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Master's thesis

Environmental innovation in the construction industry on the road to a more circular future

Miljømessig innovasjon i byggebransjen på veien mot en mer sirkulær fremtid

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Preface

After a two-year study at Høgskolen I Innlandet avd. Lillehammer this master thesis is the final work to complete my master's degree in Innovation. As a chosen trustee for the masterclass the first year, I got a verry exiting start to my studies, and got to know the school system quite well. Through many different subjects and interesting discussions, the study is now coming to an end. It has been a full learning experience, but also quite demanding. With the high level of knowledge and competencies in the class of 2021-2023, the learning environment has been extremely high, and it has pushed my limits to the top. My personal stress level has also been high through this final semester, and the fear of failing or not making it has crossed my mind a couple of times.

This thesis would not have been completed without the support of those closest to me. I am forever grateful for their support and motivation to do this master thesis and that they have believed in me during this period. I am especially thankful for my mum, Ellen Strøm and her support, and Anna J. Lauvås for believing in me and supporting me through this period. I would also like to thank my supervisor, associate professor Anne Jørgensen Nordli for her guidance and patience with all my questions and concerns. I am also grateful for the students in my master studies and their support.

I would also like to thank COWI, and our contact person there, Erik Rigstad.

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kristi S. Lie

Abstract

The circular economy has received a lot of attention in the recent years because of climate change and the difficulties with global warming. One of the industries that is known to generate a lot of emissions and waste is the construction industry. The construction industry has therefore been recommended to invest more in innovations with environmental benefits and the transition to a more circular economy is seen as a possible solution. There are many different barriers and drivers that are mentioned in relation to environmental innovations. It is therefore interesting to look closer at which barriers and drivers appear as important for environmental innovation in the construction industry in Norway, and potentially how this is related to the transition to a more circular economy. To investigate the topic more closely the thesis will look at the community innovation survey from 2018-2020 collected by Statistics Norway and perform interviews with relevant actors that work in the construction industry in Norway. The theoretical framework in this thesis is based on innovations with environmental benefits and circular strategies for a circular economy.

The results from the study show that the construction industry introduces 9% less environmental innovation compared to other industries in Norway. Several different barriers are mentioned in the study, but uncertain demand and lack of qualified personnel are some of the once that appear as important to environmental innovation. On the other hand, collaboration especially appear as an important driver for the industry to develop more environmental innovations. Profitability, risks, laws and regulations and the business model also appear as important in relation to environmental innovation. Bringing In the right type of knowledge and competence is also perceived as necessary to be successful with innovation and environmental innovation. Introducing more environmental innovation, especially solutions that are demountable is also seen as important for the construction industry and the move to a more circular economy. Collaboration and knowledge is also perceived as important for environmental innovation and the circular economy.

Overall, the study shows that there still seems to be a need for new business models in the construction industry that are more sustainable and allow for more collaboration and leaves room for innovation. Cooperation is seen as essential in the analysis and it seems to be crucial to achieve better cooperation in order for this industry to be able to become more sustainable in the future and a part of becoming more circular.

Sammendrag

Sirkulær økonomien har fått mye oppmerksomhet de siste årene som en følge av klima endringer og problemer med global oppvarmingen. En av industriene som er kjent for ha et høyt utslipp og som genererer mye avfall er byggebransjen. Byggebransjen har derfor blitt anbefalt å investere mer i innovasjoner som har miljømessige fordeler og overgangen til en mer sirkulær økonomi er sett på som en mulig løsning. Det er mange barrierer og drivere som nevnes i relasjon til miljømessige innovasjoner. Det er derfor interessant og se nærmere på hvilke barrierer og drivere som fremstår som viktige for miljømessig innovasjon i byggebransjen i Norge, og eventuelt hvordan dette henger sammen med overgangen til en mer sirkulær økonomi. For å undersøke temaet mer inngående vil denne studien se på Community innovation Survey fra 2018-2020 som er samlet in av Statistisk sentralbyrå og gjennomføre intervjuer med noen relevante aktører som jobber med byggebransjen i Norge. Det teoretiske rammeverket i denne oppgaven er basert på innovasjoner med miljøfordeler og sirkulære strategier for en sirkulær økonomi.

Resultatene fra studien viser at byggebransjen introduserer 9% mindre miljømessig innovasjon sammenlignet med andre bransjer i Norge. Mange ulike barriere nevnes i studien, men usikker etterspørsel i markedet og mangel på kvalifisert personell, er noen av dem som fremstår som viktig for miljømessig innovasjon. På den andre siden fremstår samarbeid, som spesielt viktige for industrien for å utvikle flere miljømessige innovasjoner. Lønnsomhet, risiko, lover og reguleringer og forretningsmodellen fremstår også som viktige med tanke på miljømessig innovasjon. Å komme inn med riktig type kunnskap og kompetanse ses også som nødvendig for å lykkes med innovasjon og miljømessig innovasjon. Spesielt det å introdusere løsninger som er demonterbare ses som viktig for bygge bransjen og overgangen til en mer sirkulær økonomi. Samarbeid og kunnskap fremstår også som viktig for miljømessige innovasjoner og sirkulær økonomien.

Samlet sett, viser studien at det fortsatt er behov for nye forretningsmodeller i byggebransjen som i større grad er bærekraftige og legger opp til mer samarbeid, og gir rom for innovasjon. Samarbeid ses som essensielt i analysene og det virker som det er avgjørende å få til bedre samarbeid for at denne bransjen skal klare å bli mer bærekraftig i fremtiden og som en del av det å bli mer sirkulær.

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1.0 Introduction

This master thesis is interested in looking at environmental innovation in the construction industry as a mean in the desired move towards a more circular economy. The base of the thesis is that the construction industry is known for their high emissions, and that they have been recommended to spend more money on environmental sustainability innovations (Duong et al., 2021, p. 398) and the circular economy is seen as a solution to become more sustainable for the construction industry (Guerra et al., 2021; Wuni, 2022, p. 1). The move to a circular economy needs new innovations (Yu et al., 2022, p. 2) that are environmental sustainable and eco-innovations are seen as relevant (de Jesus & Mendonça, 2018, p. 2999; Scarpellini et al., 2020). According to an article by Wuni (2022) the construction industry is still lacking when it comes to transitioning to the Circular economy (Wuni, 2022, p. 11). A definition of Environmental innovations by Oltra and Saint Jean (2009) is "[…] innovations that consists of new or modified processes, practices, systems and products which benefit the environment and so contribute to environmental sustainability" (Oltra & Saint Jean, 2009, p. 567). This thesis is therefore interested in looking closer at the barriers and drivers of environmental innovations in the construction industry and how environmental innovation can help the move to a more circular economy. By looking at the barriers and drivers of environmental innovation in the industry it could help define some of the problems that are stopping these innovations with environmental benefits, and possibly how this can be seen in relation to this transition.

1.1 Background

The worlds carbon budget is sinking, and the need to act now is more urgent than ever to stay within the 1,5-2 °C limit to stop the global warming (United Nations Environment Programme, 2022, pp. 33–34). According to the Emissions Gap Report from 2022 there is a need to reduce greenhouse gas emissions in several areas for the world to reach the Paris agreement targets (United Nations Environment Programme, 2022, pp. 38–39). In 2021 the Norwegian government released a new strategy called "National strategy for en grønn, sirkulær økonomi" where they write that a move to a more Circular Economy is important, and that Norway wants to be a leading country in this process (Klima- og miljødepartementet, 2021, p. 6). By 2050, Norway has a goal of a 90-95 % reduction in greenhouse gases and plans to be emission free in the long run and become a low-emission society (Klima- og miljødepartementet, 2021, p. 19). The strategy mentions a few areas where the circular economy has a high potential, and the construction industry is one of them. Innovation and research is seen as an important part of this transition and especially cooperation and the development of a support system to reach this goal is an important focus for the government (Klima- og miljødepartementet, 2021, pp. 8–9).

The construction industry is responsible for about 40% of the energy consumption in the world (UN Environment and International Energy Agency, 2018; referenced in; Duong et al., 2021, p. 398), and about 40% of the total material resource use and waste generated are from buildings (United nations Environment programme, 2012; Referenced in; Eberhardt et al., 2022, p. 93). The industry is known globally for contributing to the high pollution and for being resource-intensive (Duong et al., 2021, p. 398). Put simply "The construction industry is currently the largest global consumer of resources and raw materials"(Ellen Macharthur foundation, 2020; stated in; Guerra et al., 2021, p. 1). This industry is known for their production of waste and the problem is mentioned in many research papers and reports/strategies (De Wit et al., 2020; Duong et al., 2021; Klima- og miljødepartementet, 2021). According to the strategy plan for 2021-2023 for the contractor's association (Entreprenørforeningen bygg og anlegg, n.d.) for the Norwegian construction industry, one of their main goals is to control the greenhouse gas emissions before 2030 and reduce these by 50%. To reach a sustainable future, the construction industry has a key role in this process and this includes innovations, reuse and a circular economy approach (Entreprenørforeningen bygg og anlegg, n.d., pp. 3–7).

Jørgensen and Pedersen (2018, p. xiii) also talks about sustainability issues and the need to change, and writes "In order for companies to be part of the solution rather than part of the problem, we need comprehensive changes to business models" (Jørgensen & Pedersen, 2018, p. xiii). As a result of the current problems that are coming from the building industry, Circular economy has gotten more interest and is seen as a possible solution (Eberhardt et al., 2022, p. 93). The move to a Circular Economy is seen as important for the industry (Wuni, 2022). The construction industry has also been recommended to put more money on environmental sustainability innovations (Duong et al., 2021, p. 398). So, environmental innovation has received a lot of attention the last years and there are numerous of studies on the topic (D'Orazio & Valente, 2019; Karttunen et al., 2021; Kyaw, 2022; Liao, 2018; Souto & Rodriguez, 2015). An example of how environmental innovation can be important in construction, can be seen in Karttunen et al., (2021, p. 2)'s study on the Cement industry, since the construction industry uses large amount of cement. "[…] environmental innovation in the cement industry includes increases in energy efficiency and resource efficiency, as well as carbon capture […] strategy for reducing CO2 emissions include substituting clinker with supplementary cementitious material "(Karttunen et al., 2021, p. 2). One of the results from Duong et al., (2021, p. 412), also show that environmental innovation can lead to reduced emissions.

For the construction industry, Innovation is seen as essential to survive in the future (Gambatese & Hallowell, 2011, p. 553). The industry is also looked at as conservative (Hart et al., 2019, p. 623). Compared to other industries, the construction industry has a lower productivity and innovation rate,

and they invest less money on research and development (Blayse and Manley, 2004; Suprun and Stewart, 2015; referenced in; Gong & Wang, 2021, p. 223). The industry also puts itself in a position that can limit innovation because of liability terms in their contracts with others (Hart et al., 2019, p. 622). The construction industry is known for being complex, and to be able to handle the requests for the future, innovation is very important (Lindblad & Guerrero, 2020, p. 468). "[…] innovative solutions are in demand to address wicked CE challenges in the construction industry"(Yu et al., 2022, p. 2). Especially Eco innovation is mentioned as important to the transition to Circular Economy (de Jesus & Mendonça, 2018; Scarpellini et al., 2020). "Eco-innovation is key to transforming the traditional linear system of production and consumption into a circular Economy (CE)"(Scarpellini et al., 2020, p. 1850).

A lot of literature has been generated in the past years regarding barriers or drivers to the circular Economy (de Jesus & Mendonça, 2018; Grafström & Aasma, 2021; Wuni, 2022) and barriers and/or drivers/determinants of innovations with environmental benefits, like green innovation, eco innovation and environmental innovation (Horbach, 2008; Horbach et al., 2013; Stucki, 2019). Some also look at barriers and drivers in the construction industry, and through a systematic literature review, Wuni (2022) found that there are 95 barriers in the construction industry when it comes to adopting a Circular Economy. So, still in the resent years there are studies that point to the construction industry and their failed transition to the circular economy (Wuni, 2022, p. 1).

It seems that there remains a lot of work when it comes to implementing circular economy in the construction industry and that innovations with environmental benefits can be seen as an important part of this proses. The purpose of this master thesis is therefore to investigate possible barriers and drivers of environmental innovation in the construction industry in Norway to help explore this continuing lack of transition to a more circular economy.

1.2 Research question

Based on the introduction and background above, this thesis has two research questions that it will try to answer. The first research question seeks to uncover which barriers and drivers appear as important to environmental innovation in the construction industry in Norway. This will first be investigated by using quantitative data from the Norwegian construction industry. In-depth interviews with key-actors in the industry will then be utilized to further investigate barriers and drivers within and outside the scope of the quantitative data, and to elaborate on which barriers and drivers appear as especially important in the construction industry. The second research question intends to explore these findings and identify how these drivers and barriers appear in the construction industry and how they are related to the transition to the circular economy. This is achieved by using a large consultancy company

that works with the construction industry as an entrance to deeper insight about the industry. The two questions are:

> Research question 1: Which drivers and barriers of environmental innovation appear as especially important in the construction industry?
>
> Research question 2: How do these barriers and drivers appear and how do they relate to the transition to a circular economy in the construction industry?

The research questions are developed in a way so that they can capture the overall perspective of the barriers and drivers that appear as important for environmental innovations in the construction industry in Norway and to try to get a deeper understand of the barriers and drivers and how they appear in real life. By looking closer at how they work as barriers and drivers to environmental innovations it will also open the possibility to look at the relation to the circular economy and the desired transition. Since the thesis will use a big consultancy company and relevant actors from their network in the construction industry to get a deeper insight about the industry, the thesis will also be interesting in look closer at the consultancy company and their possible contribution to this transition. The answers to the research questions will hopefully be helpful for the company and the construction industry in Norway when it comes to working with environmental innovations and the transition to a more circular economy and to help Norway become a low-emission society by 2050.

1.3 Delimitation

The construction industry is quite big and complex, so to delineate the thesis, I have chosen to look closer at the construction industry in Norway. To investigate environmental innovation in the construction industry in Norway I will use data from the Community innovation survey (CIS)[1] from 2018-2020 collected by Statistic Norway and conduct statistical analysis for answering the first research question. After looking at the statistics on a national level, I will delineate the thesis further by looking at a company that works directly with consulting and planning for the building and construction industry on selected projects in Norway, called COWI. They are relevant to investigate in this thesis because they often contribute in the process when it comes to setting the premises for the construction projects they work with, and when it comes to questions about sustainability, it's a part of their role to give advice to the projects to send them in the right direction (COWI, 2021, pp. 15, 21). By using COWI as a case, it will allow me to investigate drivers and barriers that appear as important

[1] See more information about the CIS here: https://www.ssb.no/teknologi-og-innovasjon/forskning-og-innovasjon-i-naeringslivet/statistikk/innovasjon-i-naeringslivet
And how it is collected here: https://www.ssb.no/innrapportering/innovasjon-i-naringslivet

to environmental innovation in more depth in the construction industry. COWI will therefore be further introduced later in the thesis under the qualitative method. This master thesis is an independent research project at Høgskolen I Innlandet, and COWI is only used as a case for the chosen topic. Permission to use the company as a case and their name in the thesis has been given from my contact person in COWI.

1.4 Clarifications

This thesis is and individual research project that is written alone by me as a master candidate, but the qualitative data collection from the interviews were done in collaboration with another student that wrote about the same company and a similar topic. We have only collected the empirical material together, but the rest of the thesis, i.e., analysis, interpretation, discussion and conclusion is done individually. Since we have the same data material, it could lead to similarities appearing that were not planned but seen as a natural consequence of the data material being the same. Se the bibliography for the other students (Refseth, 2023) master thesis.

1.5 The structure of the thesis

Chapter 1 in this thesis gives an introduction and a background of the current situation about the construction industry and the research question, the delimitation of the thesis, some clarifications and an overview of the thesis and its chapters. Chapter 2 looks at Norway and the current context to explain more about the circular economy and the construction industry in Norway. Chapter 3 introduces the theoretical framework by looking at, sustainable development, sustainable business models, the circular economy, innovation and environmental innovations, and possible barriers and drivers of environmental innovation. Chapter 4 looks at the different methods that are used to collect and analyze the empirical material for this thesis and the specific case that is chosen in this thesis. Chapter 5 presents the results and analysis of the qualitative and quantitative method and integrates these too, before chapter 6 discuss the different results in relation to the theory. Chapter 7 will then try to summarize the theory and the results from the analysis in a final conclusion.

2.0 Context in Norway: Circular Economy – The construction industry

This chapter will give a short introduction of the context the construction industry is working under inn Norway and the status of the situation for the circular economy. With the goal of becoming a low emission society and a role model for others, Norway has to implement a lot of changes to keep up with the EU and the Green deal (Klima- og miljødepartementet, 2021, pp. 6–8). In Norway, only 2.4 % of the materials consumed are recycled, meaning that more than 97% is not salvaged for future use (De Wit et al., 2020, p. 6). This is also referred to as the Circularity Gap. Norwegian citizens have one

of the highest consumption rates in the world, and therefore needs to reduce it's material footprint. Recycling and reusing are only used/adopted to a small extend in the construction industry, even dough the industry is known for creating waste in large quantities (De Wit et al., 2020, p. 6). According to De Wit et al., (2020) two of the areas that have a potential in reducing the material footprint through the circular economy is, infrastructure and housing (De Wit et al., 2020, pp. 6–7).

The government especially focuses on the fact that creating sustainable products is essential to a Circular Economy (Klima- og miljødepartementet, 2021, p. 29). The construction industry is also one of the industries where the circular economy is mentioned to have a great potential in creating value (Klima- og miljødepartementet, 2021, p. 8), and in this industry especially buildings and the building materials that is used is of particular focus (Klima- og miljødepartementet, 2021, p. 52). Digitalization is seen as important since it will make the product information more available, a process that is seen as essential for secondary raw materials and the reuse of these (Klima- og miljødepartementet, 2021, p. 10). The lifecycle of a product and the missing information about this, is one of the areas that is mentioned as a challenge in the circular economy (Klima- og miljødepartementet, 2021, p. 25).

The EU also affects Norway, and the European Green deal is seen as important to make sure that the nature and the people are not harmed in any way and follow up on the United Nations sustainability goals (Klima- og miljødepartementet, 2021, pp. 16–17). Creating markets where you can sell and by used goods is also a part of the plan for the EU (Klima- og miljødepartementet, 2021, p. 53). Tuesday 14th of March 2023, OMBYGG circular resource center also opened as the first market for used construction materials in Norway (Resirqel AS, 2023). The European Green Deal also includes the EU taxonomy and the path to a green change through private investments in the EU (Miljødirektoratet, 2022). "The EU taxonomy is a classification system, establishing a list of environmentally sustainable economic activities" (European Comission, n.d. What is the EU taxonomy?). The EU taxonomy is supposed to create a common system of what is environmentally sustainable, so that it's easier to evaluate what a sustainable investments is through different conditions and regulations that have to be meet by the companies (European Comission, n.d.).

The construction industry in Norway also need to follow different regulations (Direktoratet for byggkvalitet, 2013). According to the Directorate for building quality (Direktoratet for byggkvalitet, 2013) some of the regulations they mention that are important in Norway and their translation of them are: "The planning and building act ("Plan-og bygningsloven")", "Regulations on technical requirement for construction works ("Byggteknisk forskrift - tek17")", "Regulations relating to building applications ("byggesaksforskriften – sak10")" and "Regulations on technical requirement for building works ("byggteknisk forskrift – tek10")" (Direktoratet for byggkvalitet, 2013). As mentioned here, a law that

says something about the rules that apply when it comes to the planning of projects and construction cases in Norway is The planning and building act (Plan og bygningsloven, 2008). This law states that «Loven skal fremme bærekraftig utvikling til beste for den enkelte, samfunnet og framtidige generasjoner»(Plan og bygningsloven, 2008, §1-1). This can be interpreted as meaning that you must think about the future and that the development has to be sustainable.

