *measur*, it can be concluded that the companies communicate about measuring sustainability performance, and measures (actions) to tackle sustainability challenges. Topic 8 of sustainability solutions and environmental problems has top words of *solut(-ion), sustain(-able, -ability), environment* and *problem*. There also appear words such as *materi(-al), digit(-al, -alization), product* and *develop.* These words can be concluded to indicate that the

companies communicate about solutions for environmental problems in terms of materials, digitalization, products and developments.

Topic 9 plastic waste and renewable materials consists of top words such as *wast(-e), renew(-able)* and *plastic*. The top word *amp* refers to an ampersand and therefore has no semantical value in the topic. The topic also includes words that refer to seminars, and by examining the tweets with the word *seminar*, it can be concluded that some of the seminars are about sustainability issues and some are not. Plastic waste poses various environmental, social and economic sustainability challenges. As most plastics are not degradable, they pose a threat to the environment through contamination, to the society through detrimental effect on human health and to the economy due to the high cost of cleaning plastic waste. (Pinto da Costa, Rocha-Santos & Duarte 2020).

Topic 10 of emission reduction includes top words such as *emiss(-ion), Helsinki,* and *reduc(-tion, -e)*. There are also other words such as *share, day* and *eur* which indicate that the topic also refers to financial issues in addition to emission reduction. Climate change is often referred to as the most crucial environmental challenge to which GHG emissions contribute to (UN 2021). Thus, the reduction of GHG emissions represents a crucial sustainability issue to be addressed. Topic 11 sustainable pulp and paper consists of top words of *pulp, paper* and *sustain(-able, -ability*). The topic also includes words such as *renew(-able), mill,* and *packag(-e, ing).* Given that the forest industry plays an important role in Finland, it is not surprising that paper and pulp emerge as a topic in the Twitter communications. The words in the topic indicate a theme of renewable, sustainable paper products such as packaging and pulp.

In topic 12 sustainable building and carbon footprint, top words are *citi(-y, -es), sustain(-able, -ability), build, fleet* and *carbon.* The topic refers to building and maintaining of sustainable cities and fleets and reducing carbon footprint. Building or construction represents an environmental sustainability challenge due to high consumption of raw materials and resources as well as pollution of the local environment. Thus, sustainable building aims to minimize the negative environmental impacts of building. (Ding 2008). A carbon footprint is used to describe the total amount of GHGs generated by an organization, a person, a product or any other entity and their action. As GHGs contribute to climate

change, reducing a carbon footprint is a way to fight climate change. (The Nature Conservancy 2021).

As for topic 13, sustainable water solutions, the topic consists of top words of *water, sustain(-able, -ability)* and *solut(-ion)*. The topic also consist of words such as *sourc(-e, -ing)* and *improv(-e)*, which indicate that the topic refers to improving sustainable water solutions and sourcing. Access to water is a human right and one of the foundations of sustainable development and it represents environmental, social and economic challenges. It is estimated by the World Health Organization (WHO) that by 2025, 50 % of the global population will live in a water-stressed area. Sustainable water solutions, for example the management of wastewater, are crucial as issues such as climate change and population growth further worsen the situation. (WHO 2019).

Topic 14 personnel, people and social aspects, consist of words such as *work, meet, talent, loveourteam* (love our team, a hashtag in the tweets), *people* and *careerstori(-es, -y)*. These words can be concluded to form a topic of tweets related to the companies' personnel and people. For example, telling their employees' career stories, welcoming new employees and communicating about their teams and people and their talent. Although this topic does not directly address a social sustainability challenge, it can be said to represent social engagement with employees and other stakeholders and to reflect the work culture at the companies.

Topic 15 represents a social topic with top words such as *autom(-ate, -ation), safeti(-y), termin(-al)* and *technolog(-y).* The other words that appear in the topic such as *system, solut(-ion),* and *enhanc(-e)* indicate that the topic has to do with technological systems and solutions that enhance safety through automation. Customer and employee safety are important aspects of social sustainability. Topic 16 represents community support through corporate volunteer work and cooperation with schools and students with top words such as *help, school, volunt(-ary, -eer)* and *student.* The companies' cooperation with schools and students can be seen as a way to engage with possible future employees, customers and partners while having a positive effect on the society through education.

Topic 17 is formed of top words such as *sustain(-able, -ability)* and award. The words indicate that the topic is about sustainability award announcements. Eroglu, Kurt & Elwakil (2016) study the reaction of stock markets to companies' announcements of quality, safety and sustainability awards in logistics and find that the markets react positively to all three in terms of stock prices, however the reaction is stronger when it comes to sustainability awards. As various company stakeholders are demanding sustainability, companies are likely to communicate about their success in terms of sustainability awards. The final topic identified, topic 18, has to do with customers, partners and sustainable practices with top words such as *custom(-er), partner, sustain(-able, -ability)* and *practic(-e).* The companies communicate about their partnerships and customers on their journey towards sustainability as well as their sustainable business practices. All of the identified topics, top terms and examples of the original tweets related to the topic are presented in table 5 below. The company names and hyperlinks have been removed from the tweets.

Table 5. Identified sustainability topics on Twitter, top terms and example tweets

Topic	Terms	Example Tweet
T1 Circular economy	circular, economi	*"We may have as little as 12 years to tackle #climatechange. It's time to act faster and bolder. Watch the video and find out our journey to become a global leader in renewable and circular solutions. #climate #renewables #circulareconomy #sustainability"*
T2 Sustainable food and packaging	food, sustain, packag	*"A big trend in food retail is packaging with a more natural look and feel. Today at FachPack we launch Foodbox™ by , an eco-friendly packaging board with a natural, uncoated surface. Find out more:"*
T3 Forestry & biodiversity	forest, biodivers	*"Forest owner's goals give a guideline for sustainable and responsible forest management. Our specialists help forest owners manage their forests in a way that safeguards #biodiversity and allows the forest to grow well. #sustainableforestmanagement"*
T4 Sustainable aviation	aviat, sustain, renew, fuel	*"The biggest challenge for aviation in the century ahead is #sustainability." As air-passenger numbers are expected to show a record of 4.6 billion, we need to come up with #sustainable solutions – fast. Read the full story:"*
T5 Transition to renewable energy	energi, future, transit, renew	*"The future is renewable. We continue to lead the transition to renewables with a major investment in Singapore. #renewables #circulareconomy #sustainability"*
T6 Sustainable wastewater treatment	treatment, sustain, measur, wastewat	*"The Kaukas plant and Kekkilä Recycling show us how #recyclednutrients can be put to sustainable use in wastewater treatment."*

T7 Renewable fuel	sustain, renew, innov, diesel	*"Indeed, in 2018 our renewable fuels helped customers to reduce #climate emissions globally by 7.9 million tons. The same as if 3 million passenger cars had been removed from the roads, for a full year! #renewables #lowcarbon #climatechange #MY"*
T8 Sustainability solutions & environmental problems	solut, sustain, environment, problem	*"Our renewable products are an essential part of the solution for reducing emissions in transport and aviation. Find out more #MY #aviation #flylowcarb #travel #sustainability #sustainable #renewables"*
T9 Plastic waste & renewable materials	wast, renew, plastic, materi	*"How can wood-based #renewablematerials help combat plastic waste? One example is that they biodegrade faster, meaning less waste on land and in the oceans. Learn more:"*
T10 Emission reduction	emiss, reduc	*"Our climate is in crisis. We need to act: reduce emissions, make more environmentally responsible choices and transition to cleaner energy. Read our CEO Rajeev Suri's blog how we are committing to a cleaner, more connected world."*
T11 Sustainable pulp and paper	pulp, paper, sustain	*"Reusing #waste material is essential for sustainable operations in #paper and #cardboard making business. See how #preshredding makes cardboard #recycling and #pulping process more efficient and more profitable:"*
T12 Sustainable building	citi, sustain, build, carbon, footprint	*"We need to consider how we build #sustainable cities for people to live in. What do we want technology to do for us as human beings." Our @janerygaard at #MWC19 #smartcities panel. #5G #digitalization"*
T13 Sustainable water solutions	water, sustain, solut	*"Today is World Water Day, which gives us a good reminder of the importance of water quality and accessibility. plans to decrease water consumption 20 percent to 2030. Read more about our actions to achieve this target. #WorldWaterDay"*
T14 Employee engagement	work, meet, talent, welcometo	*"We provide our people with international experience on their career journey. Meet Jannie Chen who started her career at China and is currently on an international assignment in Finland as an HR Specialist in the Global HR Talent & Reward Team. #loveourteam #careerstory"*
T15 Safety & technology	autom, safeti, termin, technolog	*"#automation #technology assists #port #operators in similarly focusing on the most important tasks at hand – those that improve the #efficiency and #safety of their operations. Find out the key benefits of port terminal automation. "*
T16 Community support	help, school, volunt, student	*"The future of work is based on continuous skills development & #education. Securing close cooperation between schools & companies bring benefits to everyone, now & in the future" Kai Kamila, Head of HR, Finland."*
T17 Sustainability awards	sustain, award	*"Today we proudly announce that our sustainability work has been awarded with the third consecutive @ecovadis Gold rating! We are in the top 1% of suppliers assessed, regardless of their industry. Read more at"*
T18 Sustainable customers, partners and practices	custom, partner, sustain, practic	*"We are now inviting our partners, customers and suppliers to join this journey to do concrete good — on every front, together. Partnerships are truly the key for sustainable business." Read our VP, Sustainability @ahsalla blog #sustainability #partnerships"*

The findings indicate a clear emphasis on the environmental dimension of sustainability in the analyzed companies' Twitter communications. 67 % of the identified themes are primarily related to an environmental sustainability issue while some topics represent other sustainability aspects as well. When analyzing the results, the top words for each latent topic were examined and the greatest weight was given for the words with the highest beta-value as the bigger the value the more likely the word is to belong to a particular topic. However, some of the top words in the topic groups have no semantical value or are not related to sustainability and thus, they were excluded from the analysis. In addition, some identified topics are specific for an industry, such as topic 3 forestry and biodiversity, or a company such as topic 4 sustainable aviation, where a majority of the related content is posted by one company. Thus, it is clear that the most active companies' sustainability posts emerge as topics in the findings of this thesis.