3.0 Theory

This chapter will present the theoretical framework for the thesis. The theoretical framework will start by defining sustainable development and sustainable business models before it moves on to explain the circular economy and the circular strategies that are seen as possible solutions for this industry to become more sustainable. The section on circularity and circular strategies will also focus on explaining how innovation and more specifically how environmental innovation can be seen as an important mean for becoming more circular. Which lead to the next theory section addressing innovation and environmental innovations. The chapter will finish with presenting possible barriers and drivers to environmental innovation in the construction industry and the hypothesis that are developed, before it moves on the next chapter and explain the case and the methodology that is used to collect data in this thesis.

3.1 Sustainable development and sustainable business models

To understand how the Construction industry can become more sustainable, we will first look at the term sustainable development. Sustainable development was explained by the Worlds commission on environment and development in 1987 as "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN. Secretary-General & World Commission on Environment and development, 1987, p. 54). A lot has happened since that time, and today sustainability is well known and included in most companies strategies (Jørgensen & Pedersen, 2018, p. 4). According to Jørgensen and Pedersen (2018) three-dimensionality is important in becoming sustainable and the three areas are; environmental, social and financial (Jørgensen & Pedersen, 2018, p. 153).

Already In 1995, Spence and mulligan (1995) wrote a paper on sustainable development and the construction industry, and how resource intensive the industry is. Spence and Mulligan (1995) address that the industry needed to change and find new ways that were more sustainable. This included e.g using less materials, and energy and finding materials that had a lower negative impact. For the construction industry to change, regulations and the actions from the government were also seen as important (Spence & Mulligan, 1995, pp. 287–289). Li et al., (2022 Section 5.2) writes about the

Chinese construction industry, and mention that green innovation is seen as a solution to help reduce the emissions in the industry. In a study by Nykamp (2017) about the construction industry and green buildings in Norway, the changes in the market and the regulative, along with innovation in niches and the exchange between them were seen as important for the transition to sustainability. "Findings indicate that the transition moved forward through interplay between innovation in niches, a growing constituency among green building and a string of regulative and market changes"(Nykamp, 2017, p. 83).

For companies to be more sustainable, they have to change their business models as mentioned by Jørgensen and Pedersen (2018, p. xiii). "To become more sustainable, companies need to go from traditional linear business models based on `Take, make and dispose' to circular business models, based on reuse, resource efficiency, the sharing economy and closed loops"(Jørgensen & Pedersen, 2018, p. 103). The focus is on becoming more circular, through the way companies handle resources and products and the reuse of these (Jørgensen & Pedersen, 2018, p. 106). When taking about business models, Osterwalder et al.,(2005) defines a business model as:

> "A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams" (Osterwalder et al., 2005, p. 10).

So, a business models says something about the firms logic and what value they offer, how they create it, and how it is delivered (Osterwalder et al., 2005, p. 10). According to Osterwalder et al., (2005) the main point of the business model is the business concept and to discover and form a way of doing business that has a good prospect for the company (Osterwalder et al., 2005, p. 8). In this case, it would imply to find a business concept for the construction industry and the consulting companies that are more promising than what they are doing today. When working with projects, the accomplishment has often been defined by budget, time and certain elements, also called the triple constraints, but this is starting to be out dated (Shenhar & Dvir, 2007, p. 22). "In a dynamic world of business-related projects, however, abiding by the triple-constraint is no longer sufficient and a new model is needed"(Shenhar & Dvir, 2007, p. 22).

This is also seen by Geissdoerfer et al.,(2018, p. 410) which point out that sustainable business models are going to take over because business models that are not sustainable are going to be out of date.

One way to defined sustainable business model is as “A business model that incorporates pro-active multi-stakeholder management, the creation of monetary and non-monetary value for a broad range of stakeholders, and which holds a long-term perspective” (Geissdoerfer et al., 2018, p. 409). It’s about creating something with a long-term perspective that includes many different stakeholders (Geissdoerfer et al., 2018, p. 409). When talking about sustainable business model innovation it can be explained like, “Sustainable business model innovation is understood as the adoption of the business model to overcome barriers within the company and its environment to market sustainable process, product, or service innovations” (Boons & Lûdeke-Freund, 2013, Stated in; Geissdoerfer et al., 2018, p. 407). This definition, show that it’s about changes in the business model, and how you can make it more sustainable through innovations. According to Jørgensen and Pedersen (2018, pp. 18–19) one way for companies to be more sustainable is to follow their RESTART framework for a sustainable business model innovation. In this model alliances are seen as important for companies to become sustainable because the problem is to huge to handle on you own, and you need collaboration across the different companies that require business models that are more open to see the whole picture (Jørgensen & Pedersen, 2018, p. 121). Since the construction industry is recommended to become more circular the thesis will look at possible circular strategies and models.

3.2 Circular Economy and Circular models

The Circular Economy has gotten a lot of attention the last years, and the Ellen Macarthur Foundation is highly recognized and often cited as a source to explain this phenomenon (see, Bocken et al., 2016; Eberhardt et al., 2022; Guerra et al., 2021; Wuni, 2022). The Ellen MacArthur Foundation (2015) defines Circular Economy like this, “A Circular Economy is one that is regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles ”(Ellen Macarthur Foundation, 2015, p. 2). The Circular Economy is a new economic model, with a goal to change the resource consumption and the current global economic development (Ellen Macarthur Foundation, 2015, pp. 2–3). One important part of this strategy is to eliminate pollution and waste (Ellen Macarthur Foundation, n.d.-b) It’s about becoming circular and going away from the linear take, make and waste system, to a system where the used materials find their way back to the economy at the end (Ellen Macarthur Foundation, n.d.-b), and try to attain the highest value of the product and the material so that they stay in the circular economy and not ends up as waste(Ellen Macarthur Foundation, n.d.-a). This is illustrated by the technical cycle and the biological cycle which say something about the possible pathway of the product or material in the Circular Economy(Ellen Macarthur Foundation, n.d.-a). “In the technical cycle products are reused, repaired, remanufacture and recycle. In the biological cycle, biodegradable

materials are returned to the earth through processes like composting and anaerobic digestion“(Ellen Macarthur Foundation, n.d.-a).

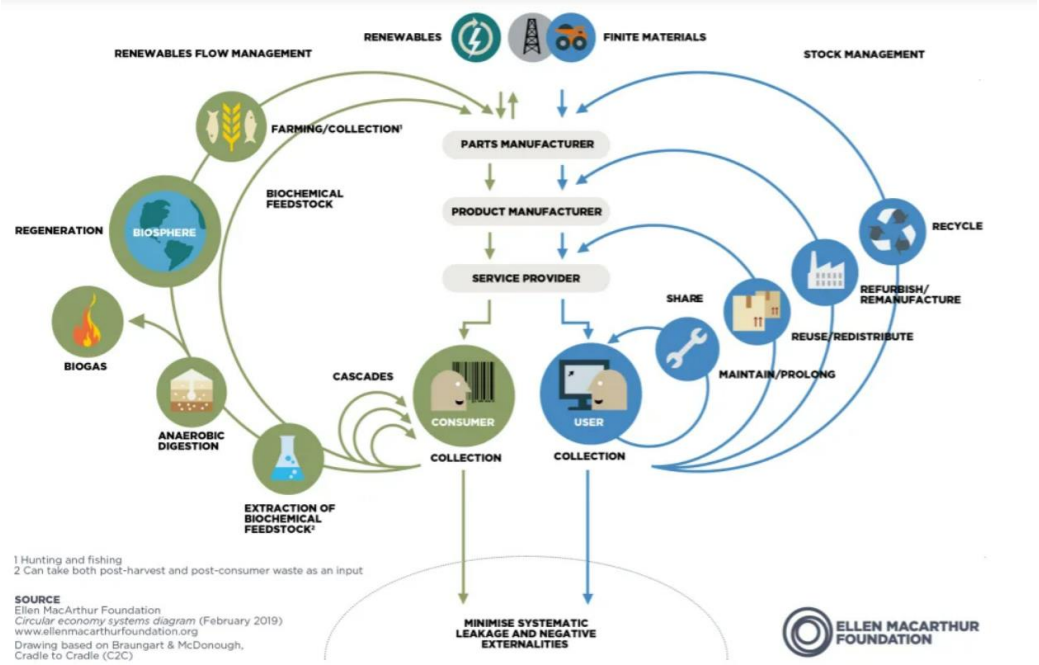

Figure 1"The butterfly diagram"(Ellen Macarthur Foundation, n.d.-d)

Another goal in the circular economy is restoring the nature without extracting more raw materials, and instead helping it to grow (Ellen Macarthur Foundation, n.d.-c). In a study by De Jesus and Mendonca(2018) they define circular economy based on the existing literature as:

> “Drawing on existing literature, the CE can, therefore, be defined as a multidimensional, dynamic, integrative approach, promoting a reformed socio-technical template for carrying out economic development, in an environmentally sustainable way, by re-matching, re-balancing and re-wiring industrial processes and consumption habits into a new usage-production closed-loop system” (de Jesus & Mendonça, 2018, p. 76).

The statement above, show that the circular economy needs new processes and consumption habits that are environmentally sustainable. In the circular economy there are three resource cycles that are seen as essential, and these are closing, slowing and narrowing (Bocken et al., 2016, p. 309). Building on others, Bocken et al., (2016, p. 309) suggest that one solution is slowing resource loops. This methods goal is that the resources stay in the product for a longer time period through having a design with a focus on remanufacturing or through repairing, that leads to a longer utilization period. The second suggestion is what is called closing resource loops, and this method focuses on recycling, and the fact that the resources stay in the cycle and do not leave it. The third suggestion is what they call

narrowing resource flows, which simply means that for every product you produce you use less resources (Bocken et al., 2016, p. 309).

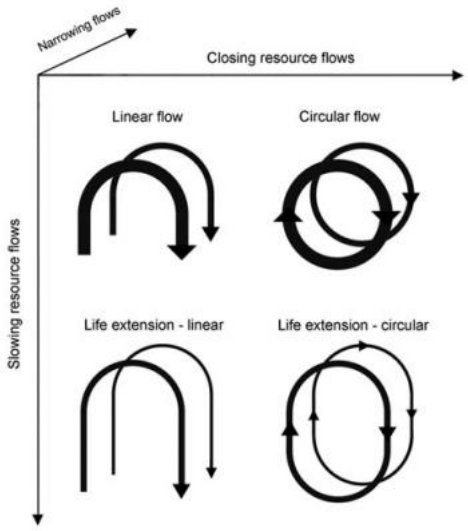

Figure 2"Categorization of Linear and Circular approches for reducing resource use"(Bocken et al., 2016, p. 309)

An important part of becoming more circular is to look at the design phase of the products. It is important to start from the beginning, because when the product is finished its hard to change it (Bocken et al., 2016, p. 310). Bocken et al.,(2016, p. 312) also writes this about the circular economy model:

> "The move to a Circular Economy model is an example of a radical change, which will require a new way of thinking and doing business. The more radical the technical or product innovation, the more challenging and the greater the likelihood that changes are required to the traditional business model" (Lofthus et al, 2017, referenced in; Bocken et al., 2016, p. 312).

So, based on this it seems that for companies to become more circular, radical product innovation is needed.

3.2.1 Barriers and drivers to the Circular Economy

According to Yu et al., (2022) and their recent study on information and communication Technologies (ICT) in the construction industry, they found that ICT support tools are verry important for the transition to the circular economy. Yu et al., (2022, p. 3) looks at 7 different technical solution, and one of them is building information modelling (BIM). Building information modelling is a new technology that can reduce waste and resource consumption in construction through making the design as good as possible, and is therefore seen as an important part of the transition to a circular economy. The model gives you information about the material and its life cycle and makes room for a new space to

discuss and collaborate on this information (Yu et al., 2022, p. 4). In their study Yu et al.,(2022) finds that “The ICT-based decision support tools are vital to successful CE implementation in the construction industry, because they provide robust information management facilitating circular construction and demolition practices (Yu et al., 2022, p. 13).

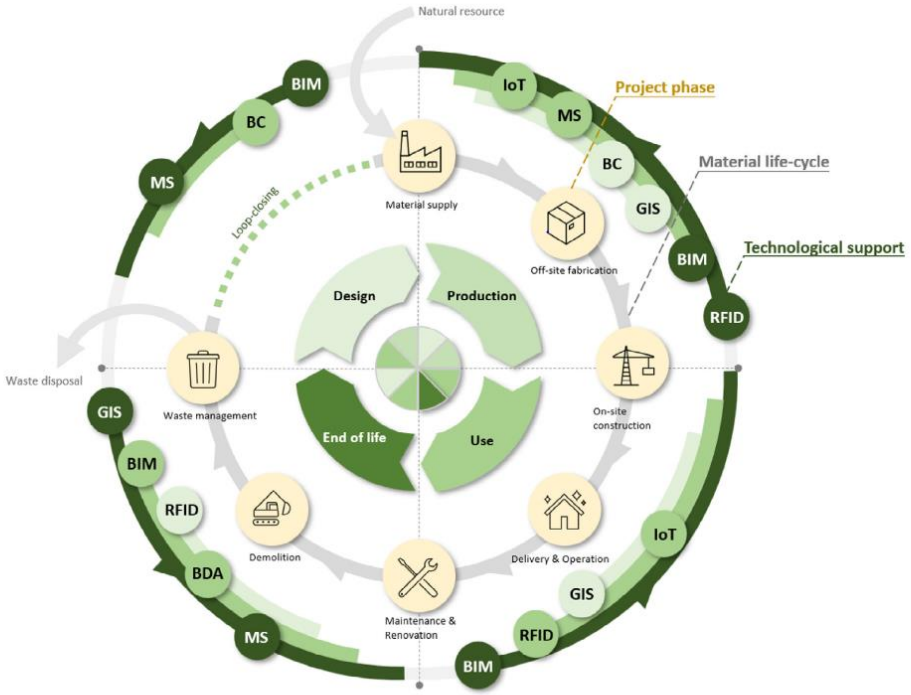

Fig. 4. Aligning ICT-based solutions with construction life-cycle phases towards CE in a three-orbit system covering technological support, material life-cycle, and project phase (Legend: BIM — Building Information Modelling, GIS — Geographic Information Systems, RFID — Radio Frequency Identification, BDA — Big Data Analytic, IoT — Internet of Things, BC — Blockchain, MS — Modelling & Simulation).

Figure 3"fig 4. Aligning ICT-based solutions with construction life-cycle phases towards CE […]"(Yu et al., 2022, p. 9)

As shown in the figure 4, the ICT-based solution can help the construction industry and the materials through their life Cycle. Eco-friendly products are also mentioned in relation to the Circular economy (Ellen macharthur foundation, 2017, Smol et al., 2015; referenced in; Norouzi et al., 2021, p. 2):

> “The construction sector has been known as one of the three sectors with high potential to implement CE strategies [37] particularly through the adoption of eco-friendly products and technologies [38]” (Ellen Macarthur foundation, 2017; Smol et al., 2015; referenced in; Norouzi et al., 2021, p. 2).

So, eco-friendly products can be seen as an important part of this transformations. As mentioned under 3.2 the products are an important part of the transformation to a more circular economy. According to Wuni’s (2022, p. 12) study, the suppliers don’t have the awareness of what is needed to provide this. In the industry, the supply chain and its complexity is seen as one of the critical barriers, along with too few proper partners in the supply chain and collaboration between them among other things (Wuni, 2022, p. 9). Finding circular materials and products is seen as a barrier because of

inadequate suppliers (Giorgi et al., 2022; referenced inn; Wuni, 2022, p. 9). The interest in barriers in the construction industry increased according to Wuni (2022, p. 12) during 2018-2022 and the once that were cited highest are, "(i) Higher upfront investment costs; (ii) Lack of CE knowledge, technical capabilities, and expertise in construction; (iii) Lack of regulatory framework, appropriate policies, and sound legislations for CE in construction; (iv) Limited stakeholder awareness for circular, materials, products, services, and strategies; (v) Lack of government financial support mechanism and tax incentives for circular business models" (Wuni, 2022, p. 12). A Knowledge barrier can be defined as "… skills gaps and knowledge deficits inhibiting CE adoption in the construction industry" (Wuni, 2022, p. 7). Examples of this could be too little knowledge about the Circular Economy, to little expertise or not enough knowledge about circular materials among the stakeholders (Wuni, 2022, p. 7).

The circular economy is as mentioned under 3.2 about reducing waste and creating products that can stay in a circular loop and possibly restore the nature. Some of these things seems to require new innovations that are focused on reducing the environmental impact through creating sustainable materials or sustainable solutions. Environmental innovation is seen as innovations that can reduce environmental harm (Oltra & Saint Jean, 2009; schiederig et al., 2012; referenced in; Karttunen et al., 2021, p. 2). In a study by De Jesus and Mendonca (2018) they also look at eco innovation in relation to the circular economy and writes "EI is understood as a systemic problem-solving tool for enabling a holistic and transformative departure from the current unsustainable state-of-play" (de Jesus & Mendonça, 2018, p. 77). This thesis also tries to look at environmental innovation in the construction industry as a mean on the path to a more circular economy. The thesis will therefor move over to the next section to look closer at innovation and specifically environmental innovations.

3.3 Innovation and Environmental innovation

Innovation is an important part of this thesis. The Oslo Manual is a tool that is often used to define innovation since it gives a standard of how you can measure innovation through different guidelines (OECD & Eurostat, 2018, p. 19). According to the Oslo manual (OECD & Eurostat, 2018), Innovation is generally defined as, " […] a new or improved product or process(or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users(product) or brough into use by the unit (process)"(OECD & Eurostat, 2018, p. 20). Since this thesis uses the Community innovation survey data, which is based on the Oslo manual, this definition represents how innovation is understood in this thesis.

Innovations can be divided in four different categories and these are, incremental, modular, architectural and radical innovations (Henderson & Clark, 1990, pp. 11–12). The two outer points are incremental and radical innovations. Incremental innovations, simply means that the innovation is

based on a design and core concepts that already exists, but radical innovation on the other hand, is an innovation that is based on new concepts and a new design (Henderson & Clark, 1990, p. 11). Se Henderson and Clark's (1990, p. 12) framework for defining innovation under.

Figure 1. A framework for defining innovation.

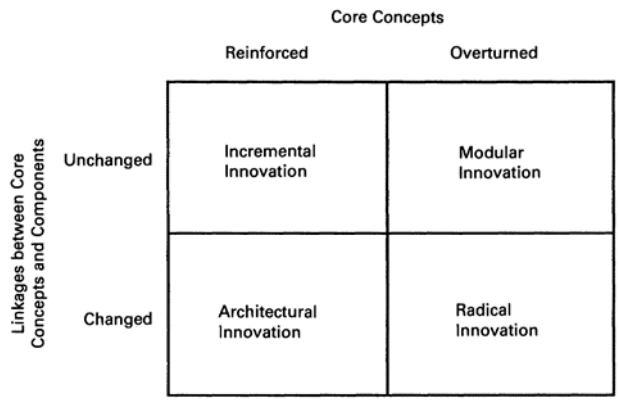

Figure 4"Figure 1. A framework for defining innovation"(Henderson & Clark, 1990, p. 12)

In the construction industry, a new way of handling resource, through reduced energy use or new ways to handle renewable recourses and recycled materials can be seen as radical innovations (Duong et al., 2021, p. 399). These radical innovations can have risks that are biger, compared to incremental innovations (Duong et al., 2021, p. 411). Duong et al., (2021) found that companies in construction can profit from incremental environmental innovations when they chose partners and work on small improvements, because they have smaller risk, and therefor might be seen as a better option (Duong et al., 2021, p. 411). Risk, is often included as a part of innovations (Aasen & Amundsen, 2011, p. 66), because the final costs are always uncertain, and you don't know how the final results will be received (Pavitt, 2005, References in; Aasen & Amundsen, 2011, p. 97).

When working with innovations, knowledge is seen as an essential factor (Aasen & Amundsen, 2011, p. 18). According to Jensen et al., (2007, p. 680) there are especially two different approaches to how you can acquire the knowledge needed to produce innovations, and they are based on different types of learning. One approach can be seen as "The production and use of codified scientific and technical knowledge, the Science, Technology and Innovation (STI) mode"(Jensen et al., 2007, p. 680), and the other approach is explained as "[…] an experienced-based mode of learning based on Doing, using and interacting (DUI-mode)"(Jensen et al., 2007, p. 680). So, its divided between knowledge from Science, and knowledge from experience (Jensen et al., 2007, p. 680). The theory also show that those who manage to use both these types of learnings often get a better result (Jensen et al., 2007, p. 689). Jensen et al., (2007) writes, "And most important, they support the view that firms adopting mixed

strategies combining the two modes tend to perform significantly better than those relying predominantly on one mode or the other" (Jensen et al., 2007, p. 689).

The growing complexity in today's society lead to a strong need for collaboration across organizations, countries, and disciplines to solve the major changes (Aasen & Amundsen, 2011, p. 139). So, collaboration is seen as an important part of this knowledge sharing that need to take place to create innovation (Aasen & Amundsen, 2011, pp. 140–141). When you put people from different professional backgrounds together, that combination of knowledge can produce new innovation (Aasen & Amundsen, 2011, p. 141). This Knowledge flow between organizations or people, can also be seen as open innovation (Chesbrough, 2006, Refferd to in: Aasen & Amundsen, 2011, p. 141). The customers are also important in this process, because without someone that are willing to buy the product, the company will not survive (Aasen & Amundsen, 2011, p. 139).

3.3.1 Environmental innovations

There are many similar words that are used when talking about innovations with environmental benefits and these are, environmental innovations, green innovation, sustainable innovations, and ecological innovations (eco-innovation) (Schiederig et al., 2012, pp. 181–182). According to a study by Schiederig et al., (2012) they found that they can be used interchangeably since they mainly explore the same matter, but with some small changes. Sustainable innovation, includes a social aspect and therefor differs a little bit more from the others (Schiederig et al., 2012, pp. 188–189). In the introduction, Oltra and Saint Jean's definition was mentioned, but another possible definition of Environmental innovation that is a little broader is mentioned in Karttunen (2021) is:

> "[…] Innovations that include new or modified processes, practices, systems and products that reduce the negative impact on the environment when compared to alternatives, and enhance environmental sustainability by responding to customer needs"(oltra and saint jean, 2009; Schiederig et al., 2012; referenced inn; Karttunen et al., 2021, p. 2)

Eco-innovation on the other hand can be defined as:

> "the creation or implementation of new, or significantly improved, products (goods and services), processes, marketing methods, organizational structures and institutional arrangements which – with or without intent – lead to environmental improvements compared to relevant alternatives" (OECD, 2009; stated in; Schiederig et al., 2012, p. 181)

Statistics Norway also defines innovations with environmental benefits in their CIS survey, and they call it "Green innovation" (See appendix 9.5). "An innovation has an environmental benefit if it has a

positive - or less negative - effect on the environment in relation to the companies' previous products and processes, or in relation to other products that already are available on the market" (See appendix 9.5 Innovasjoner med miljøfordeler, Own translation). This definition is similar to the once mentioned above and since it's a part of the CIS that is used in this thesis, it will also be included in this thesis when talking about environmental innovations. In this thesis I am interested in all the innovations that have environmental benefits and will therefore not focus on the small differences, but more on the barriers and drivers to all innovations with environmental benefits and how they are all relevant in the production of solutions that can be relevant for the move to a more circular economy.

According to Rennings (2000) companies had already started to work with finding environmental solutions through innovations or the implementation of other processes back in 2000, and firms saw eco-innovation as a rising problem they had to deal with (Rennings, 2000, pp. 319–320). At this time there were according to Rennings (2000) little theoretical articles about what factors affected innovations that was directed at sustainability. So, he recommended creating a framework to determine factors that could be seen as drivers or determinants of innovations that are sustainable, and if these were different than from regular innovations (Rennings, 2000, p. 320).

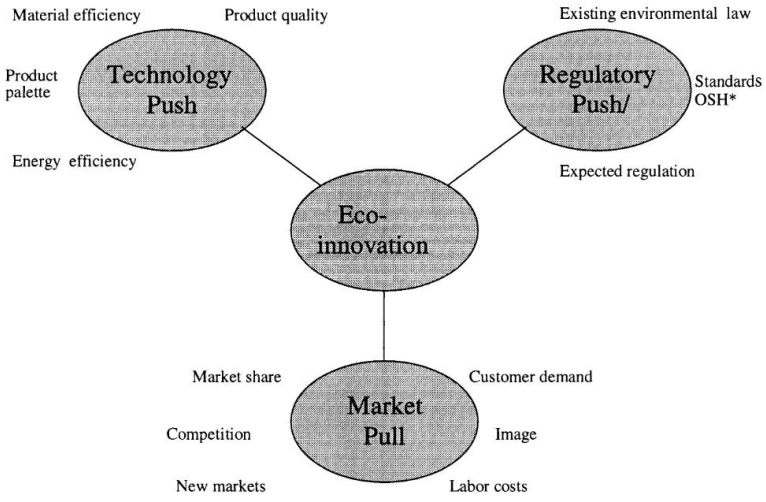

Fig. 2. Determinants of eco-innovations. *OSH = Occupational Safety and Health.

*Figure 5 "Fig. 2 Determinants of Eco-innovation. *OSH=occupational safety andn health"(Rennings, 2000, p. 326)*

As shown in figure 6 above there are three different categories that point to Eco-innovation; Technology push, Regulatory push and the Market pull. The technology push refers to eco-innovations that are new technologies seen as eco-efficient and are driven by the technological development, while market pull is products that are favorable for the environment and seen as a result of a demand factor from the market because of certain preferences. The regulatory push, also seen as the regulatory push/pull effect refers to the regulatory framework and its influence on eco-innovation (Rennings,

2000, p. 326). Aasen and Amundsen (2011) also mention technology push, and Market pull, but they also mentioned cost reduction and total quality management as important drivers of innovation through history (Aasen & Amundsen, 2011, pp. 32–35). Meng and Brown (2018, p. 1221) also looked at market-pull and technology-push in construction and innovation and writes that the technology push has a lower effect on construction innovation than what market-pull does.

Cainelli et al., (2015, p. 212) points out that environmental innovations is seen as more uncertain, since it often operates with novelty of a more advanced level. Environmental innovation is often not focused on here and know, but rather on the long term when it comes to the profit, and its seen to have more risk (Ahuja et al., 2008; Berrone et al., 2013; Reffered to in; Karttunen et al., 2021, p. 2). According to theory, getting a bigger market share is seen to have a positive effect when it comes to environmental product innovation, along with getting a better reputation (Rennings et al., 2006; Reffered to in; Karttunen et al., 2021, p. 3). Regulations, cost savings and the capabilities in a firm is also seen to lead to a higher investment in eco-innovation (Kesidou & Demirel, 2012). According to Kesidou and Demirel (2012) and their study on eco-innvovations in the UK, it shows that demand factors alone are not enough, and for eco-innovations to be adopted or made there has to be implemented certain environmental regulations that motivates this (Kesidou & Demirel, 2012, pp. 868–869).

3.4 Barriers of environmental innovation

Stucki (2019) looks closer at barriers for green product innovation, and he puts the barriers in three different types based on the earlier work by Rennings, the supply-side, the political factors and the demand-side (Stucki, 2019, p. 1245).

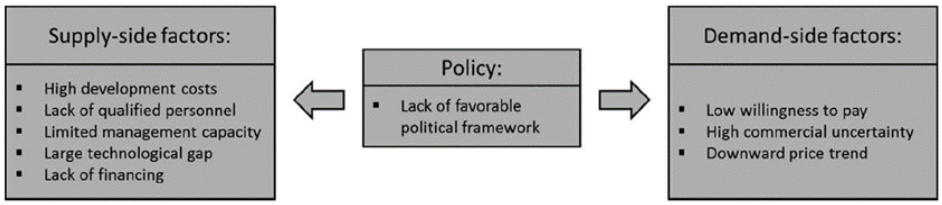

Figure 6 "Figure 1. Types of green innovation barriers"(Stucki, 2019, p. 1246)

According to Stucki (2019) when looking at Green technology innovation there are fore barriers that stand out, and these are high development costs, low willingness to pay, lack of favorable political framework, and high commercial uncertainty (Stucki, 2019, p. 1242). Green innovation are also affected by environmental policies, which means that a barrier to this type of innovation can be political barriers (Stucki, 2019, p. 1246). Financial barriers also seem to be important according to Ghisetti (2017, p. 131), and public funding is also mentioned by Souto and Rodriguez (2015, p. 55) as

important. Lack of qualified personnel is also mentioned as a potential barrier (Consoli et al., 2016, Stated in; Stucki, 2019).

3.4.1 Financial Barriers

Financial barriers is confirmed as a relevant factor for environmental innovations in a study by Ghisetti et al.,(2017, p. 131). They found that concerning environmental innovations, investment decisions are directly influenced by financial barriers, and especially the access to funding through external sources (Ghisetti et al., 2017, p. 142). "The presence of financial constraints and weak access to credit significantly reduce the likelihood of firm to innovate" (Savignac, 2008, referenced inn; Ghisetti et al., 2017, p. 133). According to Ghisetti et al., (2017, p. 133) this is also relevant for Environmental innovations. Liao and Liu (2021, p. 1852) also confirm that environmental innovation is effected by subsidies from the government in a positive way. Environmental innovation is also positively affected by Public funding (Souto & Rodriguez, 2015, p. 55), since it helps the innovation by removing some of the financial barriers (Falk, 2007; Souto, 2012, referred to in; Souto & Rodriguez, 2015, p. 55). To quote Ghisetti et al.,(2017) "Among the factors that contribute to explaining why financial institutions provide insufficient credit to EI, a relevant role is played by the institutional context, often characterized by regulations not focused on providing incentives to green innovation" (Ghisetti et al., 2017, p. 134). The theory above has led to the following hypothesis about financial barriers in the construction industry:

> hypothesis 1: Lack of public funding and innovation support is an important barrier to environmental innovations in the construction industry in Norway.

3.4.2 Uncertain demand

As you can see figure 6 above, high commercial uncertainty is mentioned by Stucki (2019, p. 1246) as a barrier to green innovation. Compared to general innovations, environmental innovations are also seen to have a greater uncertainty and technical risk (Ghisetti et al., 2017, p. 132). The profit of Environmental innovations is first achieved after a great time and they normally demand a high financial engagement, which makes them more uncertain (Berrone, Fosfuri, Gelabert, Gomes-Mejia, 2013, Referred to in; Ghisetti et al., 2017, p. 134). According to Aasen and Amundsen (2011, p. 139) the market and the customers are seen as essential, because the company depends on them. "Demand in the market affect firms' investment decisions in environmental innovation"(Horbach, 2008; kesidou and Demirel, 2012; referred to in; Karttunen et al., 2021, p. 3). Adjustments in lifestyles and consumers demands, also affect the companies and to keep up with the market dynamics and the new opportunities that are coming from the technology its important to innovate. (Bossle et al., 2016, p. 863) "The demand from public and private actors form the basis for a well-functioning market. If

demand exists, a market should emerge"(Grafström & Aasma, 2021, p. 10). In a study by Souto and Rodrigues (2015, p. 55) uncertain demand was also mentioned as one of the main obstacles to innovation. The above theory has led to the development of this hypothesis:

> Hypothesis 2: Uncertain demand for the company's innovation is an important barrier to environmental innovations in the construction industry in Norway.

3.4.3 lack of knowledge

Knowledge is seen as an important factor in the construction companies, especially since their projects often are quite complicated and has a lot of challenges (Marinho & Couto, 2022, p. 4). Lack of qualified personnel is mentioned as important when talking about green jobs, since its seems that they require a different set of credentials (Consoli et al., 2016; Reffered to in, Stucki, 2019, p. 1246). Human capital resources are also mentioned as important for innovations, and especially for environmental innovation to be accomplished, the employees and their knowledge are essential along with their attitudes (Kyaw et al., 2021; Wang et al., 2021a,b, Reffered to in; Kyaw, 2022, p. 2). The building information modeling (BIM) is also being used in a greater extend in construction, and a consequence of this is that knowledge management has a greater demand (Sing & Mi,zaeifar, 2020; stated in; Marinho & Couto, 2022, p. 1). Lack of capabilities on how to design for waste elimination is also mentioned as a barrier in the construction industry and the transition to a more circular economy (Khandelwal et al., 2020; reffered to in; Wuni, 2022, p. 7):

> "Yet, many construction organizations, project teams, and stakeholders do not have adequate knowledge, relevant capabilities, and technical know-how to transform traditional operations to circular practices (e.g., deign for waste elimination, value recovery operation) in the construction industry" (Khandelwal & Barua, 2020; reffered to in; Wuni, 2022, p. 7).

Stucki (2019, p. 1261) also found that knowledge were not seen ass a big barrier to green innovation in the countries he analyzed, but he (Stucki, 2019, p. 1254) also noted that the barriers to green innovation and their levels changed from country to country. According to a report about the construction industry from Ramirent (2023, p. 11) 14% seem to think that in the industry sustainability experts are missing. This makes it interesting to investigate this more closely to see how this is in the Norwegian construction industry. The following hypothesis is therefore developed based on the theory above.

> Hypothesis 3: Lack of qualified personnel is seen as an important barrier to environmental innovations in the construction industry in Norway.

3.5 Drivers of environmental innovation

Already in 1990, environmental innovation and its different drivers was a popular topic to study (Liao & Huang, 2017, Refferd to in; Liao & Liu, 2021, p. 1853). According to Liao and Liu (2021) and their study on what drives environmental innovation, they look at especially four factors that are perceived as relevant, and these four are, the market, Policy, organizational characteristics, and resource capacity (Liao & Liu, 2021, p. 1853). Liao and Liu (2021, p. 1861) found that for environmental innovation, the government subsidies and regulations on the environment are seen to have a positive reaction. Their study also points out that for environmental innovation, knowledge sources, Environmental management systems, organizational performances and technological capabilities all seem to have an effect in a good way (Liao & Liu, 2021, p. 1852). Collaboration is also seen as important for environmental innovation (Souto & Rodriguez, 2015, p. 56). According to Horbach (2008, p. 163) Research and development is also seen as an important driver. Another factor that is mentioned as important is the source of knowledge (Horbach et al., 2013, p. 523).

3.5.1 Collaboration

The construction industry is seen as a complex industry, with many different projects (Lindblad & Guerrero, 2020, p. 468). In a study by Lindblad and Guerrero (2020, p. 468) client's in construction are seen as a very important drivers of innovation, but the role they are supposed to have is imprecise. According to Ozorhon et al., (2014) collaboration is an important factor in the construction industry for the innovation process and the innovation activities, and it is affected by the project participants and their strength of relation (Ozorhon et al., 2014, p. 262). Cooperation is also highlighted by many different studies in Yarahmadi and Higgins (2012, p. 401) as a booster of environmental innovations. External partners are seen as especially relevant to companies that work with environmental innovations (De Marchi, 2012, p. 614). Cainelli et al.,(2015) also found that cooperation were seen to increase the innovation effort for green innovators to a higher degree than people who work with regular innovation, making external resources an important part of environmental innovation (Cainelli et al., 2015, pp. 215–216). According to De Marchi (2012, p. 615) environmental innovations are dependent on cooperation, since they are seen as more complex, than other innovations. "The more types of partners a firm coopearates with, the more likely it is to effectively develop a new product or process with eco-friendly features"(Cainelli et al., 2015, p. 217). In a study by Souto and Rodriguez (2015, p. 56), they also found that cooperation were relevant to environmental innovations. Zubeltzu-jaka et al., (2018) found in their studies that eco-innovation gets a higher engagement from companies, when universities, public agencies and research institutes are in a network of collaboration with them. (Zubeltzu-Jaka et al., 2018, p. 1100). Internal resources are also said to have a higher influence on

environmental innovations and intensive external relationships are noted as relevant for green innovators (Cainelli et al., 2015, p. 218). On the bases of this the following hypothesis was developed:

> Hypothesis 4: Collaboration about innovation activities is an important driver for environmental innovation in the construction industry in Norway

3.5.2 Research and development

According to Aasen and Amundsen (2011, pp. 58–59) research and development is seen as essential in creating new knowledge and technology as a source to innovations. Horbach (2008) also writes that "[…] the improvement of the technological capabilities (knowledge capital) by R&D triggers environmental innovation"(Horbach, 2008, p. 163). This is also confirmed by Cainelli et al., (2015, p. 218) who also did a study on environmental innovation and found that R&D is important. An important factor to consider when talking about environmental innovation is whether the knowledge is created internally, or externally (Cainelli et al., 2015, p. 212). Internal resources can be seen as a firms internal R&D or training processes (E.g gupta et al., 1993; Laursen & Foss, 2003; Reffered to in; Cainelli et al., 2015, p. 212), and external sources can be seen as resources acquired through networks, and different alliances and relations across organizations (Das and teng, 2000; Ireland et al., 2002; Lavie, 2006; Refferd to in; Cainelli et al., 2015, p. 212). According to Cainelli et al, (2015, p. 211) and their study on spanish manufacturing firms, environmental innovations are seen to be positively effected by the internal R&D capacity. In a study by Dimakopoulou et al.,(2022) they found that in relation to eco-innovation, collaboration about R&D does not seem to have a positive effect, like what others have suggested earlier. This was also confirmed by other studies, because the companies are scared of others imitating them and the need to preserve their technologies (de Paulo et al., 2020, Refferd to in; Dimakopoulou et al., 2022, p. Section 5.1). Since R&D is seen as relevant for creating new knowledge, but collaboration about it is not, its interesting to test if self-executed R&D in the construction industry has a positive effect on environmental innovations in the construction industry. The following hypothesis is therefore developed.

> Hypothesis 5: Self-executed R&D performed in the companies in the construction industry is an important driver for environmental innovation.

3.5.3 Source of knowledge

In theory, knowledge is seen as an important driver of innovation (Aasen & Amundsen, 2011, p. 18). "Knowledge is considered to be at the basis of innovation activities which consequently depend on the capacity of firms to develop and acquire new knowledge" (Horbach et al., 2013, p. 528). So, knowledge is seen as an important part of innovation activities according to Horbach et al., (2013, p. 528). As

shown in theory, knowledge can come from internal sources or external sources (Bossle et al., 2016, pp. 866–867). Horbach et al., (2013) study also looks at the knowledge base of environmental innovations, as they believe there is a knowledge gap when it comes to eco-innovations and their main source of information. Through their study, they found that consultants, conferences and universities had a bigger affect for eco-innovations in France as a sources of information, compared to other innovations (Horbach et al., 2013, pp. 534–536). The study also show that France and Germany emphasize the sources of information differently, and that especially public sources, and external sources are seen as more important for Germany (Horbach et al., 2013, p. 536). It is therefore interesting to see if external sources of information like professional conferences is seen as an important driver to environmental innovations in the construction industry in Norway. The following hypothesis is therefore developed:

> Hypothesis 6: External sources of knowledge like professional Conferences is an important driver of environmental innovations in the construction industry in Norway

To sum up the theory section, the six hypotheses presented here will be tested in the quantitative data by looking at the CIS from statistics Norway, to see which barriers and drivers appear as important for environmental innovations in the construction industry in Norway. The theoretical framework mentioned in chapter 3.0 also lays the foundation for the qualitative analysis.