4.2 Stakeholder expectations in relation to the communicated topics

The second sub-question aims to find out how well the companies address their stakeholders' expectations. As argued by many (e.g., Abitbol & Lee 2017; Dawkins 2004; Morsing & Schultz 2006), sustainability communications should address the internal and external stakeholders' expectations. These expectations can be expressed in companies' materiality assessments where the companies identify their most important sustainability topics through stakeholder interviews and surveys. Often these assessments are presented in a materiality matrix, where the topics are positioned in terms of their importance to stakeholders and the significance of their sustainability impacts (GRI 2020a). To answer the research question, the material topics of the analyzed companies were manually collected from corporate reports or websites. By gathering all of the companies' material topics, 262 material topics form the data set to be analyzed and compared with the 18 sustainability topics identified in the first sub-question. The identified material topic themes are used as a proxy for the stakeholder expectations of the 25 analyzed companies.

As there is some overlap with the topics, the data set consists of 240 terms. The data set was uploaded to RStudio and cleaned from stop words, numbers, punctuation and white space. The data was analyzed in R using the same topic modeling technique as in the first sub-question. As the data already consists of topics, the purpose of topic modeling is to group

the topics together to identify themes on a higher level. Because the data set is quite small, the number of topics was set to 25 with 10 top words. Of the 25 topics, 20 were found to be coherent topics and because the data consists of material topics in terms of sustainability, the topics are already related to sustainability and are all taken into account. The identified topics and their assigned categories are presented in table 6 below.

Table 6. Identified material topic themes and their categories

Category	**Topics**
Environmental (30 %, 6 topics)	MT1 Circular economy
	MT2 Energy use & emissions
	MT3 Resource efficiency
	MT4 Emissions to water, air and land
	MT5 Climate change
	MT6 Forest management & biodiversity
Social (55 %, 11 topics)	MT7 Customer privacy and satisfaction
	MT8 Human rights
	MT9 Diversity, equality and inclusion at workplace
	MT10 Responsible taxpayer and employer practices
	MT11 Safety
	MT12 Employee wellbeing and competence development
	MT13 Occupational health
	MT14 Local communities
	MT15 Responsible supply chain
	MT16 Responsible sourcing
	MT17 Employee engagement
General (15 %, 3 topics)	MT18 Product stewardship
	MT19 Business ethics
	MT20 Compliance and corporate governance

Of the 262 material topics, 20 themes were found, and they are assigned to environmental, social and general categories. Out of these themes, six topics belong to the environmental category adding up to 30 % of the topics, 11 belong to the social category with 55 % of the topics and three belong to the general category with 15 % of the topics. These themes are considered to reflect the stakeholder expectations of the analyzed companies and are compared to the sustainability topics identified from the corporate communications in the first sub-question.

The material topic themes, the top words and the beta-values are presented in appendix 5, the analysis method being similar to the first sub-question. The beta-values are considerably higher for the material topic themes than for the sustainability topics in the first sub-question, which indicates that the top terms are more likely to belong in the topics than in the first sub-question. This is likely to be caused by the complexity and size of the Twitter data set compared to the simpler material topic data set with less terms. For example, the highest beta-value in the materiality topic themes is 0.705 for the term *safety(-y)* in MT11 labeled as safety. This indicates that the term *safety* has a 70.5 % probability of belonging to topic MT11. Meanwhile, in the first sub-question the highest beta-value is 0.058 for the term *forest* in T3 forestry and biodiversity, indicating a 5.8 % probability.

On the other hand, the lowest beta-value for the first term in a material topic theme is 0.2 for the term *complianc(-e)* in MT20 indicating a 20 % probability. In comparison, in the first sub-question the lowest beta-value for the first term is 0.014 for the term *solut(-ion)* in T8 sustainability solutions and environmental problems indicating a 1.4 % probability. Thus, there is a clear difference between the beta-values in the first and the second sub-question. The material topic themes are presented together with the communicated topics and their categories in table 7 below.

Table 7. Identified material topic themes and communicated topics

Material topic themes	Communicated topics
Environmental	
MT1 Circular economy	T1 Circular economy
MT2 Energy use & emissions	T2 Sustainable food and packaging
MT3 Resource efficiency	T3 Forestry & biodiversity
MT4 Emissions to water, air and land	T4 Sustainable aviation
MT5 Climate change	T5 Transition to renewable energy
MT6 Forest management & biodiversity	T6 Wastewater treatment
	T7 Renewable fuel
	T8 Sustainability solutions & environmental problems
	T9 Plastic waste & renewable materials
	T10 Emission reduction
	T11 Sustainable pulp and paper
	T12 Sustainable building
Social	
MT7 Customer privacy and satisfaction	T13 Sustainable water solutions
MT8 Human rights	T14 Employee engagement
MT9 Diversity, equality and inclusion at workplace	T15 Safety & technology
MT10 Responsible taxpayer and employer practices	T16 Community support
MT11 Safety	
MT12 Employee wellbeing and competence development	
MT13 Occupational health	
MT14 Local communities	
MT15 Responsible supply chain	
MT16 Responsible sourcing	
MT17 Employee engagement	
General	
MT18 Product stewardship	T17 Sustainability awards
MT19 Business ethics	T18 Sustainable customers, partners and practices
MT20 Compliance and corporate governance	

By examining the first category of environmental themes, there's a clear difference between the material topics and the communicated themes. While 67 % of the communicated themes represent an environmental topic, merely 30 % of the material topic themes are related to environmental issues. However, the environmental themes are quite similar as circular economy (T1 & MT1) is both a common material topic and a communicated theme as are energy use (T5 & MT2), emissions (T10 & MT2, MT4) and issues related to climate change (many topics such as T4 and T8 & MT5). Climate change is an encompassing and complex topic which includes many of the sustainability topics addressed by the companies on Twitter. MT3 resource efficiency can also be a part of a number of the communicated themes such as T6 sustainable wastewater treatment. One of the top terms, *deforest(-ation*), in MT3 is also linked to forestry and thus T3 forestry and biodiversity. MT6 forest management and biodiversity is also addressed by the identified T3 forestry and biodiversity. The companies also communicate about other aspects of environmental sustainability that do not appear in the material topics such as T2 sustainable food and packaging or T11 sustainable pulp and paper. Moreover, these issues are likely to be related to the companies' products and services and therefore could address the expectation for MT18 product stewardship.

In comparison with the themes the companies communicate about, the material topic themes emphasize the social aspects more; 55 % of the topics represent a social theme while 22 % of the communicated themes represent a social theme. By examining the social category of the material topics, it can be concluded that six (MT9 - MT13 & MT17) of the 11 (55 %) topics are related to direct employees. Employees represent an important stakeholder group, and they are often interviewed or surveyed in the materiality analysis, which might explain the heavy emphasis on the material topics. Moreover, it is possible that the employee related material topics are mostly being communicated internally which is why they are not seen in the external Twitter communications.

There are also similar themes between the communicated themes and the material topics, such as employee engagement (T14 & MT17), safety (T15 & MT11) and local communities (T16 & MT14). However, according to the results in the first sub-question, the companies do not communicate about responsible supply chains, especially the social aspects of it to include child labor or forced labor. In addition, no themes emerged about customer privacy and satisfaction or responsible sourcing. Moreover, no theme about human rights emerges

in the communications although it is one of the most common material topics in the data set. 12 of the 25 analyzed companies have set human rights as a material topic.

In terms of the general themes, business ethics (MT19) is a common material topic as 8 out of 25 companies disclose ethics as a material topic. It is a broad theme that covers many aspects of corporate responsibility and morality and it is reflected in many of the sustainability themes. However, as this analysis only takes into account the topics identified with topic modeling, business ethics is concluded not to be covered in the communications. As stated before, product stewardship (MT18) is addressed through a few different topics such as T11 pulp and paper. Product stewardship is an act meant to minimize various negative sustainability impacts of a product throughout its lifecycle while maximizing the economic benefits (Product Stewardship Institute (PSI) 2020). MT20 compliance and corporate governance also represent broad themes as corporate governance is a system for governing a company where transparency, accountability and security are important principles (Corporate Finance Institute 2020). Compliance in a corporate context means that the company follows relevant laws, policies or standards. This topic does not appear in the topic modeling results and so it is concluded not to be addressed in the communications on Twitter.