4.0 Method - Mixed Method

To understand how the data material for this thesis is collected and analyzed, this chapter will look at the research method that is used and describe the process in more detail. The chapter will also look at ethical issues concerning the collection of the data, and the evaluation of the research by looking at validity, replicability, and reliability.

This thesis will use what is called a mixed method research. According to Clark et al., (2021, p. 556) this is a research strategy, where you use qualitative and quantitative methods together. “Mostly, the idea is that the different methods complement one another, as the strengths of qualitative methods are brought together with the strengths of quantitative methods”(Clark et al., 2021, p. 556). This can probably also lead to extra value for the research, and its lets you cross-check the results from the different methods (Clark et al., 2021, p. 556). There are many ways that mixed methods are seen to gain value, and some of them are through more explanations or greater validity (Bryman, 2006a, Stated in; Clark et al., 2021, p. 557). When using mixed methods it’s important to explain the added value of using more than one method and the relationship between the research questions and what the purpose of having multiple questions are (Clark et al., 2021, pp. 571–572). Two of the research

questions in this thesis are purposely designed to complement each other, so that you can gain a greater understanding of the topic than what you would have done with just one method. “Mixed method research must be appropriate to and thoroughly integrated with, the research questions” (Clark et al., 2021, p. 572). The first research question looks at defining barriers and drivers that appear as important for the construction industry in Norway when it comes to environmental innovations, and the second research question intends to explore the topic in more depth to get a wider understanding of the barriers and drivers in the construction industry and also how they might be related to the transition to a circular economy.

Since the order of the research questions in this thesis is important, the thesis will use what is called an explanatory sequential design. The explanatory sequential design is explained by Clark et al.,(2021) as “The explanatory sequential design involves first collecting and analysing quantitative data, and then collecting and analysing qualitative data in order to elaborate or explain the quantitative findings” (Clark et al., 2021, pp. 568–569). This design is therefore used in this thesis to elaborate and expand on the results from the first quantitative analysis with relevant information from the interviews about barriers and drivers to environmental innovation from the qualitative analysis. The first method used in this thesis is therefore quantitative analysis of the community innovation survey, and the second method used is a qualitative method with interviews. The CIS[2] data that is used in this thesis is collected by statistic Norway, and not by me, se more information about the CIS under section 4.1.

4.1 Quantitative Method

The first method used in the thesis is a quantitative method. This method is used when you are interested in investigating something through numerical data, like through e.g. surveys to interpret the meaning of something (Clark et al., 2021, p. 142). This method is therefore chosen with the purpose of investigating a certain number of companies in the construction industry to find out which barriers/drivers appears as important to environmental innovations by looking at statistical numbers about innovation in Norwegian industries. The data that will be used in this part of the thesis, is from the Community innovation survey (CIS)[3] from 2018-2020 that Statistics Norway has collected. The CIS data is collected from different industries in Norway and its intention is to collect information about the different industries and their previous and current ability to innovate. The survey is sent out to about. 7000 companies each round (Statistisk Sentralbyrå, n.d.-a). The CIS used in this thesis is from 2018-2020 (See appendix 9.5).

[2]See information at https://www.ssb.no/innrapportering/innovasjon-i-naringslivet
[3]See Information about the CIS at Statistics Norway. See: https://www.ssb.no/teknologi-og-innovasjon/forskning-og-innovasjon-i-naeringslivet/statistikk/innovasjon-i-naeringslivet

4.1.1 Procedure/Approach

The purpose of this part of the thesis is as mentioned above to find out which barriers and drivers appear as important to environmental innovation in the construction industry in Norway. To do this, the thesis will test some of the hypothesis developed from the theory through logistic regression and continue the analysis to see how much they affect the development of innovations with environmental benefits through marginal effects and their percentage points. The different variables used to test the hypothesis will therefor first be defined, before the analysis continues with the logistic regression and the margins effect. The hypothesis mentioned in this master thesis is developed based on the theory presented in the thesis. This is also called a deductive approach, which means that the hypothesis is developed based on prior theory (Clark et al., 2021, pp. 19–20). The 6 different hypotheses are reproduced and shown in the table 1 under.

Table 1 Overview of hypothesis

hypothesis 1:	Lack of public funding and innovation support is an important barrier to environmental innovations in the construction industry in Norway.
hypothesis 2:	Uncertain demand for the company's innovation is an important barrier to environmental innovations in the construction industry in Norway.
hypothesis 3:	Lack of qualified personnel is an important barrier to environmental innovations in the construction industry in Norway.
hypothesis 4:	Collaboration about innovation activities is an important driver for environmental innovation in the construction industry in Norway
hypothesis 5:	Self-executed R&D is an important driver for environmental innovations in the construction industry in Norway.
hypothesis 6:	External sources of knowledge like professional conferences is an important driver of environmental innovations in the construction industry in Norway

The statistical analysis in this thesis were carried out with the usage of STATA/MP version 16. To be able to conduct a quantitative study, you need to have well defined concepts that actually measures what you want it to measure, and indicators to help this process. The variables in the research are normally made from these concepts, and they can be either dependent or independent (Clark et al., 2021, pp. 150–151). It is important to explain how one intends to measure the content of the variable and how it is operationalized (Thrane, 2017, p. 43). Missing answers, or data also have to be handled and it's important to explained how they are treated (Clark et al., 2021, p. 320).

4.1.2 Dependent variable

One important concept/measure in this thesis is Environmental innovation. This is also the dependent variable that we are interested in investigating the effect on. To measure this effect, I have created the environmental innovation variable through the following process. The CIS[4] survey that is used in this thesis have a section with questions that are directed at innovations with environmental benefits, also called "Green innovation" (See appendix 9.5). The question used to create the variable is Question 20 in the CIS:

> "Did the company introduce innovations with any of the following environmental benefit during the period 2018-2020? If yes, was the contribution to the environment/effect of the environmental benefit significant or limited degree" (See appendix 9.5, Question 20, Own translation).

This question has 12 sub-questions/statement (See appendix 9,5 Question 20). Some of the sub-questions/statements under question 20 can be seen as relevant for the circular economy, like the reduction of emissions, reduced material, recycling, or extended product life like shown in chapter 3.2. The 12 sub-questions under question 20 in the CIS data have three possible answers that measure how significant the specific question was in relation to introducing the innovation with environmental benefits. The possible answers have categories that are "Yes, with significant effect", "Yes, with some effect" and "No" (See appendix 9.5 Question 20, Own translation). When the categories can be ranged by values in the variable, it's called an ordinal variable (Clark et al., 2021, s. 324). Since this thesis is interested in what barriers and drivers appear as important to implementing environmental innovations in total and not separately, the 12 sub-questions/statements under question 20 need to be combined to one variable.

Before this process was started, the variables were recoded so that their value went from low to high, and the missing answers/responses were added as 0 (0=no). The 12 sub-questions/statements whose content were related to environmental innovation was combined into one variable, and Cronbach's α test suggests that there is enough overlap between the questions to justify the integration (α = 0.90) (see appendix 9.3.2). Internal consistency can be measured through Cronbach's α, and is therefore used to measure the reliability of the new scale. α=0,7 is the minimum criteria for the Cronbach's α to

[4] To read more about the community innovation survey (CIS) and to see the questions used in this thesis you can go to: https://www.ssb.no/innrapportering/innovasjon-i-naringslivet , se appendix 9.5 in the thesis, or go directly to an example of the survey here: https://www.ssb.no/innrapportering/naeringsliv/_attachment/454325?_ts=17989e87ed0

be reliable (Ringdal & Wiborg, 2022, pp. 156–158). However, the new variable revealed a large presence of minimum values (minimum value = 0), and it was therefore deemed more appropriate to measure the variable as a binary variable. This thesis is as mentioned above, interested in looking at environmental innovation as a total, so the binary variable is in line with this. Binary variables or dummy variables are variables with only two values or categories. These categories are often Yes and NO and refer to weather something is present or not, and the value 1 represents yes, and 0 represents no (Thrane, 2017, pp. 35–36). The environmental innovation variable is therefore recoded to a binary variable where 1=yes for the companies that did introduce innovations with environmental benefits and 0=no for the companies that did not introduce innovations with environmental innovations.

4.1.3 Independent variables

The independent variables in this thesis are barriers and drivers of environmental innovation. To measure the barriers of innovation, the thesis used three of the sub-question/Statements under question 16 in the CIS survey (See appendix 9.5 Question 16). Question 16 is:

> "How important were the following factors in preventing or inhibiting the company's initiation of innovation activities or in preventing or inhibiting the implementation of ongoing innovation activities during the period of 2018-2020" (See appendix 9.5 Question 16. Own translation).

In the CIS data and question 16, the possible answers to the sub-questions are "Not so important", "A little important", "Quite important" and "Verry important" (See appendix 9.5 Question 16. Own translation). These options can be seen as on a Likert scale. A Likert scale consists of multiple answers or so-called statements, that can measure different attitudes or feelings towards the topic in the question. The possible answers are normally ranged from one point of view to another through different options (Clark et al., 2021, pp. 151–152). To measure lack of public funding (H1), the thesis uses sub-question/statement 3 under question 16 in the CIS. Sub-question/statement 3 is "Problems with obtaining public funding or innovation support" (See appendix 9.5 Question 16, Own translation). To measure H3 about lack of qualified personnel, the thesis uses sub-question/statement 5 under question 16 in the CIS. Sub-question/statement 5 is "Lack of qualified personnel in the company" (See appendix 9.5 Question 16, Own translation). The variable lack of public funding and lack of qualified personnel in the company that is used in this thesis are derived from the answers to these sub-questions/statements under question 16. The variable uncertain demand for the company's innovation ideas used to measure H2, is also derived from the same question, but with sub-question/statement 8. Sub-question/statement 8 is "uncertain demand for the company's innovation ideas" (See appendix 9.5 Question 16, Own translation). All the barriers in this thesis, are recoded to a

binary variable, where not important is recoded to 0, and the other three answers are recoded to 1, implying that it is important, or that is had some effect.

Collaboration about innovation activities is another one of the hypothesis the thesis is testing, and the variable is measured through question 15 and the sub-question/statement number two in the CIS data (See appendix 9.5 Question 15). Question 15 is:" Did the company collaborate with other companies or organizations during the period 2018-2020?" (See appendix 9.5 Question 15. Own translation). The CIS data defines collaboration in the survey, and this short definition is also used in this thesis. "Cooperation means active participation together with other enterprises or organizations" (See appendix 9.5. Section: Samarbeid med andre foretak eller organisasjoner, Own translation). To measure collaboration about innovation activities for H4 the thesis uses sub-question two under question 15 in the CIS. The second sub-question/statement to question 15 is "Collaboration about innovation activities, without R&D" (See appendix 9.5, Question 15, Own translation). The answers to the question, has only two possible choices, yes and no, meaning that the variable is already binary. The responses/answers that were missing in this variable, were added as 0 (0=no), since it is assumed that they did not participate in this type of activity since they did not answer this sub-question but answered other sub-questions under the same main question.

The variable Self-executed R&D is derived from question 11 and sub-question/statement one in the CIS. Question 11 in the CIS is "Did the company perform research and development work (R&D) or purchase R&D services in the period 2018-2020" (See appendix 9.5 Question 11, Own translation). The first sub-question/statement used to answer this is "Self-executed Research and development (R&D) in the company"(See appendix 9.5 Question 11, Own translation). This variable is also binary, with the answers Yes and no, stating weather they used the method or not. The variable Self-executed R&D is derived from the answers to this sub-question. Research and development is defined in the CIS as "R&D is creative activity that is performed systematically to get hold of new knowledge or the use of knowledge to find new applications or to reduce scientific or technical uncertainty" (See appendix 9.5 Question 11, Own translation). The same definition of R&D is therefore used in this thesis.

The variable external source of knowledge, like Professional conferences is derived from sub-question/statement one in question 7 in the CIS (See appendix 9.5). The Community innovation survey uses question 7 to investigate what channels the company uses to acquire knowledge, and Question 7 in the CIS is: "Did the company use any of the following channels/methods to acquire knowledge" (See appendix 9.5 Question 7, Own translation). The first channel/method is "Professional conferences, meeting, fairs, and exhibitions" (See appendix 9.5 Question 7, Own translation). This sub-question has only two possible answers, yes and no. The variable external source of knowledge is derived from this

sub-question/statement, and its also binary, where yes means that it was used to collect knowledge and no means it was not used. This variable is used to measure H6.

Another important part to consider when doing multiple regression is relevant control variables (Thrane, 2020, p. 48). In this thesis the control variable will be number of employees and Economic regions. This is also recorded in the CIS data as a variable of number of employees in the company and the economic regions[5] in Norway. The economic regions is according to Statistics Norway a classification system used to differentiate the different regions in Norway (Statistisk Sentralbyrå, n.d.-c).

4.1.4 Analysis

This part of the thesis will look closer at the quantitative analysis that is chosen to answer the first research question in this thesis and the hypothesis that were developed from the theory. Since this thesis is interested in the construction industry in Norway, the thesis will use the NACE codes from Statistic Norway in the analysis to distinguish that industry from the others. According to Statistics Norway (Statistisk Sentralbyrå, n.d.-b) NACE[6] codes are standard industrial classifications from the EU, that make it possible to distinguish the different industries based on activities, which then can be used to perform statistical analysis. See the text from own work (Own work, 2022) to explain the code for the construction industry:

> "The construction industry is coded under F, and it includes mainly construction and construction activities like, the construction or repair of buildings (e.g. residential, public or business) or infrastructure (e.g. roads, airports and railways) and other things like e.g. sewage and water systems and power lines (Statistics Norway, n.d b)"(Statistics Norway, n.d b; Refferd to in: Own work, 2022, p. 6).

The definition of the NACE[7] codes under F by statistic Norway is therefore used when talking about the construction industry in this thesis. When you have a dependent variable with only two categorical values you can use what is called logistic regression (Thrane, 2017, p. 166). Since the dependent variable, environmental innovation in this thesis, is recoded as a dummy/Binary variable with only two categorical values and most of the independent variables also are binary, logistic regression is chosen for the analysis. Descriptive statistics of the relevant variables for the analysis have been carried out in

[5] Se information about the Economic regions here: https://www.ssb.no/klass/klassifikasjoner/108
[6] See information about the NACE codes here: https://www.ssb.no/klass/klassifikasjoner/6
[7] See information about code F from the NACE codes here: https://www.ssb.no/klass/klassifikasjoner/6

STATA and the results are shown in table 2 on the next page. The analysis in this paper is based on a sample of 603 companies in the construction industry out of a total of 6427 companies in Norway.

According to the descriptive statistics shown in table 2 on the next page, 44% of all the industries except the construction industry that participated in the CIS survey seem to have implemented/introduced environmental innovation. On the other hand only, 35% of the companies in the construction industry seem to have implemented or introduced innovations with environmental benefits in 2018-2022. This indicates that the construction industry is 9% less innovative when it comes to implementing environmental innovations.

Table 2 Descriptive statistics of the relevant variables

Variable name	Obs.	Mean/frequency	Std. dev/Percentage	Min =0	Max =1
Environmental innovation(y) All industries - except construction industry	5824	0,443853	0.4968802	0	1
Environmental innovation (Y) Construction industry	603	0.3548922	0.4788779	0	1
Lack of public funding and innovation support	603	0.3880597	0.4877129	0	1
Lack of Qualified Personnel	603	0.5472637	0.4981744	0	1
Uncertain demand	603	0.4892206	0.5002988	0	1
Collaboration about innovation activities	603	0.0978441	0.2973504	0	1
Source of knowledge (professional conferences)	603	0.7595357	0.4277203	0	1
Self-Executed R&D	603	0.1160862	0.3205942	0	1
LogANSATTE	603	4.202532	0.9607715	2.995732	8.1425354

According to table 2, 38% of the companies respond that they have experienced problems with lack of public funding or innovation support, and 54% se lack of qualified personnel as a barrier to innovation. 48% also seem to think that uncertain demand for the company's innovation ideas is a barrier. 9% of the companies participated in collaboration about innovations activities, and 11 % performed self-executed R&D in the company. A total of 75% of the companies in the construction industry also used professional conferences, meetings, fairs and exhibitions as a source of knowledge during the same time period.

Cramer's V, is used on nominal variables for testing association, and a strong association has values over 0,5 and a weak association if it's under 0,2, and values between these two are seen as moderate (Ringdal & Wiborg, 2022, pp. 58–59). Cramer's V is checked in STATA and presented in table 3.

Table 3 Cramer's V (N=603)

Variables	Cramer's v	Pearson Chi	Pr
Environmental innovation - Lack of Qualified personell	0.2986	53.7693	0.000
Environmental innovation – Source of knowledge (professional conferences, etc)	0.1903	21.8267	0.000
Environmental innovation - collaboration about innovation activity	0.3157	60.0948	0.000
Environmental innovation - self-executed R&D	0.3155	60.0158	0.000
Environmental innovation - Lack of public financing and innovation support	0.1206	8.7691	0.003
Environmental innovation - Uncertain Demand	0.1616	15.7464	0.000

According to table 3 and the results from STATA, there are three variables that have a weak correlation, and three variables that have a moderate correlation. The two variables with the highest association to Environmental innovation is self-executed R&D at 0.3155 and collaboration about innovation activities at 0.3157. Next, the six variables are tested with multiple logistic regression analysis and the results are presented in table 4.

Table 4 Logistic Regression: Environmental innovation as a dependent variable

	Model 1		Model 2	
Independent variable	$\boldsymbol{\beta}$	SE $\boldsymbol{\beta}$	$\boldsymbol{\beta}$	SE $\boldsymbol{\beta}$
Lack of public funding and innovation support	-0.4306265	0.2702386	-0.4283903	0.2704246
Lack of Qualified personnel in the company	1.757294**	0.3059852	1.756747**	0.3060111
Uncertain demand	-0.6653506*	0.32034	-0.6743072*	0.3212924
Collaboration about innovation activity, without R&D	1.742818**	0.3730689	1.73277**	0.3736903
Source of knowledge (Professional conferences, etc.)	0.8268612**	0.2557018	0.8247869**	0.2557615
Self-executed R&D	1.577853**	0.3289304	1.552523**	0.3355483
LogANSATTE			0.0398656	0.1055038
Con_	-2.128436*	0.2580488	-2.28695*	0.4934373
Pseudo-R^2	0.1857		0.1859	
Pearsons Goodness-of-fit	50.54*			
Hosmer-lemeshow (Goodness of fit)			3.66	
Area under ROC Curve	0.7757		0.7745	

*P < 0,05, ** p < 0,01

The first model is tested with all the variables used to test the hypothesis. As mentioned earlier it is important to include control variables, so in this analysis number of employees is included as a control variable in model 2. Economic regions were also tested as a control variable but were not included in the model since none of the regions were significant under the 5% level. Two of the regions were significant under the 10% level. These regions are according to the classification of economic regions by statistic Norway[8], Stavanger and Follo.

When working with statistical analysis you need a way to evaluate your findings. Statistical significance gives you a way to evaluate your results and it says something about how confident you can be in them. In most cases its normal to use a significance level of 5% ($P < 0,05$), but some also use 1% ($P < 0.01$) which is seen as a stricter level. The significance level is then used to determine what you do with your hypothesis, and if it gets support or not (Clark et al., 2021, pp. 339–341). To test how the models fit, its normal to use Pearsons and Hosmer-lemeshow goodness-of-fit (Ringdal & Wiborg, 2022, pp. 198–199). According to the test, the second model has the best model fit. The Area under Roc Curve in the table above is at 0.7745, and it is telling us that the model has a good fit. According to theory the model has a good explanatory power when the area under ROC curve lies between 0.6 and 0.9 and the curve is high (Ringdal & Wiborg, 2022, p. 201).

As we can see in table 4, Lack of public funding and innovation support is negative, but it is not significant since the p-value is above the significance level off 0,05. Lack of qualified personnel in the company has a positive effect and is significant with a p-value under 0.01. Uncertain demand for the company's innovation ideas has a negative effect, and it is significant with a p-value under 0.05. Collaboration about innovation activities is also significant, and positive with a p-vale under 0.001. Source of knowledge (Professional conferences etc.) also has a positive effect and is significant in the model with a p-value under 0.001. Self-executed R&D also has a positive effect on environmental innovation and is significant with p-values under 0.00. So, now we know which variables are significant, but we do not know how much they affect the environmental innovation variable.

To measure the size of the effect in logistic regression, one of the ways you can use is called marginal effects (Thrane, 2017, p. 168). The marginal effect can be explained like "change in y in percentage points given a one-unit increase in x_1" (Thrane, 2020, p. 124). To measure the size of the variables in this thesis, the next step in the analysis is therefore looking at the marginal effects. Se table 5 for overview of the results from the marginal effects.

[8] For more information about Economic regions se: https://www.ssb.no/klass/klassifikasjoner/108

Table 5 Marginal Effect = Margins, Dydx(*) (Run after logistic regression)

Environmental Innovation	Dydx(*)	p>Z
Lack of Public funding and innovation	-0.0732498	0.101
Lack of qualified personnel	0.3204739**	0.000
Uncertain demand	-0.1135799*	0.026
Collaboration about innovation activity	0.3511382**	0.000
Source of knowledge Professional conferences	0.138669**	0.000
Self-executed R&D	0.3152616**	0.000
LogANSATTE	0.0070146	0.705

*p<0,05 ** p<0,01

To get an overview and better understand of the results from the marginal effects, the results of the percentage points are presented in figure 8 under.

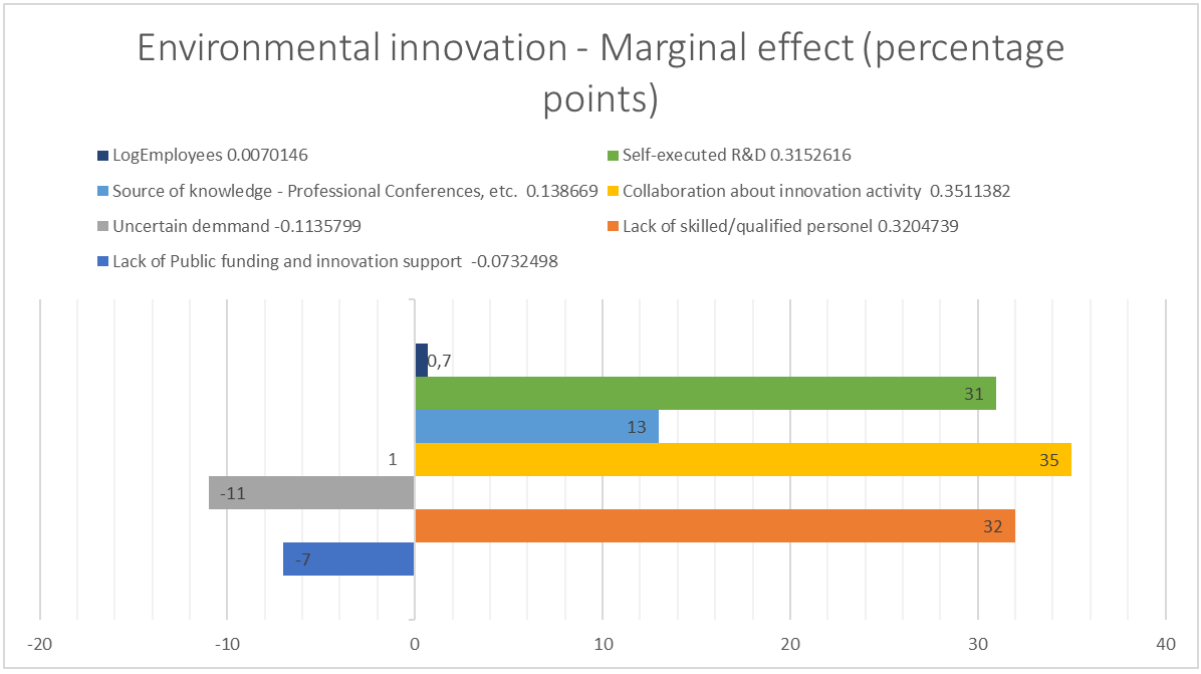

Figure 7 Environmental innovation - Marginal Effect (percentage points)

As we can see from the results in figure 7, Collaboration about innovation activities have the highest positive percentage points in relation to Environmental innovation. This means that those who participate in collaboration about innovation activities have a 35 percentage point higher probability of introducing environmental innovations than those who do not. Uncertain demand for the company's innovation ideas seems to have a negative effect on environmental innovation, which means that people who experience uncertain demand about the company's innovation ideas are 11 percentage point less likely to introduce innovations with environmental benefits. Companies that

mark/experience Lack of qualified personnel as a barrier on the other hand, seem to have a 32 percentage point larger probability to introduce environmental innovations. Companies who obtain information/knowledge through professional conferences have a 14 percentage point larger probability of introducing environmental innovation than those who do not participate. Companies who perform Self-executed R&D have a 31 percentage point larger probability of introducing environmental innovations than those who did not perform self-executed R&D. Lack of public funding and number of employees is also shown in the table, but as the results show in table 5, they are not significant.

4.1.5 Assumptions

In linear and logistic regression there are different assumptions that have to be meet to be able to trust the results (Thrane, 2020, p. 133). One assumption is choosing the right model (Ringdal & Wiborg, 2022, p. 202). The analysis chosen in this thesis is logistic regression, because the variables are binary from the start or they are made binary, and therefore the first assumption is meet. As mentioned under section 4.0 and 4.1 The CIS data are collected by Statistic Norway, and it is therefore also assumed that they have collected and processed the data in a correct way. Another assumption to check for is influential outliers (Thrane, 2020, p. 86) and residuals (Ringdal & Wiborg, 2022, pp. 202–207). Since I consider all the answers in the CIS to be relevant for the results, I did not remove any outliers or check residuals. This is therefore discusses in more detail under reliability and validity, since it might affect the results. To check for non-linearity is also an important assumption in logistic regression (Thrane, 2017, p. 179). The independent variables were therefor multiplied by itself and added one by one to the logistic regression as suggested by Thrane (2017, pp. 179–180). The test showed that none of the new variables were significant.

One of the assumptions you have to check when working with regression, is perfect multicollinearity. Multicollinearity says something about the correlation the independent variables have with each other and looks at the possibility that they don't have a special variation to measure because the correlation is so high. Multicollinearity is normally measured through VIF-scores. These can go all the way up to 10 before they might show a problem of multicollinearity (Thrane, 2020, pp. 83–86). In our case, the VIF scores are under 3, and far away from implying any form of multicollinearity. Se table of VIF scores inn appendix 9.3.1 for the results. This test was done after performing a normal regression in STATA.

Another thing to test for is interaction moderates. This means testing the independent variables to see what gives a better model fit of the additive model and the interaction/multiplicative model (Thrane, 2020, pp. 127–129). This was tested, and it showed that some of the interaction variables were significant, but with only a small effect on the model fitting. Since this thesis is interested in finding out

which barriers and drivers are important to environmental innovation alone, and not how they affect each other, the interaction variables are not included in the analysis.

4.2 Qualitative Method

When you want to explore how something is perceived by others, you can do this by looking at people that work in that context to see what they think about the situation through different qualitative research methods (Clark et al., 2021, pp. 354–355). This can be done through what is called semi-structured interviews (Clark et al., 2021, p. 425). Since the thesis is interested in finding out more in-depth information about the barriers and drivers to environmental innovation in the construction industry in Norway, and how this might be related to the transition to a circular economy, the study will use semi-structured interviews to talk to the people that work in the context they appear in to get a deeper understanding. The chapter will therefor start by presenting the case that is chosen for this thesis, before it moves on to look at the procedure and data collection of the empirical material, and the thematic analysis that is used.

4.2.1 Case – COWI

COWI is chosen as a case in this thesis because of their view on sustainability and relation to the construction industry in Norway. COWI was established in 1930 (COWI, n.d.-a) and is a global full service consulting company, where architecture and engineering are two examples of various fields they work with (COWI, n.d.-b). They thrive to create a sustainable and liveable world together with their customers and partners (COWI, n.d.-a). Sustainability is seen as essential by the company (COWI, 2021).“[…] sustainability is part of our identity and incorporated into our business model” (COWI, n.d.-c). In 2021, they launched a new vision “Together, we shape a sustainable and liveable world” (Berg, stated in; COWI, 2021, p. 7). In Norway the company is constantly involved in about 3700 different projects. When it comes to e.g sustainable city development and complex functional buildings and the project planning and consultancy of these, COWI is one of the leading engineering companies in Norway (COWI, 2021, p. 3). In 2021 the company also focused more on buildings and infrastructure projects and how materials could be reused and entered into different partnerships with relevant actors in this field (COWI, 2021, p. 11).

As a consultant and advisory company, COWI is able to set the premises and affect the projects, and it’s their task to plan, and find good solutions for their clients that meet the climate requirements (COWI, 2021, pp. 15, 20). To document climate effects, COWI also uses BREEAM, life cycle analysis and CEEQUEL certifications (COWI, 2021, p. 21). COWI contributes to the consultancy and planning of many projects (E.g Fornebubanen, regeringskvartalet, tanberghøgda, and sykehuse Nordmøre Romsdal) and

one example is Oslo Storbylegevakt, where the focus is to create a building that throughout the whole life cycle has the lowest energy use possible (COWI, 2021, pp. 32, 40, 42, 47, 50). COWI is therefore a very relevant consultancy company to use as an access-point to get in contact with relevant actors from the construction industry, and also as an interview object in terms of accessing knowledge about the industry in Norway.

According to COWI, an important part of reaching success, lies in the material and the way it is used. They write that it's important for them to reduce the material use, and at the same time create materials that have a longer life span, are emission free, and that are recyclable (COWI, 2021, p. 20). This is also in line with the circular economy model that will be discussed later. COWI believes that to reach the emission targets, technological developments and innovation will be essential (COWI, 2021, p. 20). COWI is especially chosen In this thesis because of their stand on sustainability, and in their new strategy "Future now" they say no to fossil projects (COWI, n.d.-d). "The ambition is clear. Within approximately three to five years, 100 per cent of our revenue must come from projects driving sustainability" (COWI, n.d.-d Section: Going 100% sustainable).

4.2.2 Procedure/Data Collection

Semi-structured interviews are seen as a possible method to collect material for the qualitative research, which includes having an interview guide that are made in advance (Clark et al., 2021, p. 425). In this type of interviews it's important that "The questions need to be framed in an open way that allows and encourages the interviewee to articulate a fairly detailed response"(Clark et al., 2021, pp. 425–426). This type of interview also leaves room for follow-up questions on answers from the informants to capture what they find important as well as the ability to change some of the words in the questions and the order you ask them (Clark et al., 2021, s. 425-426). To collect detailed information about the topic I have therefore chosen to conduct semi-structured interviews and prepare an interview guide in advance.

To find participants for this study the thesis uses purposive sampling. Purposive sampling can be explained like this, "[…] selecting participants on the basis of the kind of information they can provide, usually because they have the right kind of life experience for the research in question or because they are expert in a certain field" (Clark et al., 2021, p. 378). The informants selected for the interviews in this thesis come from two different samples. The possible samples of informants for this thesis were selected and sent to me, from my contact in COWI based on the selection criteria I had given. The selection criteria were the topic for the thesis, the working research questions, and a suggestion of questions for the interview guide. One sample is internal employees in the company that is chosen as a case for this thesis COWI, and the other sample are people working in a company that is or has been

either a customer or partner of COWI. The informants had different backgrounds and experiences from buildings, constructions, or more towards real-estate, but they were all connected to the construction industry in a way.

Choosing the number of participants for you study, is considered to be complicated and the requirements are discussed by many researchers (Clark et al., 2021, p. 386). The qualitative data collection through interviews, were as mentioned under section 1.4 clarifications, done with a fellow student. This was a practical solution since we wrote about the same company with a similar topic and had access to the same informants. I therefore ended up with doing 8 interviews together with a fellow student. During the analysis I realized that it was more time consuming that what I had though and ended up with only using 5 out of the 8 interviews in the analysis.

As mentioned above when doing a semi structured interview, you have to prepare an interview guide in advance. This was a process that first was done alone based on the topic, prior theory and the analysis from the quantitative method. The analysis and the results from the quantitative method gave some ideas for topics that seemed relevant to explore more in depth in the interviews. So, after preparing my own interview guide, I talked to my fellow student and we looked at all the questions together and combined some of them and made two joint interview guides, one for the internal informants in COWI, and one for the External informants. Se appendix 9.1 and 9.2 for the interview guides. Because I did the interviews with a fellow student, the interview guide will be the same in here master thesis, se here thesis (Refseth, 2023) in the bibliography. The interview guide was then discussed with my supervisor and tested on another fellow student before the first interview. The interview guide was verry flexible and some of the questions were changed and adapted to every interview based on the content/context and the answers from the informants that emerged during the interview.

When conducting the interviews, we always started with a brief explanation concerning relevant information about the interview process, and a short introduction of our master theses. Since this thesis uses a mixed method research, all the participants/informants were informed at the start of each interview that there had been carried out quantitative analysis which were used to develop some of the questions that were asked in the interview.

Recording the interview is normal when doing qualitative interviews, and this procedure also lets you transcribe them and do further analysis (Clark et al., 2021, p. 441). To get the most correct information of what was said under the interview, we recorded the interview and then transcribed it and wrote it down after. All the direct citations/quotes from the interviews that are used in the thesis have been

translated to English by me the author of this thesis. I have tried to reproduce the meaning correctly through the translation, but the translation of some word and the different grammars in the language might have affected the content/meaning.

4.2.3 Ethical principles

According to Tjora (2021) when you are working with people and interviews, It's verry important to remember that there should be no harm inflicted on your informants' Inn anyway. Anonymity is a big part of this, especially in the cases where the participants could be recognized (Tjora, 2021, pp. 187–191). The informants in this thesis will therefore be anonymized, but some information might lead to them being recognized, and this is therefore mentioned in the informed consent document. To anonymize the participants In this thesis, they will be referred to as internal informants (employees in COWI) or external informants (People who work in a company that is or has been a customer or partner of COWI).

Another part of doing research is to get informed consent from the participants, so they have knowledge about the study and how it is conducted (Clark et al., 2021, pp. 117–118). I therefore sent out information about the research and how I would handle personal data in advance and collected the participants consent to participate in the research. The application for the notification form of personal data was sent to the Norwegian agency for shared services in education and research (Sikt[9]) before we started the interviews. See appendix 9.4 for evaluation of the application that was sent.

4.2.4 Thematic analysis

There are many ways to analyze data in qualitative research, but one way is through a thematic analysis (Clark et al., 2021, p. 524). One definition of a thematic analysis can be " Thematic analysis is a method for identifying, analyzing and reporting patterns (Themes) within data"(Braun & Clarke, 2006, p. 79). These patterns or themes are developed through a process of coding (Braun & Clarke, 2006, pp. 82–84). Codes can be seen as labels, that refer to parts from the transcription that seem to have theoretical or empirical significance (Clark et al., 2021, p. 528). Coding can be seen as a way to reduce and structure the empirical material you have collected (Huberman & Miles, 1994, Refferd to in; Clark et al., 2021, pp. 534–535).

According to Clark et al., (2021, p. 538), Braun and Clarke (2006, Clarke & Braun 2013; Reffered to in; Clark et al., 2021, p. 538) suggest a thematic analysis that is popular. This specific method lets the researcher develop themes based on its own interest, while at the same time its transparent and seems

[9] Se Information about Sikt here: https://sikt.no/fylle-ut-meldeskjema-personopplysninger

to capture the prominent qualities of the data (Clark et al., 2021, p. 538). The qualitative analysis in this thesis is inspired by a thematic analysis. Some of the themes are predeveloped from the quantitative part, but the process shown under has also lead to extra themes coming forth as relevant through the analysis of the empirical material. According to Braun and Clarke's (2006, Clarke & Braun 2033, Reffered to in; Clark et al., 2021, p. 538) thematic analysis, there is a six-stage process that you need to follow, and this process is iterative. Meaning that you constantly have to look at the emergent codes and themes and compare them with each other (Braun & Clarke; refferd to in; Clark et al., 2021, p. 538). To analyze the empirical material in this thesis, the following six steps were used as inspiration to analyze the material.

The first step starts with looking at the material you have collected, like the interviews and the transcription of them and this step is called familiarization (Clark et al., 2021, p. 538). When all the interviews were transcribed, I started reading and listening to them to get to know the material more closely. When I was reading the interviews, I also made some notes. When reading through the transcripts, some of the material that seemed important were highlighted and moved into a new table on the side.

After working with the transcription and reading all the interviews, the coding process starts. The coding is the second step in the process which is called initial coding (Braun & clarke, 2006, Clark & Braun, 2013, Reffered to in; Clark et al., 2021, p. 538). The codes are according to Braun and Clarke (2006, p. 88) often lead by either theory or the empirical data material. In this thesis a abductive reasoning was used. This means combining the two methods and using what seems to be the best option (Atkinson et al., 2003, Reffered to in; Clark et al., 2021, pp. 22–23). To code the material in this analysis, the various extracts that were highlighted during the readthrough were then given short descriptions and codes. Extra text that was not included in the first part of highlighting, was also added in the second. The first coding process was influenced by the hypothesis and the analysis in the quantitative methods in the thesis, and the already existing themes. Some of the themes were therefore matched with relevant codes.

Identifying themes is the third step in the process, and this means looking at the codes over again and evaluating them, and explaining relations that appear in the data and the analysis (Clark et al., 2021, p. 538). "[…] the researcher needs to compare and contrast any emergent codes with both previous codes and any theoretical concept of interest" (Clark et al., 2021, p. 538). Since this is a mixed method research, the coding and the themes were seen in relation to the hypothesis and the first analysis. But, in addition to this, a lot of relevant information was found in the data material, which has led to the development of several new themes to capture important and valuable points about the topic. The

next step in the process is reviewing the themes. This is a process that involves creating high-order constructs which mean putting together some of the different themes (Clark et al., 2021, p. 538). Some of the themes were reviewed again and seen in comparison to the themes from the hypothesis and the research question. There were many different barriers and drivers that were mentioned in the qualitative analysis, so to delineate this the thesis has chosen to only focus on those that were perceived as the most important.