Based on the analysis, 10 out of 20 stakeholder expectations about sustainability topics are communicated on Twitter, adding up to 50 % of the expectations. More specifically, all six environmental themes are addressed on Twitter communications, while 27 %, three out of 11 topics, of the expectations in the social category are being addressed. As stated before, it is likely that the social topics related to employees are being communicated internally and therefore do not appear in the LDA results in the first sub-question. One third of the general topics, 33 %, is seen to be addressed in the sustainability communication themes, although some of the themes are vague and it is difficult to ascertain whether they are being addressed or not. The results are presented in table 8 below.

Table 8. Material topic themes and their disclosure on Twitter communications

Topics	Addressed on Twitter
MT1 Circular economy	YES
MT2 Energy use & emissions	YES
MT3 Resource efficiency	YES
MT4 Emissions to water, air and land	YES
MT5 Climate change	YES
MT6 Forest management & biodiversity	YES
MT7 Customer privacy and satisfaction	NO
MT8 Human rights	NO
MT9 Diversity, equality and inclusion at workplace	NO
MT10 Responsible taxpayer and employer practices	NO
MT11 Safety	YES
MT12 Employee wellbeing and competence development	NO
MT13 Occupational health	NO
MT14 Local communities	YES
MT15 Responsible supply chain	NO
MT16 Responsible sourcing	NO
MT17 Employee engagement	YES
MT18 Product stewardship	YES
MT19 Business ethics	NO
MT20 Compliance and corporate governance	NO

It should be noted that this analysis only takes into account the identified sustainability topics that are being communicated and they are compared to the themes identified from the materiality assessments. In addition, it should be taken into account that many of the topics are complex and broad. Moreover, it is possible that the companies do address some of the topics, but they do not appear in the topic modeling results because other topics are more dominant. On the other hand, the results indicate that some frequent material topics, such as human rights, are not included in the companies' Twitter communications at least not as extensively as some other topics that are not perceived as material topics.

4.3 Stakeholder engagement in relation to the stakeholder expectations

The third sub-question aims to find out which topics the stakeholders engage most with on Twitter in terms of favorite counts. Moreover, the objective is to find out whether the stakeholders engage most with the topics they perceive as important in the materiality assessments and expect to be communicated about. Thus, the most popular tweets are compared to the themes identified in the material topics. In addition, the emerging popular topics can provide useful practical implications for communications, CSR and marketing planning.

To identify the most popular content in the Twitter data set, the 8,369 tweets and their respective favorite counts were adjusted according to favorite count-to-follower ratio. This was done because the number of favorite counts varies significantly per analyzed company. Thus, by merely looking at the highest favorite counts the data would not represent the analyzed companies equally. However, it should also be taken into consideration that one does not have to follow someone on Twitter to be able to like a tweet. By adjusting the favorite counts in relation to the number of followers, the data consists of a more varied data set and includes more companies. The adjusted favorite count represents the percentage of how many of the companies' followers have engaged with the tweet via liking it.

Once the favorite counts were adjusted, the data was filtered to only include 20 % of the tweets to include the ones with the highest favorite count-to-follower ratios. Thus, the data used in this analysis consists of 1,679 tweets and 4,942 terms. The data set ranges from the lowest favorite count-to-follower ratio of 0.0017 to the highest of 0.09. The data is analyzed using topic modeling to identify the themes that receive the highest engagement from the stakeholders. Because of the size of the data set, the number of topics was set to 30 with 10 top terms. Of the 30 topics, 23 semantically coherent topics were identified. Out of the 23 identified topics 15 are considered to be related to sustainability adding up to 65 % of the identified topics. The 23 identified topics are presented in table 9 below and in appendix 6 with their beta-values.

Table 9. Identified topics from tweets with the highest engagement

Category	Topics
Non-sustainability (35 %, 8 topics)	ET1 Financial results ET2 Summer jobs and new challenges ET3 High-quality products ET4 Paper products ET5 Car racing ET6 Leadership interviews ET7 Stainless steel products ET8 Career opportunities
Environmental (43 %, 10 topics, 67 % of sustainability topics)	ET9 Sustainable forestry ET10 Carbon emissions ET11 Renewable materials ET12 Plastic waste ET13 Sustainable solutions & zero emissions ET14 Circular economy ET15 Climate change ET16 Sustainable packaging ET17 Sustainable aviation & renewable fuel ET18 Healthier planet for children
Social (13 %, 3 topics, 20 % of sustainability topics)	ET19 Employee engagement ET20 People and work culture ET21 Safety & sustainability awards
General (9 %, 2 topics, 14.3 % of sustainability topics)	ET22 Sustainability ranking ET23 Sustainable innovations

The analysis method is similar as in the other two analyses; the top terms with the highest beta-values were assessed for each topic and the labels were assigned based on the terms in each topic. Overall, the beta-values are higher compared to the first sub-question and lower compared to the beta-values in the material topic themes. This supports the conclusion that beta-values are likely to be lower for more complex and sizable data as the data used in this analysis is between the other data sets in terms of size. The highest beta-value is for ET6

leadership interviews with the top term as *CEO* (Chief Executive Officer) with a beta-value of 0.135, indicating that the term *CEO* has a 13.5 % probability of belonging to ET6. The lowest beta-value is for the top term *excit(-ed)* with a beta-value of 0.033 for topic ET5 car racing indicating that the term *excited* has a 3.3 % probability of belonging to ET5.

The non-sustainability topics are presented in this analysis also for practical implications and they are related to products, job opportunities, financial results, interviews with leadership and car racing. The non-sustainability category represents 35 % of the topics with the highest engagement, thus indicating that the stakeholders engage most with topics related to sustainability. 43 % of the identified topics with the highest engagement are placed to the environmental category, 13 % to the social category and 9 % to the general category. Furthermore, the environmental category represents 67 % of the sustainability topics, while the social category represents 20 % and general category represents 13 %. The findings indicate that stakeholders engage more with environmental topics than other sustainability dimensions or non-sustainability topics. The identified sustainability topics with the highest engagement are next compared to the material topic themes identified in chapter 4.2. Both of them are presented in table 10 below.

By examining the environmental category, it seems that the stakeholders engage highly with all of the environmental material topic themes. While environmental topics represent 30 % of the material topic themes, they represent 43 % of the most highly engaged with topics and 67 % of the most highly engaged with sustainability topics. ET9 sustainable forestry is similar to MT6 forest management and biodiversity, while ET10 carbon emissions is similar to both MT2 energy use and emissions as well as MT4 emissions to water, air and land. In addition, ET11, ET12 and ET16 can all be concluded to deal with MT3 resource efficiency. ET14 circular economy matches MT1 and ET15 climate change matches MT5. ET17 sustainable aviation and renewable fuel is also similar to MT2 and MT4 although it is industry specific. ET18 healthier planet for children is also related to many of the material topic themes, but mostly MT5 climate change. Thus, it can be concluded that the stakeholders do engage highly with the environmental topics they perceive as important in the materiality assessments and expect to be communicated about.

Table 10. Identified high-engagement sustainability topics and material topic themes

Topics with highest engagement	Material topic themes
Environmental	
ET9 Sustainable forestry	MT1 Circular economy
ET10 Carbon emissions	MT2 Energy use & emissions
ET11 Renewable materials	MT3 Resource efficiency
ET12 Plastic waste	MT4 Emissions to water, air and land
ET13 Sustainable solutions & zero emissions	MT5 Climate change
ET14 Circular economy	MT6 Forest management & biodiversity
ET15 Climate change	
ET16 Sustainable packaging	
ET17 Sustainable aviation & renewable fuel	
ET18 Healthier planet for children	
Social	
ET19 Employee engagement	MT7 Customer privacy and satisfaction
ET20 People and work culture	MT8 Human rights
ET21 Safety & sustainability awards	MT9 Diversity, equality and inclusion at workplace
	MT10 Responsible taxpayer and employer practices
	MT11 Safety
	MT12 Employee wellbeing and competence development
	MT13 Occupational health
	MT14 Local communities
	MT15 Responsible supply chain
	MT16 Responsible sourcing
	MT17 Employee engagement
General	
ET22 Sustainability ranking	MT18 Product stewardship
ET23 Sustainable innovations	MT19 Business ethics
	MT20 Compliance and corporate governance

By examining the social category, there is a clear difference between the themes the stakeholders engage with and the themes they perceive as important in the materiality assessments. 55 % of the topics identified in the material topic themes represent the social category, while merely 13 % (20 % of sustainability topics) of the topics the stakeholders engage the most with are related to social topics. ET19 employee engagement is linked to MT17. ET20 people and work culture can be linked to MT9, MT12 and MT17. ET21 safety and sustainability awards is related to MT11 safety although ET21 is related to award announcements in the field of safety and sustainability. In conclusion, many of the social material topic themes do not appear in the external Twitter communications and likely therefore also not in the content with the highest engagement.

The general sustainability topics represent 9 % of the themes with the highest engagement (14.3 % of sustainability topics) and 15 % of the material topic themes. ET22 sustainability ranking is not linked to any of the material topic themes identified. ET23 sustainable innovations on the other hand can be said to be linked to MT18 product stewardship which refers to minimizing the adverse sustainability impacts in a product's lifecycle (PSI 2020). MT19 business ethics and MT20 compliance and corporate governance do not appear in the results of the first sub-question and they also do not appear among the topics with the highest engagement.