When you are finished with developing the themes, you need to explain the themes and the sub teams that you have chosen to proceed with in the research. This step is called defining themes, and it's the fifth step in the process (Clark et al., 2021, p. 538). The final themes in this thesis that were based on the prior hypothesis and additional relevant themes are: Barriers to environmental innovation with sub themes, financial barriers, right type of knowledge, and Uncertain demand, Drivers of environmental innovation with sub theme, Source of knowledge, The need for collaboration, and Research and development. The themes that relate to the hypothesis are the first six in the two boxes in table 6. The new themes that were developed to capture important information about the barriers and drivers, and the move to a more circular economy from the interviews are: Profitability and Risk, laws and regulations, the need for new business models, trends in society, move to a circular economy and contribution in the process (Last box in table 6). See overview of themes in table 6 under:

Table 6 Overview of themes and sub themes from analysis

Main themes	Sub themes	Section
Barriers to Environmental innovation	Financial barriers (Relates to H1)	5.2.1.1
	Uncertain Demand (Relates to H2)	5.2.1.2
	Right type of knowledge (Relates to H3)	5.2.1.3
Drivers to environmental innovation	Need for collaboration (Relates to H4)	5.2.2.1
	Research and development (Relates to H5)	5.2.2.2
	Source of knowledge (Relates to H6)	5.2.2.3
New themes that are seen as a barrier and/or driver to environmental innovation and the relation to the Circular Economy	Profitability and Risk	5.2.3.1
	Trends in society - reputation and digitalization	5.2.3.2.
	Laws and regulations	5.2.3.3
	The need for new business models	5.2.3.4
	Move to a Circular Economy	5.2.3.5
	Contribution in the process	5.2.3.6

Ann example of how one theme was developed can be seen by looking at the codes used to form the theme Source of knowledge. Some of the codes used to form this theme are: access to up-to-date knowledge, reading demands more, good ideas are shared and networking. The last step in the process is evidencing themes (Braun & clarke, 2006, Clarke & Braun, 2013, reffered to in; Clark et al., 2021, p. 538). This will be done in the analysis of the material in the next chapter.

4.3 Reliability, validity, and replicability

When working with research, it is always important to evaluate what you are doing. This evaluation is normally concerned with reliability, validity and replicability (Clark et al., 2021, p. 40). Since this thesis is based on a mixed method research the evaluation has to look at both research methods.

Reliability is one of the evaluations, and it's about the ability to repeat the research you have done to see if you get the same outcome. This is especially important, when you have concepts and measurements in quantitative research (Clark et al., 2021, p. 40). To make sure that the quantitative part of this thesis is reliable, the concepts and measurements that were used are explained. The CIS[10] data is also collected by someone else, and it should therefore be possible to use the exact same data and variables.

Another way of evaluation is through replicability. This means that the study should be able to replicate, meaning that you should be able to do the study over again with the same design(Clark et al., 2021, p. 40). This implies that you give a detailed description of your study, so that others know exactly what you have done, and are able to copy that (Clark et al., 2021, p. 40). Since this is a mixed method, the quantitative part of this study should be able to replicate, but the qualitative part with the semi-structured interview will be hard to replicate. To ensure the replicability of the quantitative method, the concepts, measurements, and steps in the analysis were described in detail.

Validity is the last evaluation principle. "Validity is concerned with the integrity of the conclusion generated from a piece of research" (Clark et al., 2021, p. 40). So, its about the sincerity of your study, and how you can trust your results (Clark et al., 2021, pp. 40–41). The mixed method that is used in this thesis, is especially used with a purpose of creating a higher validity, through using two different methods to investigate a certain topic. In this thesis a weakness can be seen in the way that the missing values, and the outliers/residuals were handled. In this thesis I chose not to do anything with possible outliers/residuals as I think that all the answers in the CIS form are relevant to the company's answers. This can be seen as a weakness in the data material and the results since it could have produced

[10]Se information about the collection of the CIS data here: https://www.ssb.no/teknologi-og-innovasjon/forskning-og-innovasjon-i-naeringslivet/statistikk/innovasjon-i-naeringslivet
And here: https://www.ssb.no/innrapportering/innovasjon-i-naringslivet

different results if it had been treated in a different way. This especially counts for the way I chose to add the missing answers in some of the variables.

5.0 Quantitative and Qualitative analysis and results

This chapter will look at the results and the analysis from both methods used in this thesis. The thesis will first present the results from the quantitative methos and the statistical analysis and connect them to the different hypothesis. After the hypothesis have been discussed, the thesis will move on to present the qualitative analysis and the results from the interviews. After the results from both of the methods have been introduced, they will be integrated before the thesis moves on to the discussion.

5.1 Results from the quantitative analysis

To test the hypotheses that were developed, the thesis will now look at the results from the statistical analysis. Table 4 presents the results from the logistic regression that will be used to discuss the hypothesis, and table 5, and figure 8 of the graph to see the different marginal effects.

The first hypothesis H1, concerning problems with lack of public finding and innovation support does not get support from the analysis. This variable used to measure this has a marginal effect that is negative as shown in table 5, but it is not significant. This means that we do not get support to the first hypothesis stating that problems with obtaining public finding and support appears as an important barrier to environmental innovation. The second hypothesis on the other hand seem to be confirmed as an important barrier to environmental innovation. The variable uncertain demand has a negative marginal effect, and it is significant. This means that we get support to the hypothesis and, uncertain demand is seen as an important barrier to environmental innovations in the construction industry. This variable has a negative marginal affect, which means that companies who experience problems with uncertain demand for the innovation has a negative impact on the introduction of environmental innovations.

The third hypothesis look at lack of qualified personnel in the company, and the results from the test also give support to the hypothesis. The variable lack of qualified personnel has a positive marginal effect, and it is significant. This means that lack of qualified personnel is seen as an important barrier to environmental innovation in the construction industry. Since the marginal affect is positive, this means that even dough it is a barrier, it seems to have a positive effect on the implementation of environmental innovation. This is quite interesting and is something we will look further into in the discussion later in the thesis. The variable measuring collaboration about innovation activities is also significant and with a positive marginal effect. This gives support to the fourth hypothesis stating that

collaboration about innovation activities in the construction industry are seen as an important driver for environmental innovations.

The results from the logistic regression, also show that "Self-performed research and development in the company" is significant in relation to environmental innovations. This gives support to hypothesis 5. The variable is significant, and it has a positive marginal affect, meaning that R&D performed in the company has a positive effect on the introduction of environmental innovations. Hypothesis 6 looks at the source of external knowledge through professional conferences, meetings, fairs and exhibitions. The variable used to measure this is also significant in the logistic regression, and it has a positive marginal effect. This means that participating at professional conferences has a positive outcome for environmental innovations in the company.

The results from the Marginal effect and the percentage points, also says something about the size of the effect. According to the results, collaboration about innovation activities have the highest increase in percentage points and you might therefor say that it has the highest effect. I also think that this can be seen as an indicator of collaboration about innovation activities being one of the most important drivers of environmental innovation. On the other hand, uncertain demand for the company's innovation ideas has a negative marginal effect and the highest negative percentage point, and is therefore seen as the barrier with the highest negative effect. Lack of qualified personell is seen as a barrier, but it still has a relative high increase in percentage points, and it therefor seems that the companies that record that they are lacking qualified personnel also in reality have a bigger possibility to introduce environmental innovations.

The results from the quantitative analysis show that uncertain demand for the company's innovation ideas and lack of qualified personnel appear as important barriers in the construction industry in Norway. On the other hand, professional conferences, collaboration about innovation activities and Self-executed R&D also appear as important drivers to environmental innovations. Do the companies in the construction industry and COWI see the same barriers and drivers as important for environmental innovation? To explore the barriers and drivers to environmental innovation in more depth and to elaborate on some of the findings the thesis will move on to the qualitative method and the qualitative analysis, before it integrates the quantitative and qualitative analysis and results.

5.2 Qualitative analysis and results

The thesis will now present the qualitative analysis and results from the interviews. The analysis will be presented through some overall themes and sub themes that were found in chapter 4.2.4 and are meant to reflect the research questions. The analysis will start by looking at the themes under barriers

for environmental innovation before it moves on to look at the themes that are mentioned under drivers for environmental innovation. The analysis will then move on to present other findings and new themes that are seen as relevant from the interviews.

5.2.1 Barriers to Environmental innovation

This part of the thesis will present the themes from the analysis that are related to the hypothesis and barriers to environmental innovation. The themes are, financial barriers, right type of knowledge, and uncertain demand.

When talking about barriers and drivers to innovation and environmental innovation, there seems to be different opinions among the informants as to whether barriers and drivers differ between them. Some of the other informants seem think that the barriers can be the same, and one informant thinks the innovation process is the same process no matter what you are innovating. One of the informants also imply that innovations and environmental innovations have had the same barriers, but that this is something that maybe is changing. One informant said:

> "It has been the same, I think, but some of it is starting to change because there is so much focus on environmental sustainability […]" (External informant, Own translation).

On the other hand, one informant thinks that environmental innovation maybe has different barriers and specifies that when it's about sustainability it's more about who benefits from it.

> "[…] when talking about barriers on sustainability, it's more a question about who benefits from the effect of creating a facility or building that is more environmental friendly" (Internal informant, own translation).

So, according to this, some of the barriers and drivers that were mentioned for regular innovations might be valid for environmental innovation also. Many of the informants also talk about sustainability and innovation, and not directly environmental innovation.

5.2.1.1 Financial barriers

Through the interviews financial barriers were mentioned by some of the informants in different forms in relation to innovation and possibly environmental innovation. Some of the informants talked about access to capital and lack of incentives and one also mentioned lack of money. The EU taxonomy and new demands were mentioned in relation to access to capital, documentation, and green financing and it was perceived as both a barrier to innovation and a driver to innovation. For some of the informants the documentation was seen more as a driver to innovation than a barrier. The informant said:

> "[…] financing, green financing where you have to document according to the EU taxonomy. That helps. That is a driver that helps "(External informant, Own translation)

Another informant talked about their access to capital and how the EU taxonomy affects them directly, and said this in the interview:

> "The influx of the Eu taxonomy […] the fact that the taxonomy have arrived, effects our capital access right, where we collect capital, and our investors […] they are hit directly by the taxonomy, so now it's easier to talk to investors and discuss priorities and that sustainability should be prioritized" (External informant, own translation).

So based on these two statements, its seems that the Eu taxonomy effect the financial side of the industry, and that it can be seen as a maybe both a barrier and a driver, since there are certain requirements that have to be meet it will be harder to get financial support. It's also seen as a driver since it pushes companies to act to be able to get access to the capital. Since they talk about green financing and sustainability It might also be seen as relevant for environmental innovations.

The need for different incentives were also mentioned by some of the informants in various contexts, and when talking about innovations one informant also talked about the lack of incentives for doing innovations and said this:

> "[…] there is no incentive to have innovations in the projects or on the outside of the projects […] you don't have time, or you don't have the margins or money for it" (External informant, own translation)

So, lack of incentives can be seen as a barrier to innovation, and therefor also maybe a indirect barrier to environmental innovations. This theme can also be seen in relation to profitability.

5.2.1.2 Right type of knowledge

According to the analysis and the informants, having the right type of knowledge seems to be important for working with the implementation of innovation and environmental innovation. Lack of competencies and knowledge is seen to affect the innovation and the innovation process. Lack of qualified personnel in Norway is also seen in relation to the green transition, due to the fact that the oil and gas demands high competencies, and that too few are educated in Norway. One informant said this:

> "[…] there is a huge task with the green conversion and there are too few arms and heads" (Internal informant, own translation).

Most of the informants seem to agree that competencies is important for innovation and that lack of qualifications or competencies can be a barrier, but they seem to differ on what type of competencies and qualifications they are lacking. For some of the informants they talk about lack of competencies when it comes to innovations and innovation processes while others talk about competencies and knowledge about different topics. One informant said:

> "If you don't have expertise in a field, it is harder to persuade that we have to implement an innovation in that field, because you don't understand why you have to do it"(External informant, own translation).

One informant also talks about the innovation process and how it demands different forms of competencies from the start till the end, like competencies on sustainability and business models. So, according to the analysis, lack of qualified personnel is seen as a barrier to environmental innovation because you need skills and different types of knowledge to be able to implement innovations and run innovation processes.

5.2.1.3 Uncertain demand

According to the analysis of the interviews, it seems that insecurity about profit, a conservative market and uncertain demand in the market affects the companies in different ways when it comes to environmental innovation. Since they don't know if it will be profitable or not, it seems to create a higher uncertainty, and the fact that the market is seen as conservative seem to affect the demand. One of the informants said this about barriers to innovation:

> "[…] and of course, it is a conservative user/customer market, […] for innovations. So, yes, that's how we have always done it thinking, and its scary to use money on something new, it's not certain that we will get a return on it, like on our side, and that is a barrier"(External informant, own translation)

The same informant further confirms it by saying that:

> "[…] if you come up with a smart solution, that you know is environmentally smart, but that you either don't have the legal requirements to look at, or don't get a commercial profit from doing, because it's not appreciated yet or regulated, then it will, naturally be a higher barrier then. So, everything that comes up in the day, that this is something we have to deal with, its easier there I think" (External informant, own translation).

Based on the statements above, it seems that innovations that are related to environmental benefits have a higher barrier if the market/customer is not aware of the benefits, but that the current situation

in the society makes it easier now than what it was before. So, the market seems to have an effect on the company and their decisions.

5.2.2 Drivers of Environmental innovation

This part of the thesis will present the themes developed in relation to the hypothesis and the drivers of environmental innovation. The themes are: Source of knowledge, Collaboration, and research and development.

5.2.2.1 Source of Knowledge

Many of the informants talk about different sources for obtaining knowledge and information. According to the informants they use, internal and external courses or platforms, some use external consultants as information sources, and some participates at conferences among other things. According to some of the informants, professional conferences in the construction industry seems important because you get access to new knowledge about the industry. It is also explained by one informant as a place where good ideas are exchanged, but the informant feels that learning from actual projects, where they can test things is something they get more out of. The internal informant explained it like this:

> "It's an arena for the exchange of good ideas, but many times I find that we get a lot more out of it when we get into the big projects, that's where we learn and that's where we have an environment where we can test things out" (Internal informant, Own translation).

Participation at professional conferences is also seen by one of the informants as important because there are networking opportunities and the participation at professional conferences is also seen as an easier way to learn. The external informant explained it like this:

> "I think it's easier to go to a professional conference that has topics and presentations that I know in advance will be important for me to learn something about and hear about. […], and it's also connected to networking, which also is important in this context. It's easier than sitting at a home office to read up on the same things, and this isn't literature that you can get your hands on and read about, this is up-to-date knowledge, that those on stage can convey, so it is important" (External informant, Own translation).

So, going to professional conferences seems like a good way to access new information about the latest updates, exchange ideas and create a network with other companies. As shown in the statement above, one of the informants think that learning in the projects have a higher effect than going to conferences because you can test things. Another informant also talked about the need to learn more

between the projects. So, learning in and between projects is also seen as an important driver of innovation.

5.2.2.3 The need for collaboration

In the analysis, collaboration is mentioned as important by all the informants in one way or another in the construction industry and it can be seen in relation to innovation, environmental innovation, or circular economy and sustainability. One informant said:

> "…good ideas normally arise in collaboration" (internal informant, Own translation).

Collaboration about innovation activities is also seen in the interviews as important because sustainability is more complex and therefor needs more collaboration. It's also is seen as important because you are dependent on other actors in the same chain, and because innovation happens in the intersection of things. Collaboration with other actors in the value chain is seen as necessary because no one works alone according to one informant.

> "so, I think that you, no one works alone, and you are dependent on, have always been dependent on collaboration with other actors in the value chains for what you do"(External informant, own translation).

Innovations with environmental benefits are also in the analysis perceived to require more collaboration than other innovations by one of the informants, because the problems are so comprehensive when it comes to sustainability. The informant said this:

> "But, on a part of the sustainability theme at least, the problems are so comprehensive and so intertwined that we need more cooperation than we have achieved today" (External informant, own translation).

Another informant also highlighted that you need to see the connections, to bring out the environmental benefits and explained it like this:

> "To bring out the environmental benefits, you also have to see that things are connected […] Innovation happens at the interface between things, […], between disciplines, between expertise and things like that, so if you are able to see both the various interior designs disciplines together with the design from the architect together with the fact that this should be appropriate to build and the environmental effect, then it is when everything is connected, that is where the innovation lies."(Internal informant, Own translation).

One of the external informants said this to collaboration about innovation and innovation activities:

> "We become stronger together […] so, by collaborating you can pull on more forces" (External informant, own translation)

Based on the analysis and the statements mentioned here, it seems that environmental innovations are more complex and need more collaboration because you are dependent on others, and you need to se the connections from the different fields. So collaboration about innovation activities is seen by some of the informants as an important driver for environmental innovations.

5.2.2.4 Research and development

According to the analysis, the informants seem to have different experiences with research and development. Some of the informants talk about experience with research and development and collaboration with universities and research institutes, and one informant mentioned that it's important to share knowledge from what they have done and that they spend a lot of money on research. Other informants talk about research and development and that it might be more important to be connected to real projects and someone who actually need it, and that the research projects with research institutes can be seen as problematic. One of the informants also acknowledge that they maybe should have done more themselves. The informant explained it like this:

> "[…] those processes are very little optimal for achieving good cooperation with industry and institutions. It is verry often on the premises of the research institution" (External informant – own translation).

One of the informants also mentioned that an innovation process might be more relevant in finding new solutions, because it's easier than research since its seen as a more complicated process. So, according to the analysis there are different views and experiences with R&D and how they are connected to innovation and possibly environmental innovation.

5.2.3 New Themes from the analysis

This part will introduce the new themes that were developed in the thematic analysis that are perceived as important barriers and/or Drivers to environmental innovations in the industry. The new themes are, societal trends, laws and regulations, profitability and risks, the need for new business models and the transition to a Circular Economy.

5.2.3.1 Profitability and Risks

An important theme that has emerged from the analysis of the interviews is profitability and risks. Profitability is seen as important by most of the informants in relation to innovation, environmental innovation, and the transition to a more sustainable industry. Profitability is especially related to the company and their cost and profits, and often what the customers/market is willing to pay for.

Profitability is seen in relation to risks because it costs money to take risks. In the qualitative interview it seems that some of the informants think it's a barrier to do something new when you don't know how the outcome will be, what the profit will be or who will get the profit or benefit from the innovation. Lack of short-term profit for the company is also mentioned as a relevant barrier in relation to environmental innovations and one of the informants explained it like this:

> "[…] It is difficult to sell something that is not profitable, or that has such a long-term benefit for society rather than short-term bottom line earning for a company or an organization" (External informant, own translation).

Reducing cost and improving the quality is also mentioned as a driver for environmental innovation and one respondent said this:

> "Yes, it's the fact that we are able to get more with a better quality, sustainability quality, for less money, […]" (External informant, own translation).

So, reducing costs, and getting a better quality is seen by the informants as an important driver for environmental innovation, but the long-term profit or lack of profit makes it harder. According to one respondent, when it comes to the transition to a circular Economy and reuse of materials, one of the problems also have to do with the profitability, because the new products have to compete with the cost efficiency of the already existing products, and this means that the price is seen as very important. Profitability therefore seems to be perceived as both a barrier and driver to environmental innovation by the informants. When talking about barriers to innovation, one informant said:

> "Another barrier may be, well, who is rewarded for taking a risk on different projects […] risk costs money"(informant, own translation)

When talking about environmental innovations one informant also said that people like to do things they are confident on, and that is not good for innovations.

> "[…] on the barrier side, people often like to do things they can, and do things they are confident in, and that is not, that is not an innovation driver" (External informant, own translation).