Based on the analysis, it can be concluded that on Twitter stakeholders engage most with environmental sustainability topics which they also perceive as important in the materiality assessments. It should also be noted that the environmental topics are dominating the identified sustainability topics in the Twitter communications in the first sub-question, which could affect the results in this analysis. In addition, 65 % of the identified topics with the highest engagement rates represent a sustainability topic, while 35 % represent a non-sustainability topic. The material topic themes, their disclosure and their level of engagement on Twitter communications is presented in table 11 below. The table also presents the previous findings of whether the material topics were addressed on the Twitter communications.

Table 11. Material topic themes, their disclosure and level of engagement on Twitter

Topics	Addressed on Twitter	High engagement
MT1 Circular economy	YES	YES
MT2 Energy use & emissions	YES	YES
MT3 Resource efficiency	YES	YES
MT4 Emissions to water, air and land	YES	YES
MT5 Climate change	YES	YES
MT6 Forest management & biodiversity	YES	YES
MT7 Customer privacy and satisfaction	NO	NO
MT8 Human rights	NO	NO
MT9 Diversity, equality and inclusion at workplace	NO	YES
MT10 Responsible taxpayer and employer practices	NO	NO
MT11 Safety	YES	YES
MT12 Employee wellbeing and competence development	NO	YES
MT13 Occupational health	NO	NO
MT14 Local communities	YES	NO
MT15 Responsible supply chain	NO	NO
MT16 Responsible sourcing	NO	NO
MT17 Employee engagement	YES	YES
MT18 Product stewardship	YES	YES
MT19 Business ethics	NO	NO
MT20 Compliance and corporate governance	NO	NO

In terms of the social topics, no themes appear in the most popular content about customer privacy and satisfaction, human rights, responsible taxpayer and employer practices, occupational health, local communities or responsible supply chain. Thus, it can be stated that 36 % of social material topic themes also appear in the content with the highest engagement. However, it is not possible to ascertain whether the other social topics would receive high engagement if they were communicated externally in the first place. In terms of the general sustainability topics, 33 % (MT18 product stewardship) of the material topic themes appear in the content with the highest engagement.

All in all, 11 out of 20 (55 %) material topic themes are seen to emerge among the most popular Twitter content. Thus, roughly half of the topics the stakeholders like the most are also topics they expect to be communicated about. As can be seen from table 11 above, two additional social themes are seen to emerge as popular topics in this analysis compared to the findings of the first sub-question. The topics represent a responsible work culture and employees, and the finding indicates that the companies communicate about the topic less than some of the other topics, but the topic receives high engagement when communicated about.

As the data set used in this analysis excludes 80 % of the tweets used in the first sub-question it is possible that some topics that did not emerge then, do emerge now because other more dominating, but less engaging topics are excluded. Another interesting finding is that the companies communicate about supporting local communities through for example volunteering, yet the topic does not make it to the list of high engagement topics. Otherwise, the findings match the previous findings. The next chapter further discusses the findings of this chapter and offers an answer to the research question of this thesis.

5 DISCUSSION AND CONCLUSIONS

The purpose of this thesis was to find out how large companies in Finland implement sustainability communications on Twitter and how effective the communications are in terms of stakeholder expectations. In addition, the goal was to identify topics the stakeholders engage most with and examine whether the popular topics match the stakeholders' expectations. After excluding inactive Twitter users and companies only tweeting in Finnish, the data in this thesis represents 25 large companies listed on Nasdaq Helsinki. The findings of the thesis are based on topic modeling method which was used to approach the sub-questions of this thesis. The LDA results were analyzed to identify 18 sustainability topics in the corporate Twitter communications, 20 material topic themes in the companies' materiality assessments, and 23 topics with the highest engagement on Twitter of which 15 are related to sustainability. These findings are first presented, reflected to previous research and literature, and their theoretical contributions are discussed. A summary of key sustainability findings is presented in table 12 in chapter 5.1. Next, practical implications of the findings are discussed. Finally, the limitations of the thesis are discussed and suggestions for future research are presented.

The findings in this thesis offer many new insights about sustainability communications and stakeholder expectations and engagement. Moreover, this thesis addresses an important research gap in current literature as for example Etter (2013) argues that the CSR related messages should be analyzed further to identify which CSR topics are being addressed by the companies. The results in this thesis provide evidence and shed light on the current trends in sustainability communications in terms of which topics the companies address on Twitter. In addition, Lee (2017) argues that sustainable marketing communications have been mainly studied from the company perspective, while this thesis examines the topic from the stakeholder perspective. Furthermore, Ye & Cheong (2017) argue that knowledge about the efficiency of companies' social media communications is limited, while Podnar (2008) argues that research about consumers' expectations and reactions towards CSR communications is scarce. This thesis aimed to fill this gap by studying how stakeholders' expectations are reflected in and how the stakeholders react to the sustainability communications.

5.1 Theoretical contributions

The first sub-question examined the latent sustainability topics or themes that are communicated on Twitter. From the 38 semantically coherent topics that were identified from the 2019 corporate communications, 18 or 47 % are related to sustainability. Of the 18 sustainability topics, 67 % are related to environmental issues, 22 % to social issues and 11 % represent general sustainability issues. In previous research many have found that companies largely communicate about topics not related to sustainability on social media. For example, Etter (2013) finds that 85 % of corporate communications on Twitter address a non-sustainability topic, while Cho et al. (2017) find that on Facebook 80 % of the companies' posts address a non-sustainability topic. The results in this thesis are rather different as nearly half of the topics identified address a sustainability topic, which offers a new perspective on the topic. This could be caused by a recent increase in the integration of sustainability issues in companies' strategies and communications due to increase in demand for sustainability or the urgency of the sustainability issues we are facing.

In addition, the difference could be caused by regional differences (e.g., legislation) or even the sustainability ranking of the companies studied. For example, Farache, Tetchner and Kollat (2018) find that if a company has a higher CSR ranking it is also likely to have a larger percentage of CSR-related tweets. In 2019, five of the 25 analyzed companies in this thesis were ranked by the Corporate Knights (2019) among the 100 most sustainable companies globally. As stated before, all the analyzed companies in this thesis are legally bound to disclose sustainability information due to their size since 2014, which could impact the results of this thesis. However, according to KPMG (2020) there is a significant increase in the number of Finnish companies disclosing sustainability information in their annual reports from 2017 to today. This indicates that even after the legislation, the number has been growing and disclosing sustainability information has become mainstream in Finland.

Table 12. Summary of key sustainability findings

SQ1: Communicated topics	SQ2: Material topic themes	SQ3: Themes with the highest engagement
Environmental		
T1 Circular economy	MT1 Circular economy***	ET9 Sustainable forestry
T2 Sustainable food and packaging	MT2 Energy use & emissions***	ET10 Carbon emissions
T3 Forestry & biodiversity	MT3 Resource efficiency***	ET11 Renewable materials
T4 Sustainable aviation	MT4 Emissions to water, air and land***	ET12 Plastic waste
T5 Transition to renewable energy	MT5 Climate change***	ET13 Sustainable solutions & zero emissions
T6 Wastewater treatment	MT6 Forest management & biodiversity***	ET14 Circular economy
T7 Renewable fuel		ET15 Climate change
T8 Sustainability solutions & environmental problems		ET16 Sustainable packaging
		ET17 Sustainable aviation & renewable fuel
T9 Plastic waste & renewable materials		ET18 Healthier planet for children
T10 Emission reduction		
T11 Sustainable pulp and paper		
T12 Sustainable building		
Social		
T13 Sustainable water solutions	MT7 Customer privacy and satisfaction	ET19 Employee engagement
T14 Employee engagement	MT8 Human rights	ET20 People and work culture
T15 Safety & technology	MT9 Diversity, equality and inclusion at workplace**	ET21 Safety & sustainability awards
T16 Community support		

SQ1: Communicated topics	SQ2: Material topic themes	SQ3: Themes with the highest engagement
Social (continued)		
	MT10 Responsible taxpayer and employer practices MT11 Safety*** MT12 Employee wellbeing and competence development** MT13 Occupational health MT14 Local communities* MT15 Responsible supply chain MT16 Responsible sourcing MT17 Employee engagement***	
General		
T17 Sustainability awards T18 Sustainable customers, partners and practices	MT18 Product stewardship*** MT19 Business ethics MT20 Compliance and corporate governance	ET22 Sustainability ranking ET23 Sustainable innovations

* Material topic theme occurs in communicated topics
** Material topic theme occurs in themes with the highest engagement
*** Material topic theme occurs both in communicated topics and themes with the highest engagement

In terms of the sustainability topics identified, the results are similar to what has been discovered in prior research in terms of topics related to emissions, water, waste, energy, employee engagement, safety, community support, sustainability awards, sustainability solutions and products (e.g., Cao et al. 2016; Chae & Park 2018; Nielsen & Thomas 2007 and Saxton et al. 2019). However, it should be taken into account that some of the prior research focuses on CSR reports (e.g., Cao et al. 2016; Nielsen & Thomas 2007), other social media channels (e.g., Lee 2017), CSR-specific Twitter accounts (e.g., Saxton et al. 2019) or only tweets with sustainability or CSR related hashtags (e.g., Chae & Park 2018), while this thesis studies general corporate Twitter accounts and, thus presents new findings and perspective to prior research.

New topics emerging in this thesis are circular economy, sustainable food and packaging, forestry and biodiversity, sustainable aviation, sustainable pulp and paper as well as sustainable building. Many of the new topics are industry- or company specific in terms of the 25 companies analyzed. For example, the forest industry is represented by three companies in the data set which explains the emergence of topics related to forestry, pulp and paper as well as packaging. In addition, sustainable aviation is actively addressed by practically one company in the data set, thus making it a company-specific topic.

The second sub-question examined the stakeholder expectations of the studied companies with the goal of evaluating the effectiveness of corporate communications on Twitter. It is argued by many (e.g., Abitbol & Lee 2017; Dawkins 2004; Morsing & Schultz 2006) that companies should take stakeholder expectations into consideration when planning their sustainability communications. The material topics collected from the materiality assessments of the analyzed companies represent the various stakeholder expectations in this thesis. Moreover, the materiality assessment is an important tool in identifying the stakeholder expectations and topics they perceive as important, and it is argued by Calabrese et al. (2019) that by applying the materiality principle in the communications, the companies are able to enhance the effectiveness of the communications. Thus, the goal was to determine to what extent the companies address the identified material topics in their communications.

The second sub-question addresses an important research gap and provides evidence about the integration of stakeholder expectations in corporate communications. Very limited prior

research has been conducted with empirical evidence about how well companies address stakeholder expectations in their communications. Ingenhoff and Sommer (2011) study corporate reports and compare them to potential stakeholder expectations collected via a survey and find that the CSR disclosure corresponds to the expectations well. While this thesis utilizes the material topics as a proxy for stakeholder expectations and thus, examines the stakeholder expectations of the studied companies, Ingenhoff and Sommer (2011) survey a group of students not related to the studied companies. The approach taken in this thesis also has its limitations which are further discussed in chapter 5.3.

The findings in this thesis indicate that the studied companies incorporate 50 % of the identified stakeholder expectations into their Twitter communications with a heavy emphasis on addressing the environmental topics that the stakeholders perceive as important. Interestingly, environmental topics represent merely 30 % of the stakeholder expectations, yet up to 67 % of the communicated themes represent an environmental topic. On the other hand, the material topics emphasize social topics, yet they are not communicated by the companies comprehensively as only 27 % of the social material topics are addressed. As most of the social material topics identified are related to employees, it is likely that the employees' expectations are communicated internally and not externally on Twitter, which could explain the weak result in the category.

In contrast to e.g., Saxton et al. (2019) no topic emerged in Twitter communications about human rights, which is a common material topic among the studied companies. The lack of communication about the important topic could be due to the fact that Finland is one of the best countries in protecting human rights (World Justice Project 2020) and the topic might be seen as self-evident and not worthy of communicating extensively about. In terms of the general sustainability topics, product stewardship is the only material topic that is addressed by the companies, adding up to a third of the topics. However, the general topics such as business ethics are complex entities, and it is difficult to ascertain whether they are reflected in the identified topics or not. As the companies in this thesis address half of the identified stakeholder expectations, it can be concluded that the sustainability communications are quite effective overall whereas the environmental expectations are communicated very effectively. However, there seems to be a gap between the social topics the stakeholders see as important and what the companies communicate about on Twitter.

The third sub-question examined the stakeholder social media engagement in terms of the tweets' favorite counts. The goal was to find out which topics the stakeholders engage most with and whether they are similar to the topics they perceive as important in the materiality assessments. The findings indicate that the stakeholders like environmental topics most with 43 % of the identified topics with high engagement figures. Overall, 23 different topics were identified, of which 35 % represent non-sustainability topics such as financial results. In contrast to previous research, the findings in this thesis indicate that stakeholders engage more with sustainability topics than non-sustainability topics as sustainability topics represent 65 % of the identified popular topics. For example, Cho et al. (2017) find that the public has a greater tendency to engage with non-CSR messages on Facebook, while Etter (2013) finds stakeholder interaction to be significantly higher for non-CSR related tweets. Cho et al. (2017) explain their findings with the public's indifference towards CSR messages on social media. The findings in this thesis could indicate a significant change in the stakeholder attitudes towards sustainability on social media.

In terms of the material topics, the findings indicate that 55 % of the identified material topics emerge among the most popular tweets meaning that roughly half of the topics the stakeholders most engage with are topics they perceive as important in the materiality assessments. This indicates that the stakeholders also engage highly with topics they don't necessarily expect to be communicated about. These findings are supported by the previous findings as 50 % of the material topics appear in the Twitter communications. There are some differences between the topics that emerge in the first sub-question and the topics that emerge in the third as the third sub-question only uses 20 % of the data set used in the first sub-question.

The two new topics that do emerge are social topics related to employee work culture, and it can be concluded that the companies communicate little about the topic externally, but the findings indicate that the topic receives comparably high engagement when communicated. Interestingly, the companies communicate about helping local communities through for example volunteering, but local community support does not emerge among the topics with the highest engagement. Kim and Austin (2019) find that young consumers respond more positively to consistent socially responsible business practices than temporary corporate philanthropy type of initiatives, which could also explain the finding in this thesis.

Again, the environmental topics are highlighted as all of the environmental material topics are also among the topics with the highest stakeholder engagement. The findings indicate that the stakeholders approve the companies' messages about sustainability, and especially environmental sustainability topics, as the approval can be demonstrated through for example liking tweets (Choi et al. 2019). Another interesting finding is that the stakeholder expectations consist of merely 30 % of environmental topics, yet they engage most with environmental topics on Twitter. As the environmental topics dominate the identified sustainability topics also with the larger data set, it is likely that the number of tweets related to the environment is large, which could impact the results of the third sub-question as well. In terms of the general sustainability topics identified as popular topics, it is not surprising that stakeholders engage highly with good news such as sustainability rank announcements or sustainability innovations.

Industry-specific topics such as sustainable forestry also emerge among the most highly engaged with topics. As stated before, three forestry companies are included in the data set. This supports the finding of Abitbol and Lee (2017) who find that on Facebook stakeholders engage most with CSR messages that are congruent with the company's core business and industry. Also, Morsing (2006) argues that the sustainability information should be linked to the company's core business. Moreover, sustainable aviation and renewable fuel emerge as a popular topic in this thesis which is a topic mainly addressed by one company operating in the oil industry. This finding also indicates that the stakeholders engage highly with topics that are linked to the company's core business.

An interesting finding related to the sub-questions and their results is that the economic dimension of sustainability is not very clearly represented. For example, Cao et al. (2016) identify job opportunities as an economic sustainability topic, however they study CSR reports which inherently discuss CSR related issues. In this thesis, it was concluded that tweeting about career and job opportunities is not sustainability related as the top terms do not represent any of the aspects related to economic sustainability, for example regarding the impact on stakeholders in terms of salary (EK 2020). In the identified material topics, one topic is concluded to represent both the social and economic dimensions as it is related to responsible taxpayer and employer practices. However, paying taxes to the society, which

is clearly economic sustainability, is not reflected in the identified corporate communications.

On the other hand, communication about financial results emerges among the most highly engaged with topics, which could be related to economic sustainability through for example profitability and financial growth (Fischer 2020). However, the topic was concluded to not be sustainability related as the top words indicated it is purely a financial topic. In terms of the non-sustainability topics the companies communicate about, which represent 53 % of the topics, many are related to disclosing information about share prices and stock markets. It should be taken into consideration, that a few of the 25 companies analyzed, tweet about their share price daily which is likely to affect the results. Moreover, merely disclosing information about share price was concluded not to represent the economic dimension of sustainability.

To answer the main research question of how sustainability communications are implemented on Twitter among large companies listed on the Helsinki Stock Exchange, the findings of the sub-questions are examined. It can be concluded that in the analyzed companies' Twitter communications nearly half of the identified topics are related to sustainability which offers a new perspective to prior knowledge. In addition, if the communications are not greenwashing and companies are indeed integrating sustainability to their actions more, the findings are societally significant as the companies' role in sustainable development is crucial. New sustainability topics identified are circular economy, sustainable food and packaging, forestry and biodiversity, sustainable aviation, sustainable pulp and paper as well as sustainable building which further build on the prior understanding of the sustainability issues companies address in their communications.

Moreover, of the sustainability topics 67 % are related to environmental issues indicating that the companies emphasize environmental matters over other sustainability dimensions in their social media communications. In addition, the companies' stakeholders seem to favor environmental topics over other topics. There could be many reasons as to why the environmental topics dominate the results. It is possible that the companies communicate about the environment so extensively because environmental sustainability has been a hot topic in the media over the past few years. In addition, new political agendas within Finland,

EU or UN might be a reason. Moreover, the demand for sustainability among consumers is increasing. However, many consumers associate the concept of sustainability mostly with the environment (e.g., Barone, Rodrigues, Nogueira, Guimarães & Behrens 2020), which could also result in companies emphasizing the environment in their communications. On the other hand, the companies are likely to monitor the engagement on social media and tweet more about topics that are received well. Moreover, the findings in this thesis indicate that environmental topics receive high social media engagement.

In contrast to this, the stakeholders' expectations emphasize the social aspects of sustainability in the materiality assessments and there seems to be a gap between what the companies communicate about and what the stakeholder expectations are in terms of social sustainability. In conclusion, the large, listed companies in Finland communicate very effectively about stakeholders' environmental expectations, but quite poorly about their social expectations. The economic dimension of sustainability is not represented in the companies' communications but on the other hand the stakeholders seem to not expect communications about it.