So, according to the statements, playing safe and doing what you know, might be bad for innovations. It therefore seems like risk might be necessary for innovations, but that it cost money to take risks and that its seen as an uncertainty, since you don't know the results. So, risk is therefor seen as a barrier to innovations by the informants, and maybe higher for environmental innovations since its more uncertain who gets the benefit and what the profit will be.

5.2.3.2 Trends in society – reputation and digitalization

There seems to be a common perception among the informants that there has been a change in term of focus on sustainability in the society and that the current situation is seen as a driver for environmental innovation. The analysis show that technology and digitalization and new ways to store information is seen as a opportunity for the industry by some of the informants. Becoming more attractive for the customers/market is also seen as important by some of the informants and the market seem to influence the firms to a great extent.

Having a good reputation and creating value appears as a driver for environmental innovations through different environmental measures, like for example environmental certifications. One informant talked about environmental certifications and another talk about environmental classifications. One of the informants explained it like this:

> "The fact that you can market yourself, on that it is environmentally certified, and have lower operating costs also makes you more attractive in the market" (Internal informant, own translation).

Another informant also mentioned that it has a value to achieve certain certifications and said this:

> "[…] you have building certification scheems, like BREEAM certifications or futurebuilt criteria's, things like that will come and be appreciated. If you say that you are a futurebuilt role model project or have BREEAM certification, then it has a value, and that can help incentivize environmental innovation" (External informant, own translation).

Becoming more attractive in the market through different environmental measures and keeping a good reputation is therefore seen as a driver of environmental innovations by some of the informants. This also points to the market as an important barrier or driver of environmental innovation.

Digitalization and technology is also mentioned by some of the informants as important, and one informant see them as a driver for the construction industry to develop new innovations and for the industry to become more environmentally sustainable. One informant said:

> "Some of the things that are drivers, is that, that automation that is going on. So, everything that goes on in the society around us, […] like those trends that are, it's the whole digitalization, internet of things" (Internal informant, own translation).

The statement above is not mentioned directly in relation to environmental innovation, but since the informant talk about sustainability, I think that it probably can be relevant for environmental

innovation as well. Another informant also mentioned that digitalization is essential in transforming the industry.

5.2.3.3 Laws and regulations

Laws and regulations are also seen by some of the informants as a driver to innovation and environmental innovations through new and different demands. The EU taxonomy is as mentioned under 5.2.1.1 seen to affect the access to financing and capital, but it is also seen by some of the informants as a driver, since it has certain demands. The policy is also seen by some of the informants to influence the framework for the construction industry. The new demands can be seen as a driver, since they might push companies to readjust to be sure that they can get financial loans at least in the private sector. One informant said this:

> "There is certainly a driver in that you see, at least in the private sector, you see that they risk becoming outdated if they do not innovate, because there is coming stricter requirements, at least when it comes to loans. So they will often be interested in doing enough, to bring about a change" (External informant, own translation).

So, it seems like laws and regulations can contribute as a driver to environmental innovations. One informant also talked about finding the right balance with laws and regulations in relation to regular innovation. The informant said:

> "Laws and regulations are always an important player, but there is also a balancing act ofcourse" (External informant, own translation).

Based on the statements it therefor seems like it's important to find the right balance of laws and regulations to find the best outcome for environmental innovations.

5.2.3.4 The need for new business models

In the empirical material a finding that appears important for innovations, is that the business model can be seen as a barrier to innovation. Some of the respondents talk about the way the industry is organized to make money, the contract and lack of collaboration and the need to create common goals. One informant said:

> "Often a good idea, can run aground, in the fact that the business model is not good enough" (Internal informant, own translation).

This is also seen in the analysis through the way some of the informants talk about how most of the companies are organized to make money and their contracts. The construction industry is often paid through the amount of hours they spend, and not the value they create. This can be seen as a barrier

to innovations because some of the customers want them to work as fast as possible and as cheap as possible, and this leaves less room for spending time on innovations. One of the informants explained it like this:

> ”[…] when we think business models, we think a little in that context, […] how can we help influence the industry in relation to the fact that the contract models, business models that is used, moves a little on us for this somewhat traditional thinking, with only getting paid per hour you manage to produce over to the point where you actually get paid more for the value you generate, because then you are able to also base innovation and digitalization, in a way so that advisors or others in the industry get rewarded to actually invest in innovative elements” (Internal informant, own translation).

The same informant also said this about the need for new business models in relation to collaboration:

> “The prerequisite for delivering good products and services, is close cooperation, so we should have business models from all parties that stimulate to working better together” (Internal informant, own translation).

There seems to be a general problem with too little collaboration in the industry. Some of the informants talk about the need for a model that looks more at a common value creation and the ability to create something together.

> «the joint value creation, common incentives for streamlining processes, efficiency of quality results, i.e construction projects, is not that good. So, I think there is something with those processes that we also, it becomes difficult to do innovation […], because then you have to change your approach, collaboration with the supply chain, right, needs to start earlier, and you need to create other types of incentives to make money” (External informant, own translation).

The analysis and statements above, seems to show that the industry needs new business models that facilitates collaboration and innovation through maybe changing the focus from getting paid per hour, to getting paid for the value and creating a joint value (and incentives). It therefor seems reasonable to see the challenges with the business models and collaboration as a barrier for environmental innovations as well and the need for a new business model that better facilitates this for the industry to be able to change.

5.2.3.5 Move to a Circular Economy

Another interesting find in the interviews is that most of the informants seem to think that the circular economy is a good solution for the industry, but that the business models and the systems are not quite there yet. Some of the informants talk about the reuse of materials and when talking about making the industry more circular there seems to be a common conception that the reduction in costs are important and that it has to be worth it. One external informant said this:

> "If it became required by law, not just voluntary, that would help, but in addition I also think that you need to have a financial incentive as well, that it is cheaper to reuse and take care of the building material and the building elements then, than to through them away and buy new"(External informant – own translation).

It seems that there is a common thought from the interviews that it costs more to be sustainable, and that this is a problem. And that to solve this, it must change so that it will be more expensive to not think sustainable. The reuse of materials is mentioned by many of the informants when talking about the circular economy and according to one informant, this has not been implemented as much as it should, because of technical standards and access to materials. According to the analysis, when talking about innovation and sustainability it seems that innovation can contribute with options in the production of materials and the way things are built. Technology and digitalization is also mentioned as relevant for the industry to become more sustainable and for the move to a more circular economy. One informant said this:

> "[…] so it is both in the materials that are produced and the way we build, i.e fossil-free building sites" (Internal informant, own translation).

Especially digital solutions that can handle all the information needed and solutions that can be dismantled and reused seem important. One informant said this:

> "An innovation for the circular economy and reuse, would be to come up with new construction methods that mean that instead of welding things together, you assemble it together so that it can be easily dismantled and reused later" (External informant, own translation).

In relation to the digitalization of the information, one informant said this:

> "And It's important that you get that information digitized, because if not, its to comprehensive. […] what we do in the construction industry is so big and unmanageable that

> if we don't digitize the information we don't stand a chance" (External informant, own translation).

So, according to the analysis, it seems that innovations that are cheaper with a higher quality, that are reusable and digital is needed to create solutions that will help the transition to a circular economy become easier and more profitable.

5.2.3.6 The consultancy's companies' possible contribution

Through the analysis of the interviews, another finding seems to be that COWI can contribute and help the construction industry on its path to becoming more sustainable and possibly more circular through different areas. Some of the areas that are perceived as important by the informants are, through knowledge, collaboration, and digitalization. The analysis show, that its important for the company to understand the situation and the customer and getting an early start to be able to influence the project as much as possible. The informants also mentioned that COWI work with R&D in different ways and they have their own research unit called Aqua team, and COWIfondet, which contributes with research and development on several different topics. According to the informants It seems that one way COWI can contribute is through sharing information and knowledge and guiding the customer in the right direction. One informant said this:

> "Where we probably have the greatest opportunity to make an impact, that is our handprint. That's where we can help to influence the customer to make the right decision and it's a lot about handling and informing and being aware that this decision has this consequence and what it means"(Internal informant, own translation)(3).

The analysis show that with employees around the world, COWI have access to a large global network of co-workers with various skills that they can bring in on the different projects. This means that if there is a lack of qualifications in Norway, they can replace it by bringing in expertise and knowledge from their coworkers in other countries. One of the informants explained it like this:

> "[…] the way we handle it in COWI, is that we facilitate working across the industry, so we put together project teams based on where the expertise are […] "(Internal informant, own translation).

Another erea where it seems that COWI can contribute is through the digitalization of the industry. One internal informant said this:

> "Believe that our main contribution lie […] towards the digitalization in the industry […] digitalization is also a lot about efficiency, because things take time" (Internal informant, own translation).

The statement show that digitalization seems important for the informants and that it can help companies become more efficient. Digitalization of the industry is something that another informants also talked about as necessary for the industry to survive. Creating a common goal with the customer through collaboration, also seems important according to one informant:

> "That we try to get inn our contract. So that we are able to create a common incentive together with the customer to succeed on these aspects. It can be on both innovative elements, and processes, and it can be on environmental conditions and it can be […] such as price or target price "(Internal informant, own translation).

So, according to the analysis and the statements mentioned, it seems that sharing knowledge and guiding customers in the right direction, collaboration and the digitalization process are some of the areas the informants seem to think that COWI can contribute inn this process.

5.3 Integrating qualitative results with quantitative results

The thesis will now try to integrate the results from the quantitative analysis and the qualitative analysis. The quantitative analysis tested six hypotheses, that the thesis will try to elaborate and give a more in-depth overview. The thesis will start by looking at the barriers and then move on to the possible drivers.

According to the quantitative analysis, lack of public funding and innovation support as a barrier to environmental innovation was not seen as significant. In the qualitative analysis financial barriers were mentioned in relation to the EU taxonomy and could be seen as both barriers and drivers of environmental innovation. Lack of other incentives were also mentioned for innovations, and profitability were seen as verry important. Lack of public funding is not perceived as an important barrier since it's not mentioned as a barrier to environmental innovation in the interviews, and it therefore seems like this is in line with the quantitative analysis and seen in relation to the quantitative finding.

Hypothesis 2 about lack of qualified personnel, were confirmed as significant in the quantitative analysis. This also seems to be confirmed in the qualitative analysis, since knowledge and competences are seen as essential for implementing innovations and environmental innovations, and that the lack of this knowledge will affect the possibility to innovate. One of the informants also meant that the

reason for the lack of qualified personnel in Norway, could be because of the high demand and that too few people are educated. Lack of qualified personnel is therefore perceived as an important barrier to environmental innovation, but as the marginal effect show, the variable also seem to have a positive effect on environmental innovation.

When it comes to hypothesis 3, uncertain demand for the companies' innovations, this was confirmed as significant in the quantitative analysis. Through the qualitative interviews it seems that the market is verry important, and that uncertainty around profit, and a conservative market makes uncertain demand for the company's innovation ideas appear as a barrier to environmental innovation. Risk is also mentioned and might be seen in relation to uncertain demand.

Hypothesis 4, collaboration about innovation activities were confirmed as significant in the quantitative analysis, and it had one of the highest percentage points. Collaboration about innovation activities are also seen as an important driver of environmental innovation in the qualitative analysis, because you cannot work alone, and you are dependent on others, and the fact that sustainability is seen as more comprehensive, makes this in line with the quantitative analysis and the high percentage points. Collaboration is perceived as important in both the analysis, but ass shown in table 2, only 9% of the companies participated in collaboration about innovation activities.

Self-executed R&D is confirmed as significant in the quantitative analysis and appear as an important driver to environmental innovation. In the qualitative analysis the informants had verry different experiences with research and development. For some of the informants they had experience with R&D that was executed in the company and Inn collaboration with others, but on the other side, some of the informants did not seem to have much experience with it, and one informant also mentioned that the research projects often are on their terms and not that optimal for the industry. It is therefore difficult to say whether the result from the quantitative analysis is confirmed or not by the qualitative analysis, with so few respondents.

Participation as professional conferences were seen as significant in the quantitative analysis. As shown in table 2, 75% of the companies also marked that they participated at professional conferences etc. In the qualitative analysis, it seems that there are different perspectives on what source of knowledge is the most important. Participation at conferences were seen by most of the informants as important, but one of the informants also mentioned that learning in the projects might have a bigger effect. In the quantitative analysis participation at conferences is important, but the percentage points show that it has a much lower percentage point than collaboration and this might mean that it has an effect, but not the same as other drivers of environmental innovation. The statistical analysis

did not check for participation or learning through projects, but it could maybe be seen in relation to collaboration about innovation activities.

6.0 Discussion

In this chapter the results from the quantitative and qualitative analysis will be discussed up against theory to try to answer the research questions in the thesis. The discussion will start by looking at the barriers to environmental innovations to see what is stopping some of the work with environmental innovations before it moves over to look at the possible drivers of environmental innovations. After the barriers and drivers have been thoroughly discussed the thesis will move on to discuss the new themes of barriers and drivers that that were seen in the interviews and the possible relation to the circular economy and look at how a consulting company like COWI can contribute inn this process. After the discussion of the relevant problems, the thesis will move to sum up the most important findings and give a short conclusion.

6.1 Barriers to Environmental innovation

According to the theory there are different barriers that are seen to stop the development or implementation of environmental innovations. This is also confirmed in the quantitative and qualitative analysis, and we will therefor look closer at Financial barriers, right type of knowledge and uncertain demand.

6.1.1 Financial barriers

One barrier that is mentioned in the qualitative and quantitative analysis has to do with financial barriers. The quantitative analysis showed that problems with getting public funding and innovation support did not appear as an important barrier compared to the other variables in the analysis. In the qualitative analysis, some of the informants mentioned financing in relation to The EU taxonomy as a driver for environmental innovation. Some of the informant also talked about financial barriers to regular innovations and talked about the need for different incentives for companies to innovate more. According to Ghisetti et al,(2017, pp. 142–143) financial barriers are seen as important for Environmental innovations, and that the policy setting have a high effect on the outcome. Ghisetti et al (2017) writes:

> “If it is true that `standard’ innovations are potentially affected by difficulties in credit access from financial institutions, EI are characterized by an even higher technical risk, longer time span, and larger uncertainty on the appropriability of private rents. Understanding the impact of factors affecting the perception of financial barrier is crucial, because they indirectly affect

> firms' decisions to invest in EI, thus giving a crucial role to the policy setting" (Ghisetti et al., 2017, p. 143).

As mentioned in the direct quote above, we see some of the same things as mentioned in the qualitative analysis. The qualitative analysis also mentions that some of the informants see the long term profit and the risk of doing something new as a barrier for environmental innovations. As mentioned by Ghisetti el al., (2017, p. 143) environmental innovations are affected by the way the financial barriers are perceived and grasped. Some of the informants also mentioned lack of different incentives as a problem in relation to innovation, but not directly in relation to lack of public funding. One informant also said:

> "… everything is limited by money, there is no doubt about that …" (External informant, own translation).

So, according to the analysis and the theory, there are financial barriers, but lack of public funding does not seem to be among the once that appear as the most important in Norway. Lack of incentives for innovation or to high costs, or lack of profit are other potential financial barriers might be more important, and as the quantitative analysis show, uncertain demand for the company's innovation ideas appear as more important barrier than lack of public funding in Norway. Souto and Rodrigues (2015, pp. 55–56) find in their study that public funding has a positive effect on environmental innovations and as also mentioned in section 3.4.1 it could remove some of the financial barriers. Lack of public funding is not perceived as a barrier in the quantitative and qualitative analysis, and this might be seen as a sign that the companies have access to this, but since they still mention other financial barriers as important to environmental innovation, it could mean that more public funding could help reduce some of these barriers .

6.1.2 Right type of knowledge

According to the theory, knowledge is essential for creating innovation (Aasen & Amundsen, 2011, p. 18). In the logistic analysis the results show that lack of qualified personnel in the company is seen as a barrier to environmental innovations. This is something we also can see in a report that was published in 2023 by Remirent. In their report about the construction industry in Norway, they found that 14% of the employees in the construction industry mention that sustainability experts are something they are missing (Ramirent, 2023, p. 4). They also note that the number one barrier to becoming more digital, is the lack of knowledge among the employees in the company (Ramirent, 2023, p. 11), something that is seen as essential to become more sustainable in the industry (Bardal, stated in; Ramirent, 2023, p. 12). According to the informants, lack of skills or competencies are also seen as a

barrier to innovations since it's hard to innovate if you don't understand why, or don't have the competency to do it. As mentioned in the theoretical framework above, the human capital resources the company has is essential when it comes to environmental innovation (Kyaw et al., 2021; wang et al., 2021 a,b; Reffered to in; Kyaw, 2022). This can also mean, that lack of this resource would be a barrier to environmental innovation. It therefore seems reasonable that lack of qualified personnel is an important barrier to environmental innovation in the construction industry in Norway. As mentioned in section 3.4.3, Stucki (2019, p. 1261) found that knowledge did not affect green innovation to much. This is the opposite of what was found in this study, and could be because the studies were on different industries.

According to the results from the analysis in relation to lack of qualified personnel, it seems that even dough it is a significant barrier, it seems to have a positive effect on environmental innovation. According to Stucki (2019) about green innovation, he say "Hence, green innovation activity increases a firm's awareness of innovation barriers, but the barriers do not prevent them from engaging in innovation activities"(Stucki, 2019, p. 1263). This can be seen in line with the results I got in this thesis. Even though the companies register lack of personell as a barrier, does not mean that they are not working on environmental innovation, on the contrary, it could mean that since they are working on environmental innovations, they are more aware of what skills/competencies they actually are missing. "General and environmental innovative firms in the past, are also more likely to innovate in the present"(Horbach, 2008, p. 172). So, this can also be seen in line with the fact that companies that has innovated, often have a higher possibility of innovating again.

6.1.3 Uncertain demand for innovation

Another barrier that that was significant in the quantitative analysis was uncertain demand for the company's innovations. This is also confirmed by the informants about innovations, and presumably also valid for environmental innovations. Uncertain demand for innovations ideas, also deem to be confirmed by theory. According to Stucki (2019, pp. 1262–1263) high commercial uncertainty is seen as a barrier to green innovation. This was also confirmed by some of the informants in the qualitative analysis, when talking about the industry as conservative. In a study by Liao and Liu (2021, p. 1861) they found that environmental innovations is seen to increase as a result of customer demand since they are more willing to pay now than before. So, that could mean that the risk of introducing environmental innovations are less in todays society than what it has been before. This was also mentioned by one of the informants as it seem that it was easier to talk about sustainability with their investors now, than what it had been earlier.

According to a study by Kesidou and Demirel (2012, p. 862), they find that companies only do the minimum requirement to satisfy customer demand, and that things like stricter regulations and cost savings are seen to affect investment in environmental innovation to a higher degree. This can also be seen in relation to what the informants said about being attractive in the market as mentioned under 5.2.3.2. Bossle et al., (2016) also writes that:

> "[…] although companies are starting to develop eco-innovations, motivation is still very much oriented towards compliance with standards, much more than by truly sustainable goals. This result also highlights the need for more education for sustainability in the business world as well as for consumers"(Bossle et al., 2016, p. 870)

The need for more knowledge about sustainability is as we can see in the statement above, necessary for both the companies and the customers. It seems that more knowledge about sustainability to the customers, could help reduce the uncertainty some of the companies are experiencing in relation to environmental innovation. Uncertain demand can also be seen in relation to societal trends, which will be discussed under 6.2.3.

6.2 Drivers of environmental innovation

Through the analysis of the quantitative and qualitative data material there are several drivers that are seen as important for environmental innovation in the construction industry, and these are; Source of knowledge, collaboration, and Research and development.