5.2 Practical implications

In addition to theoretical contributions, this thesis provides practical implications with the findings. In this thesis, evidence is provided about the current topics addressed in sustainability communications and how well stakeholder expectations are taken into consideration when planning the communications on Twitter. In addition, this thesis provides useful knowledge about the sustainability topics that the stakeholders engage most with. Also, the popular non-sustainability topics discovered are presented for practical purposes in chapter 4.3.

The insights in this thesis offer up-to-date information about the trends in sustainability communications which can be utilized by managers for example for benchmarking purposes or in CSR planning. In social media, users can demonstrate their approval for a message by liking it (Choi et al. 2019), and thus managers can utilize the popular topics identified in this thesis to see which topics the stakeholder approve of. Moreover, by identifying topics that the stakeholders like the most, the companies can take the knowledge into consideration

when planning their communications and marketing efforts. The findings in this thesis indicate that the stakeholders react well to environmental messages. The findings also indicate that the stakeholders also engage with topics outside the material topics, which should also be taken into consideration especially if the goal is to improve social media engagement.

In terms of the stakeholder expectations, given the weak result in the social dimensions in this thesis, managers should examine their own material topics and communications and see how well they address the expectations especially in terms of the social dimension. By addressing the stakeholder expectations better, managers can improve the effectiveness of their communications. Even if the social topics are communicated internally, the findings indicate that messages about for example work culture are well reacted to also externally. Thus, the managers could consider incorporating the social dimension more also to external communications and marketing efforts.

The findings in this thesis have also societal implications as it is assumed that the companies communicate about topics they have integrated to their strategies and operations. This indicates that the large, listed companies in Finland work towards tackling various sustainability challenges our world is facing for example by reducing emissions, transitioning to renewable energy and fuel, managing forests sustainably and protecting biodiversity as well as innovating solutions for a circular economy. The identified sustainability topics are also reflected in many of the UN SDGs such as climate action, life on land, sustainable cities and communities and clean water and sanitation (UN 2015). Moreover, the topics with the highest stakeholder engagement also indicate that the demand and expectations towards sustainability issues are high especially in terms of environmental sustainability. These findings provide valuable insights to anyone interested in the progress of sustainable development in Finland.

5.3 Limitations and future research

This thesis has various limitations. First, the Twitter data used in this thesis only consists of communications in 2019 for 25 companies in Finland and the findings cannot be generalized to other years or countries. In addition, the materiality assessments are used as a proxy for

stakeholder expectations, however the material topics do not necessarily represent the expectations of all stakeholder groups. Also, in Twitter, it is not known who the users who like the companies' tweets are and they do not necessarily represent all stakeholder groups equally. In terms of the methodology, the favorite count-to-follower ratio is used to identify the most popular tweets, however, this approach has its limitations as it excludes one company which has significantly more followers than the others. Moreover, Twitter's algorithm and platform enables also users who don't follow another user to like their tweets. In terms of the data, only text data is used in the analysis and so any content and topics that might appear in pictures, videos or behind URL links the companies' tweet are excluded.

In terms of the topic modeling results and the identified topics, the algorithm uses words that appear frequently to form topics and thus, companies that tweet actively appear on the identified topics more than companies that tweet less. Thus, the results might not equally represent all the 25 companies analyzed in this thesis. In addition, some topics might not emerge among the identified topics even if they are communicated as some other topics are more actively communicated and dominate the results. Thus, some communicated topics might be left out of the results. Also, it is not possible for stakeholders to engage with topics that are not communicated about and thus, the results of the third sub-question are limited to only include popular topics that the companies communicate about on Twitter. As the topic modeling results are analyzed qualitatively, the findings presented in this thesis have no statistical significance.

The findings and the limitations also provide interesting avenues for future research. This research could be replicated to compare different years to study how the sustainability communications have developed over the years. Different countries and industries could also be compared in future research to examine whether there are differences between the trends. It would also be interesting to study the stakeholder reactions further and statistical analyses would well complement this exploratory thesis. Moreover, other social media platforms could be studied as well, as different stakeholders might use other channels. Also, as sustainability communications should be interactive, this interaction could be studied for example to examine whether the companies interact with their stakeholders and how the stakeholders react to the interaction for example via comments.

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APPENDICES

Appendix 1 Analyzed companies, industries, Twitter accounts and followers

	Company	Industry	Twitter account	Twitter followers (9/2020)
1.	Ahlstrom-Munksjö Oyj	Basic Materials	@ahlstrommunksjo	937
2.	Cargotec Oyj	Industrials	@cargotec	4,935
3.	Fiskars Oyj Abp	Consumer Goods	@fiskarsgroup	1,791
4.	Fortum Oyj	Utilities	@fortum	6,421
5.	Huhtamäki Oyj	Industrials	@huhtamakigroup	1,568
6.	Kemira Oyj	Basic Materials	@kemiragroup	5,919
7.	KONE Oyj	Industrials	@konecorporation	15,238
8.	Konecranes Oyj	Industrials	@konecranes	8,499
9.	Metso Outotec Oyj	Industrials	@metsooutotec	12,947
10.	Metsä Board Oyj	Basic Materials	@metsagroup	7,696
11.	Neste Oyj	Oil & Gas	@nesteglobal	19,610
12.	Nokia Oyj	Technology	@nokia	2,172,030
13.	Nokian Tyres Oyj	Consumer Goods	@nokiantyrescom	5,329
14.	Nordea Bank Abp	Financials	@nordea	15,225
15.	Orion Oyj	Health Care	@orionpharma	1,651
16.	Outokumpu Oyj	Basic Materials	@outokumpu	4,897
17.	Sampo Oyj	Financials	@sampo_plc	1,521
18.	SSAB	Basic Materials	@ssab_ab	4,649
19.	Stora Enso Oyj	Basic Materials	@storaenso	10,569
20.	Telia Company	Telecommunications	@teliacompany	4,466
21.	TietoEVRY Oyj	Technology	@tietoevry	9,147
22.	UPM-Kymmene Oyj	Basic Materials	@upmglobal	10,476
23.	Valmet Oyj	Industrials	@valmetglobal	6,505
24.	Wärtsilä Oyj Abp	Industrials	@wartsilacorp	16,942
25.	YIT Oyj	Industrials	@yitgroup	901

Appendix 2 UN Sustainable Development Goals (UN 2015)

UN Sustainable Development Goals

1	No poverty	"End poverty in all its forms everywhere"
2	Zero hunger	"End hunger, achieve food security and improved nutrition and promote sustainable agriculture"
3	Good health and well-being	"Ensure healthy lives and promote well-being for all at all ages"
4	Quality education	"Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all"
5	Gender equality	"Achieve gender equality and empower all women and girls"
6	Clean water and sanitation	"Ensure availability and sustainable management of water and sanitation for all"
7	Affordable and clean energy	"Ensure access to affordable, reliable, sustainable and modern energy for all"
8	Decent work and economic growth	"Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all"
9	Industry, innovation and infrastructure	"Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation"
10	Reduced inequalities	"Reduce inequality within and among countries"
11	Sustainable cities and communities	"Make cities and human settlements inclusive, safe, resilient and sustainable"
12	Responsible consumption and production	"Ensure sustainable consumption and production patterns"
13	Climate action	"Take urgent action to combat climate change and its impacts"
14	Life below water	"Conserve and sustainably use the oceans, seas and marine resources for sustainable development"
15	Life on land	"Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss"
16	Peace, justice and strong institutions	"Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels"
17	Partnerships for the goals	"Strengthen the means of implementation and revitalize the global partnership for sustainable development"

Appendix 3 A list of identified communication topics not related to sustainability

Topic	Top terms
Sea & harbor	Crane, mobil, sea, port, harbor
Results & innovations	New, result, innov, product
Machines & tools	Test, machin, tool
Data	Use, power, new, data, screen, datacent
Share price changes	Eur, week, price, summari, helsinki, chang
Helsinki Stock Exchange	Helsinki, omx, eur, open, close
Car racing	Mercedesamgf, lewishamilton, valtteribotta
Stock markets	Share, eur, chang, Helsinki, market
Future innovations	Chang, future, today, innov, technolog
Helsinki Stock Exchange	Eur, helsinki, chang, close, Nasdaq, omx
Energy	Gas, electr, oil
Marine solutions	Marin, creat, innov, busi, push, solut, offshor
Sports	Valtteribotta, race, cycl, weekend
Architecture & design	Place, design, first, architectur
Power plants	Plant, agreement, power, industry, sign, powerpl
Data platforms	Find, service, platform, data, new, product
Professional discussions	Studi, discuss, webinar, meet, tour, panel
Steel industry	Steel, stainless, stainlesssteel
Port business	Contain, handl, crane, termin, portsolutionsday
Product development	New, product, develop, busi, support, technolog

Appendix 4 Identified sustainability topics on Twitter and their beta-values

Topic 1: Circular economy

Terms	Beta
circular	0.03381
live	0.0279
economi	0.02679
podcast	0.02622
space	0.01305
new	0.01248
save	0.01182
solut	0.01085
planet	0.01051
sustain	0.00966
kari	0.00831
world	0.00783
prevent	0.00759
climatechang	0.00754
roll	0.00739

Topic 2: Sustainable food and packaging

Terms	Beta
food	0.03637
sustain	0.02268
packag	0.02149
futur	0.0177
product	0.01222
recycl	0.01214
energi	0.01151
chemistri	0.01035
new	0.00948
cleaner	0.0092
materi	0.009
solut	0.00849
togeth	0.00832
renewableenergi	0.0079
innov	0.00781

Topic 3: Forestry & biodiversity

Terms	Beta
forest	0.05872
one	0.01664
compani	0.01499
biodivers	0.01327
celebr	0.01077
share	0.00951
cyber	0.00925
finland	0.00909
cybersecur	0.00896
forestri	0.00861
anniversari	0.00724
project	0.00719
famili	0.00693
index	0.00686
protect	0.0068

Topic 4: Sustainable aviation

Terms	Beta
aviat	0.04744
sustain	0.03116
renew	0.02758
flylowcarb	0.01813
fuel	0.01804
divers	0.01513
sweden	0.01345
custom	0.01319
new	0.01295
jet	0.01207
listen	0.00952
one	0.00889
airport	0.00806
involv	0.00781
emiss	0.00749

Topic 5: Transition to renewable energy

Terms	Beta
energi	0.01924
futur	0.01722
transit	0.01488
industri	0.01289
product	0.0126
year	0.01133
one	0.00999
mine	0.00909
tail	0.00884
special	0.00852
renew	0.0077
high	0.00748
ctbuh	0.00716
target	0.00708
time	0.00636

Topic 6: Sustainable wastewater treatment

Terms	Beta
new	0.02315
treatment	0.01321
world	0.01131
one	0.01092
sustain	0.01074
measur	0.00989
product	0.00976
chang	0.00945
oper	0.00913
increas	0.00912
helsinki	0.00838
especi	0.0081
cxt	0.00802
wastewat	0.00795
method	0.00715

Topic 7: Renewable fuel

Terms	Beta
sustain	0.03013
renew	0.02609
biofor	0.02188
beyondfossil	0.02063
innov	0.02038
diesel	0.0169
technolog	0.01098
futur	0.01063
product	0.00976
recycl	0.00945
compani	0.00897
industri	0.00848
digit	0.00804
straw	0.00762
differ	0.00747

Topic 8: Sustainability solutions & environmental problems

Terms	Beta
solut	0.01404
phase	0.01383
sustain	0.0133
environment	0.01301
problem	0.01061
island	0.00992
need	0.00855
materi	0.00833
digit	0.00794
product	0.00776
look	0.00694
energystorag	0.00651
develop	0.00644
renew	0.0064
get	0.00616

Topic 9: Plastic waste & renewable materials

Terms	Beta
amp	0.02006
new	0.0118
wast	0.01178
renew	0.01138
seminar	0.01066
make	0.01056
join	0.01005
plastic	0.00997
innov	0.00854
busi	0.00846
sure	0.00838
materi	0.0077
develop	0.00764
sustain	0.00763
festiv	0.00706

Topic 10: Emission reduction

Terms	Beta
emiss	0.02084
helsinki	0.01476
new	0.01446
reduc	0.01195
eur	0.01091
digit	0.01069
start	0.00921
come	0.00914
share	0.00842
day	0.00824
oper	0.00819
servic	0.0079
enext	0.00772
open	0.00728
improv	0.0072

Topic 11: Sustainable pulp and paper

Terms	Beta
pulp	0.02758
paper	0.02048
sustain	0.0192
new	0.01437
field	0.01368
oper	0.01269
mainten	0.01229
renew	0.01148
servic	0.01051
mill	0.01024
clean	0.00858
provid	0.00779
packag	0.00716
work	0.00678
qualiti	0.00672

Topic 12: Sustainable building

Terms	Beta
citi	0.03572
sustain	0.02127
build	0.0189
fleet	0.01637
carbon	0.01171
new	0.01138
wast	0.01029
amp	0.01007
footprint	0.00943
reduc	0.0091
easi	0.00902
world	0.00892
durabl	0.00868
finish	0.0082
maintain	0.00789

Topic 13: Sustainable water solutions

Terms	Beta
water	0.02985
sustain	0.01797
solut	0.01728
today	0.01407
sourc	0.01375
busi	0.0102
modular	0.01013
oper	0.01002
industri	0.0093
improv	0.00915
digit	0.00816
consid	0.00802
block	0.0077
day	0.0075
meet	0.0071

Topic 14: Employee engagement

Terms	Beta
work	0.03608
trust	0.01647
colour	0.01201
meet	0.01079
talent	0.01056
welcometo	0.01001
educ	0.00995
latest	0.00966
loveourteam	0.00961
abras	0.00961
ing	0.00885
liftyourcar	0.00881
peopl	0.00818
careerstori	0.00801
job	0.00797

Topic 15: Safety & technology

Terms	Beta
autom	0.054
safeti	0.02275
termin	0.02238
system	0.01489
cup	0.01197
technolog	0.01162
common	0.00997
manag	0.00901
solut	0.00837
event	0.00771
use	0.0077
ice	0.00747
enhanc	0.00736
uniqu	0.00729
doubl	0.00694

Topic 16: Community support

Terms	Beta
custom	0.01659
help	0.01458
school	0.01221
volunt	0.01092
now	0.01052
new	0.01048
watch	0.01028
increas	0.00965
biobas	0.00942
student	0.00937
solut	0.009
calvert	0.00891
finland	0.00878
servic	0.00846
alabama	0.00728

Topic 17: Sustainability awards

Terms	Beta
sustain	0.02898
award	0.02591
custom	0.01806
product	0.01357
creat	0.01168
renew	0.0106
share	0.00973
help	0.00938
solut	0.00932
new	0.00906
servic	0.0076
togeth	0.00735
one	0.00733
rate	0.00706
oper	0.00691

Topic 18: Sustainable customers, partners and practices

Terms	Beta
mean	0.03153
custom	0.02761
partner	0.01963
sustain	0.01922
sap	0.01651
topic	0.0158
practic	0.01385
new	0.01382
behind	0.01169
solut	0.01087
protect	0.01087
certifi	0.01047
scene	0.01
certif	0.00902
devop	0.00886

Appendix 5 Identified material topic themes and their beta-values

Materiality theme 1: Circular economy

Terms	Beta
circular	0,34999788
economi	0,34999788
safe	0,09999939
develop	0,04999971
creat	0,0499997
comfort	0,0499997
urban	0,0499997
promot	6,042E-06
choic	8,3634E-09
sustain	8,8666E-31

Materiality theme 2: Energy use & emissions

Terms	Beta
energi	0,26769913
use	0,14872174
emiss	0,0594887
communic	0,0594887
gas	0,0594887
greenhous	0,0594887
renew	0,0594887
effici	0,04320962
reduc	0,03471559
oper	0,02974435

Materiality theme 3: Resource efficiency

Terms	Beta
effici	0,38287961
resourc	0,18150599
action	0,0726024
briberi	0,0726024
educ	0,0726024
train	0,0726024
deforest	0,0363012
healthcar	0,0363012
profession	0,0363012
protect	0,0363012

Materiality theme 4: Emissions to water, air and land

Terms	Beta
water	0,22572311
emiss	0,19347695
wast	0,09673848
air	0,06449232
land	0,06449232
procur	0,06449232
system	0,06449232
thirdparti	0,06449232
verifi	0,06449232
implement	0,03224616

Materiality theme 5: Climate change

Terms	Beta
climat	0,31428571
chang	0,14285714
innov	0,14285714
conduct	0,05714286
carbon	0,02857143
case	0,02857143
digitalis	0,02857143
dioxid	0,02857143
environ	0,02857143
ghg	0,02857143

Materiality theme 6: Forest management & biodiversity

Terms	Beta
manag	0,66666669
forest	0,08333334
risk	0,08333334
biodivers	0,0833333
supplier	0,04166667
invest	0,04166667
complianc	1,4996E-23
respons	3,2992E-37
opportun	5,5561E-46
dialogu	1,5426E-51

Materiality theme 7: Customer privacy and satisfaction

Terms	Beta
custom	0,28383489
privaci	0,12614884
satisfact	0,12614884
secur	0,12614884
experi	0,09461163
inform	0,08542088
data	0,06307442
chronic	0,03153721
diseas	0,03153721
nation	0,03153721

Materiality theme 8: Human rights

Terms	Beta
right	0,45714286
human	0,31428571
understand	0,05714286
children	0,02857143
customers´ne	0,02857143
deep	0,02857143
intellectu	0,02857143
need	0,02857143
properti	0,02857143
code	2,2836E-10

Materiality theme 9: Diversity, equality and inclusion at workplace

Terms	Beta
divers	0,2962963
equal	0,14814815
inclus	0,14814815
opportun	0,14814815
workplac	0,11111111
dilig	0,03703704
due	0,03703704
nondiscrimin	0,03703704
reduct	0,03703704
engag	2,3246E-42

Materiality theme 10: Responsible taxpayer and employer practices

Terms	Beta
practic	0,34782609
employ	0,17391304
fair	0,08695652
tax	0,08695652
electromagnet	0,04347826
field	0,04347826
partner	0,04347826
taxpay	0,04347826
via	0,04347826
wealth	0,04347826

Materiality theme 11: Safety

Terms	Beta
safeti	0,70588235
cultur	0,08823529
high	0,05882353
incidentfre	0,02941176
level	0,02941176
patient	0,02941176
potenti	0,02941176
ssab	0,02941176
health	6,5918E-26
work	3,8976E-34

Materiality theme 12: Employee wellbeing and competence development

Terms	Beta
develop	0,33333333
wellb	0,25
compet	0,13888889
peopl	0,05555556
technolog	0,05555556
promot	0,02777778
connect	0,02777778
misus	0,02777778
personnel	0,02777778
staff	0,02777778

Materiality theme 13: Occupational health

Terms	Beta
health	0,42307692
occup	0,26923077
attract	0,11538462
talent	0,11538462
retent	0,07692308
safeti	1,0517E-15
cycl	3,7201E-44
growth	3,7201E-44
indirect	3,7201E-44
life	3,7201E-44

Materiality theme 14: Local communities

Terms	Beta
communiti	0,27677366
local	0,19769547
support	0,07907819
inform	0,05106179
dialogu	0,03953909
involv	0,03953909
livelihood	0,03953909
part	0,03953909
presenc	0,03953909
produc	0,03953909

Materiality theme 15: Responsible supply chain

Terms	Beta
suppli	0,39285725
chain	0,35714295
qualiti	0,07142859
servic	0,07142859
laborhuman	0,0357143
transpar	0,0357143
endus	0,03571402
grey	3,7201E-44
tire	3,7201E-44
via	1,4647E-51

Materiality theme 16: Responsible sourcing

Terms	Beta
respons	0,63888889
sourc	0,13888889
perform	0,11111111
financi	0,05555556
polici	0,02777778
purchas	0,02777778
children	3,7201E-44
livelihood	3,7201E-44
societi	3,7201E-44
procur	3,4942E-57

Materiality theme 17: Employee engagement

Terms	Beta
employe	0,33344899
engag	0,30313544
longterm	0,06062709
develeop	0,03031354
express	0,03031354
freedom	0,03031354
generat	0,03031354
motiv	0,03031354
relationship	0,03031354
return	0,03031354

Materiality theme 18: Product stewardship

Terms	Beta
product	0,50000189
materi	0,21875083
stewardship	0,09375035
chemic	0,03125012
ewast	0,03125012
lifecycl	0,03125012
raw	0,03125012
choic	0,03125011
promot	0,03124634
steel	4,5597E-12

Materiality theme 19: Business ethics

Terms	Beta
ethic	0,41176471
busi	0,35294118
anticorrupt	0,08823529
valu	0,05882353
competit	0,02941176
purpos	0,02941176
sell	0,02941176
complianc	1,0862E-30
growth	1,416E-51
indirect	1,416E-51

Materiality theme 20: Compliance and corporate governance

Terms	Beta
complianc	0,2
corpor	0,11428571
good	0,11428571
govern	0,11428571
prevent	0,11428571
corrupt	0,08571429
new	0,08571429
antibriberi	0,02857143
citizenship	0,02857143
earli	0,02857143

Appendix 6 Identified highest engagement topics and their beta-values

Engagement topic 1: Financial results

Terms	Beta
report	0,04324263
result	0,03773601
financi	0,03117492
eur	0,027114
publish	0,02609319
million	0,02473682
capit	0,02011285
market	0,0187603
strong	0,01810156
profit	0,01407505

Engagement topic 2: Summer jobs and new challenges

Terms	Beta
challeng	0,053303
next	0,03784273
open	0,02627746
new	0,02378172
talk	0,02104878
opportun	0,01937543
summer	0,01774721
stop	0,01419697
think	0,01396116
center	0,01336006

Engagement topic 3: High-quality products

Terms	Beta
custom	0,08242986
product	0,04924321
steel	0,02767761
qualiti	0,02696219
high	0,02329572
bauma	0,01900045
program	0,01893881
new	0,01431689
reduc	0,01086894
increas	0,01086347

Engagement topic 4: Paper products

Terms	Beta
paper	0,048885
colour	0,027542
cup	0,02644
abras	0,024237
market	0,018562
uniqu	0,016516
product	0,013696
stand	0,011055
food	0,010938
back	0,010916

Engagement topic 5: Car racing

Terms	Beta
excit	0,03323226
valtteribotta	0,02975569
look	0,01930563
startup	0,01752935
race	0,01665288
forward	0,01623477
mercedesamgf	0,01577642
amaz	0,01577642
year	0,01541658
first	0,01503893

Engagement topic 6: Leadership interviews

Terms	Beta
ceo	0,1358637
presid	0,04787362
finnish	0,04653853
time	0,02750666
recycl	0,02051227
say	0,0196352
group	0,01910836
life	0,0176164
interview	0,01682122
year	0,01656909

Engagement topic 7: Stainless steel products

Terms	Beta
steel	0,05868021
stainless	0,04234617
stainlesssteel	0,03131316
product	0,01645776
tornio	0,01639207
member	0,01366006
mill	0,01363056
industri	0,01185215
market	0,01139221
sustain	0,01103042

Engagement topic 8: Career opportunities

Terms	Beta
busi	0,11008855
proud	0,05257079
growth	0,02612353
opportun	0,02332149
home	0,02225613
announc	0,02073326
career	0,01923247
sustain	0,01880625
cleaner	0,01826754
rang	0,01713042

Engagement topic 9: Sustainable forestry

Terms	Beta
forest	0,04245238
sustain	0,03188656
new	0,02352728
grow	0,02256869
biofor	0,01929654
environment	0,01885858
beyondfossil	0,01833171
environ	0,01815809
year	0,01677128
manag	0,01561907

Engagement topic 10: Carbon emissions

Terms	Beta
carbon	0,06550475
key	0,0340161
footprint	0,02467105
new	0,0219579
world	0,01609088
now	0,01507649
amp	0,01335795
factori	0,01288618
open	0,01195938
dioxid	0,01181233

Engagement topic 11: Renewable materials

Terms	Beta
materi	0,08373243
renew	0,0613977
fiber	0,04592092
product	0,04254626
invest	0,02958985
use	0,02935633
recycl	0,02337945
sustain	0,02212653
raw	0,02070943
solut	0,02022082

Engagement topic 12: Plastic waste

Terms	Beta
plastic	0,09783609
find	0,05138153
wast	0,04283328
annual	0,0265277
meet	0,02349719
solut	0,02206896
biobas	0,02152394
coffe	0,01737631
problem	0,01663214
discov	0,01618736

Engagement topic 13: Sustainable solutions & zero emissions

Terms	Beta
sustain	0,09024131
solut	0,04078872
build	0,02335587
emiss	0,0211434
creat	0,0207256
fiberbas	0,02027606
togeth	0,02008919
work	0,01872472
zero	0,01814033
valu	0,01721397

Engagement topic 14: Circular economy

Terms	Beta
circular	0,05060365
leader	0,04351914
renew	0,04347667
global	0,04325878
sustain	0,03752606
circulareconomi	0,03075275
becom	0,0280385
compani	0,02637327
aim	0,02566554
commit	0,02033173

Engagement topic 15: Climate change

Terms	Beta
climat	0,09357456
climatechang	0,05269301
reduc	0,03413909
emiss	0,03124235
renew	0,02990391
year	0,02939258
faster	0,02725501
blog	0,02028098
bolder	0,0190785
help	0,01700736

Engagement topic 16: Sustainable packaging

Terms	Beta
packag	0,08788259
flexibl	0,02359529
pride	0,02056784
solut	0,01768104
divers	0,01518725
recycl	0,01473992
fast	0,0139497
togeth	0,01374744
strategi	0,0136752
equal	0,01234835

Engagement topic 17: Sustainable aviation & renewable fuel

Terms	Beta
renew	0,08046414
aviat	0,0800598
sustain	0,07778873
fuel	0,05305397
find	0,03820225
diesel	0,03420737
flylowcarb	0,03202392
emiss	0,02575947
wast	0,01981068
jet	0,01965104

Engagement topic 18: Healthier planet for children

Terms	Beta
creat	0,05024133
children	0,04006823
planet	0,03468776
healthier	0,02890647
togeth	0,02671901
fossilfre	0,02312518
steel	0,02190684
sustain	0,02176117
mill	0,01726405
pulp	0,01541678

Engagement topic 19: Employee engagement

Terms	Beta
join	0,11071811
group	0,05303875
head	0,04248486
fact	0,02832324
peopl	0,02095001
manag	0,01674252
meet	0,01611578
team	0,0156831
free	0,01532199
webinar	0,0141616

Engagement topic 20: People and work culture

Terms	Beta
collabor	0,05602645
creat	0,01950605
peopl	0,01717005
workcultur	0,01713774
alway	0,01703535
iittala	0,01547715
base	0,0154723
now	0,01492638
servic	0,01463694
releas	0,01442464

Engagement topic 21: Safety & sustainability awards

Terms	Beta
safeti	0,06209675
award	0,06107877
congratul	0,03131027
heat	0,02748544
espoo	0,01318412
energi	0,01241252
recognit	0,01187487
receiv	0,01091115
best	0,01082586
sustain	0,01033725

Engagement topic 22: Sustainability ranking

Terms	Beta
compani	0,09955693
one	0,06473587
sustain	0,04602442
world	0,02373004
rank	0,02315034
network	0,01837347
best	0,0157096
nordic	0,01435336
partnership	0,01381876
number	0,01362757

Engagement topic 23: Sustainable innovations

Terms	Beta
innov	0,13179815
work	0,02003866
custom	0,01838222
sustain	0,01818954
proud	0,01757459
imaginefib	0,01666676
famili	0,0161173
creat	0,01245152
generat	0,01124724
technolog	0,01099719