6.2.1 Source of knowledge

According to the quantitative analysis, an external source of information through professional conferences is seen as an important driver of environmental innovation in the construction industry In Norway. This is also in line with Horbach et al., (2013, p. 536) and their studies, where they found that especially for eco-innovations in France, an important source of information was professional conferences among other things. Professional conferences is also confirmed by some of the informants as important, since its seems to be a way to obtain new knowledge and share good ideas. I think this also can be seen in relation to the theory in section 3.3. which talks about how innovation can be created when you put people from different background together (Aasen & Amundsen, 2011, p. 141). This is something that might be seen too happened at professional conferences, ss the analysis of the interviews show, the professional conferences are seen as places where you can exchange ideas or get new information.

It is also acknowledged by one of the informants that the learning process on the big projects might be bigger. Learning through practicing and solving work tasks is also confirmed as an important factor

for informal learning by Jenkins referred to in Filstad (Filstad, 2016, p. 66), and this type of learning and development can count for about 70% of the total learning (Filstad, 2016, p. 66). For the construction industry this might mean that working on projects together can be seen as a verry important informal way of learning. This can also be seen in relation to DUI, as mentioned in the theory in chapter 3.3 DUI is often based on experience (Jensen et al., 2007, p. 680). "And closer interaction with users of products and services outside the organization typically is a prerequisite for the experience-based learning that supports product innovation in the DUI-mode"(Jensen et al., 2007, p. 684). So, working on projects and getting experience can also be seen as a way to acquire knowledge that is good for product innovation. This can also be seen in relation to the need for more collaboration as mentioned by some of the informants.

6.2.2 Collaboration about innovation activities

The quantitative analysis confirmed that collaboration about innovation activities were seen as an important driver of environmental innovations, and that the companies who collaborated with innovation activities had a much higher percentage point probability of implementing innovation with environmental benefits. This was also confirmed by some of the informants in the analysis, since collaboration is seen as important for environmental innovation, and that good ideas are created in collaboration, and especially since sustainability is seen as more complex. This is also seen in theory, and Jørgensen and Pedersen (2018) writes:

> "When sustainability is part of the problem however, it is perhaps even more important to collaborate since the complexity of the problem companies face requires complex competence, technology, inputs factors and other resources. This may acquire extensive alliances across both industry and sector boundaries" (Jørgensen & Pedersen, 2018, p. 126)

As mentioned in the theoretical framework Aasen and Amundsen (2011, p. 139) also writes about the need for collaborations as a result of the complexity of todays problems. This is also mentioned in the qualitative analysis by one of the informants under section 5.2.2.3, when the informant talk about the need for more cooperation because the problems are so comprehensive. One informant also said:

> "[…] good ideas normally arise in collaboration" (internal informant, Own translation).

According to Cainelli et al., (2015, p. 217) the possibility of developing eco-friendly products or processes are higher the more companies you collaborate with. It therefor seems reasonable that collaboration about innovation activities are an important driver for innovations with environmental benefits in the construction industry in Norway.

According to the theory in section 3.2 radical innovations have a high risk, while incremental innovations are seen to have a lower risk, especially when working with certain partners (Duong et al., 2021, p. 411). This could also be seen to support collaboration about innovation activities in the construction as important for incremental environmental innovations. The informants mentioned risks in many ways, and it therefore seems reasonable, that maybe projects with less risk are preferred. I therefore think that this can be seen in relation to each other, and that collaboration about innovation activities are seen as an important driver of environmental innovation.

Collaboration about innovation activities are seen as an important driver in the quantitative and qualitative analysis, and it has the highest percentage point in relation to environmental innovation. But according to the descriptive statistics, only 9% of the companies said that they did collaborate about innovation activities. This is verry low, compared to participation at professional conferences etc. which are 75%. I therefore think that this can be seen in relation to the qualitative analysis, and the point that the informants mention lack of collaboration in the industry and the needs for business models that better facilitate for collaboration.

6.2.3 Research and development

In the quantitative analysis, self-executed research and development was significant in relation to environmental innovation. In the qualitative interviews the informants seem to have different experiences with R&D, some had experience with Self-executed R&D and some had experience with R&D in collaboration with others. There are not that many studies on Self-executed research, but according to Dimakopolou et al., (2022) collaboration about R&D is not significant, and one explanation for this might be because companies are scared of being imitated (de Paulo et al., 2020, Reffered to in; Dimakopoulou et al., 2022). “The internal generation process allows the minimization of knowledge leaking to competitors and ensures the non-imitability of green technologies developed strengthening firm’s competitiveness”(Dimakopoulou et al., 2022, p. Section 5.1).

In theory, there seems to be many different answers to how R&D effect environmental innovation. In a study by Liao et al., (2021, p. 476) about environmental innovation and social ties, they found that “[…] firms political and R&D ties have significant positive effect on radical eco-innovation while business ties do not. Meanwhile, business and political ties have significant positive impact on incremental eco-innovation, unlike R&D ties” (Liao et al., 2021, p. 486). So, Research and development might be seen have different effects on environmental innovation depending on the relation.

Horbach (2008) also writes that “The econometric estimation shows that the improvement of the technological capabilities (“Knowledge capital”) by R&D, is very important for environmental

innovation" (Horbach, 2008, p. 172). It therefore seems that R&D has an effect on the knowledge capital to the companies, and that research and development can be important to some extent for environmental innovation. As shown in the analysis, COWI works with R&D on many different levels. This can therefore be perceived as a huge benefit when it comes to acquiring new technological capabilities and knowledge to develop environmental innovations.

6.3 New themes that appear as important

This section will look at the new themes of barriers and drivers that appeared as important during the interviews and the connection to the circular economy and the possible contributions the consultancy company can have in the process. The themes in this section are, profitability and risk, Social trends – reputation and digitalization, laws and regulations, new business models, move to a more circular economy, and possible contributions from the consulting company.

6.3.1 Profitability and Risk

Profitability is mentioned by many of the informants as important in relation to innovation, environmental innovation, and the transition to a circular economy. The informants talk about cost reduction and better quality as a driver to environmental innovation. In a study by Liao et al., (2022, p. 2676) about Chinese firms and the drivers to environmental innovations, they found that expected economic benefits were one of the main drivers. "Driven by the goal of profit maximization, expected economic gain is the largest driving force for firms to implement environmental innovation behavior" (Esty & Winston, 2009; Reffered to in; Liao et al., 2022, p. 2688). Horbach (2008, p. 172) found that for environmental innovation det potential of cost savings were also seen as an important driver. This is something vi also see in other studies, like Horbach et al., (2013) "The results confirm the central role of regulation and cost savings as motivations for eco-innovation compared to other innovations" (Horbach et al., 2013, p. 523). So according to theory and the results from the analysis in this thesis, it seems that profitability and cost, is very relevant for the development of environmental innovation.

In the analysis, risks are perceived as a barrier, because the informants think its scary to do something new when you don't know the outcome, and that its safter to do something you know. According to Jørgensen and Pedersen (2018), they confirm this and write that "It often feels safer for managers and other stakeholder out there in the light, where they can maneuver in safe environments without having to take unnecessary risks"(Jørgensen & Pedersen, 2018, p. 6).

6.3.2 Societal trends – Reputation and digitalization

The market and the customers are seen as important in the qualitative analysis for the introduction of innovation and environmental innovations. Having a good reputation and being attractive in the

market is mentioned in the qualitative analysis. This is in line with what is called the Market-pull mentioned by Aasen and Amundsen(2011, p. 33) and by Rennings (2000, p. 326), since market pull means that the demand from the customers is what leads the development of innovations or environmental innovations. “The demand from public and private actors form the basis for a well-functioning market. If demand exists, a market should emerge”(Grafström & Aasma, 2021, p. 10). This can be interpreted as the market deciding what they want and that the companies have to come up with solutions for this market. This can be seen in line with the qualitative analysis, as it appears that what the customer/market wants is important for the companies to follow. As mentioned by one of the informants:

> “We have to balance the whole way, how brave we are when it comes to what we suggest and recommend, and how long vi keep doing it until we have to give up, if the customer wants something else”(Extern informant, own translation).

So, it seems that what the customer wants prevails. Having a good reputation seems important for the informants and it therefore seems like they have to follow what the market wants.

The informants also mention the technology and digitalization as important for the industry too become more sustainable, especially in relation to the information about the materials in the industry. According to Meng and Brown (2018) and their study on innovation in construction, they found that “construction innovation results from a combination of technology-push and market-pull, in which market-pull may be more effective than technology-push” (Meng & Brown, 2018, p. 1221). Uncertain demand for the companies’ innovations ideas are also effected by what the market wants, so it could seem that this is relevant for environmental innovations as well in the construction industry.

According to Yu et al., (2022, p. 1) the technology with ICT tools were seen as essential in a move to a more circular economy. This is also seen in the interviews by some of the informants, when they talk about digitalization and the need to register all the information. This is also seen in the Context chapter 2 in the thesis, and the governments focus on getting information digitized. In the Ramirent report (2023), its also shown that 27% thinks that one of the reasons to why the industry is not more digital, is because of the employees and their lack of knowledge. As seen in the qualitative analysis, digitalization is mentioned as an important area in this transition and its also one of the areas COWI possibly can contribute.

6.3.3 Laws and regulations

Policy settings were seen by Ghisetti et al., (2017) in the statement mentioned under section 6.1.1 in the discussion as crucial for the development of environmental innovations. The policy was also

mentioned by some of the informant as important since it says something about what you should do. Many of the informants also talked about the need for laws and regulations and that it could be seen as a driver for environmental innovation. According to Rennings (2000) he wrote that "Because factors of technology push and market pull alone do not seem to be strong enough, eco- innovation need specific regulatory support"(Rennings, 2000, p. 326). Stuck (2019, pp. 1262–1263) also confirms in his study that the "lack of favorable political framework" is seen as an important barrier. So, when some of the informants say that laws and regulations would help, this can be seen in line with the theory. Laws and regulations are therefore seen as an important driver to environmental innovation in the construction industry in Norway. But, as one of the informants mentioned, it's important to find the right balance.

> "Laws and regulations are always an important player, but there is also a balancing act ofcourse" (External informant, own translation).

6.3.4 New business models

Through the interviews there seems to be a common thought that the business models and the way the companies in the construction industry gets paid for the jobb they are doing is problematic and might be seen as a barrier to innovation. The usual paid per hour model, does not give room for innovation and therefor also affects environmental innovation. The need for new business models for the company to become sustainable is also confirmed as necessary by Jørgensen and Pedersen (2018, p. xiii). As mentioned in the theory above by Shenhar and Dvir (2007, p. 22) the old way of doing projects, need to change. According to the qualitative analysis it seems that the construction industry is still following some of the same principle, of getting paid per hour. The analysis show that the industry seem to show signs of wanting to change, through more collaboration about common goals, and common incentives in their contracts. The Contract is as mentioned in chapter 1.1, also seen as a barrier to innovation. According to Jørgensen and Pedersen (2018, pp. 121–123) companies need to be more open and work across company boundaries to solve the sustainability problems through collaboration and different alliances. Something we also see the informants in the analysis mentioned, when talking about the need for more collaboration and the fact that you cannot do thins alone.

The informants talk about the need to create a common goal and define success together, and this seems more relevant now than ever. Some of the informants have pointed out that is scary to do something new, since they don't know the outcome. According to Jørgensen and Pedersen (2018, p. 37) becoming more sustainable can also be beneficial in the long , if they manage to change their strategy and business model so that its combined with sustainability. This seems great, but the

problem Is that long term benefits, are not always optimal for the companies and it creates uncertainty since they have to believe, instead of being sure. One informant said:

> "We have faith in that it will have a value in 10 years, what we do today, but we cannot calculate it home today, so we have to believe" (External Informant, own translation).

A sustainable business model is also as mentioned in section 3.1 seen to focus on the long term perspective (Geissdoerfer et al., 2018, p. 409). This is in line with environmental innovation which is also seen to have a long-term perspective by some of the informants in the analysis. According to Jørgensen and Pedersen(2018) taking on a circular strategy is seen as a way to be more sustainable, and this means leaving the "take, make and dispose" (Jørgensen & Pedersen, 2018, p. 103). Jørgensen and Pedersen (2018, pp. 18–19) also mention the Restart framework about sustainable business model innovation, and it includes alliances and the circular economy. This can therefore be seen in relation to the qualitative analysis, and the need for a new business modell as mentioned by the informants, with a focus on more cooperation in the construction industry.

6.3.5 Move to a more Circular Economy

So, how can environmental innovation be seen in relation to this transition? The move to a more circular economy is mentioned by many of the informants as a good solution to solve some of the problems the construction industry is facing, especially the reuse of materials, digitalization and creating materials that are demountable. Eco-innovation is seen to help companies with lowering the impact on the environment (Cai & Zhou, 2014, Reffered to in; Zubeltzu-Jaka et al., 2018, p. 1093). According to Bocken et al., (2016, p. 310) the design of products is important when thinking about the circular economy. As mentioned under 5.2.3.5 some of the informants talk about the need to produce solutions that are easier to dismantle or take apart and reuse. This can be seen in line with section 3.2 and the design for closed loops and slowing resource loops mentioned by Bocken el al., (2016).

Bocken et al., (2016) writes about "Design for disassemble and reassembly" and explains it as "[…] a strategy, which is overlapping with, and contributing to Design for a Tech-nological and biological cycle. It is about ensuring that products and parts can be separated and reassembled easily [4]"(Baker et al., 2014, Refferd to in; Bocken et al., 2016, p. 311). This can be seen in relation to the Butterfly model by the Ellen Macarthur foundation mentioned in chapter 3.2. Which also talks about the circle of the products and if they are put in the biological or technical cycle. This is also in line with what the informants said about the need for products that can be dismantled and reused. Another informant also said

> "There simply has to be more innovations on solutions that are demountable" (External informant, own translation).

This can be seen as a sign of the need for more products that fit this description. This might also be seen in relation to what Wuni (2022, p. 9) found when it comes to lack of materials in the supply chain as a barrier to the circular economy in the construction industry. I therefor think that by removing some of the barriers to environmental innovations, you might be able to produce more products that are in line with this strategy. As seen in the analysis, there also seem to be a problem with profitability when it comes to environmental innovations and the transition to the circular economy, and the fact that it still is cheaper to throw away things and buy new instead of taking care of the materials you have. This barrier can therefore be seen to directly affect the interest of developing these new products that the circular economy needs.

Some of the informants also said that reducing cost and increasing the quality is an important driver for environmental innovation. High upfront innovation cost, is also mentioned as a barrier to the circular economy by Wuni (2022, p. 12). This again could mean that by reducing the financial barriers and focusing on the drivers of environmental innovations, especially by making it easier to innovate and create cheaper and better products with environmental benefits, could help the transition to a more circular economy. One informant said this about a possible barrier to environmental innovation:

> "If you are thinking about Circular economy, like reuse for example […] the industry has worked for a long time to achieve the most cost-effective production of materials and the components that go into construction in order to be competitive and to get them cheap, […] if we are to replace the line that we have today, with other things, like if reused materials are to be seen as competitive, then they basically have to compete on price and availability, and that is demanding against a production line that has been streamlined" (Informant, own translation).

So again, it seem that all comes down to profitability and costs. Ghisetti et al.,(2017) also writes that "policies can stimulate green innovations by reversing their risk/return trade-off, or, in other terms, by reducing the perceived risk of EI and making more evident the positive economic returns of their investments"(Ghisetti et al., 2017, p. 143). More public funding and innovation support could therefore help companies to reduce the barrier they mention when it comes to high innovations costs or risks or uncertainty, which then again could lead to more environmental innovation.

Collaboration about innovation activities is seen as a drivers for environmental innovation in the qualitative and quantitative analysis. According to the informants, the creation of some of the materials needed for the circular economy is dependent on collaboration. This is also confirmed in a

study by Hopkinson et al.,(2020) and their direct quote of Yang et al., “Making supply chains circular cannot be achieved by a specific firm, as it requires collaboration between the organizations across the supply chains and other stakeholders from similar and/or diverse sectors”(Yang et al., 2018, Stated in; Hopkinson et al., 2020, p. 3). I therefor think this can be seen in relation to having more collaborations with the supply chain, that possibly could lead to new materials or new ways of doing things. This could help reduce the barrier that is mentioned to the circular economy with the supply chain under 3.2.1. This implies that you need to work on removing the barriers to environmental innovations to be able to crate the materials and systems needed for the circular economy.

Lack of knowledge is seen as a barrier to environmental innovation in the analysis. Lack of knowledge is also mentioned as a barrier to the circular economy (Wuni, 2022, p. 12). In the report by Ramirent (2023, p. 11) lack of qualified personnel, is seen as one of the biggest reason to stopping the digitalization of the workplace. Digitalization is also mentioned in chapter 2 by the national strategy for the Circular economy in Norway as an area that is very important for the change to a more circular economy. This is something we also see in the article by Yu et al., (2022, p. 1) about the need for ICT-based solutions for the construction industry to become more circular. To better implement CE in the construction sector Yu et al., (2022, pp. 12–14) recommend that the private and public actors should collaborate through a information and communication technology based environment like a Circularity information platform (CIP). This is seen as a system that through information communication technology is able to handle all the different types of detailed information that makes it possible to have an overview of what is needed for a circular strategy (Yu et al., 2022, pp. 12–14). The analysis of the interviews show that the industry is in the need of better business models and business models that facilitate collaboration in a better way, and CIP could therefore be seen to help this process.

6.3.6 Possible contributions from the consulting company - COWI

According to the analysis COWI can contribute in different ways when it comes to helping the industry become more circular. Some of the ways that seem relevant are through sharing knowledge and information with their customers, creating collaborations to reach a common goal, and possibly also setting good examples and inspiring others to do the same.

According to De Marchi (2012, p. 621), consultants are seen as one of the scientific agents that can specifically contribute with knowledge that can lead to environmental innovations through cooperations. Through the analysis and the case info about COWI, they seem to have quite a large knowledge network of competencies and skills, and they work with many different projects, with R&D in many different ways and they have their own research unit, Aqua team. This can be seen as an advantage because when other companies might lack qualified personnel In Norway, COWI can find

this knowledge through their company outside of Norway. In a study by Liao and Liu (2021) they write that environmental innovation is related to knowledge sources, "Consequently, firms with more knowledge sources can make full use of the spillover effect of their contact network, thereby promoting environmental innovation"(Liao & Liu, 2021, p. 1861). It therefor seems that COWI is in a good position to share this knowledge with their customers and partners and promote environmental innovation. Environmental innovation is also seen to be effected positively by the companies size, because they have more resources than small companies (Song et al., 2018; Stated in; Liao & Liu, 2021, p. 1861). So, since COWI is seen as a big company, they probably have more resources to use on environmental innovations. "Large-scale firms are therefore more inclined to adopt environmental innovation measures"(Liao & Liu, 2021, p. 1861).

Collaboration about innovation activities is seen as important in the quantitative and qualitative analysis. The analysis also seem to show that COWI has a focus collaborations, and as mention in the Case description 4.2.1 in 2021 they also entered into new partnerships with relevant actors. This can therefore also be seen as an area where they can contribute in the process of creating more environmental innovation. According to theory as also mentioned under 6.2.2, by Cainelli et al., (2015, p. 217) the introduction of eco-friendly products are affected by the number of partners you collaborate with. So, this means that by starting more collaborations with new partners and customers, they could contribute to eventually develop even more environmental innovations.

In the analysis, the informants say that COWI's new strategy "Future now" set certain demands for the projects, like no to fossil fuels This has led to the company saying no to different projects, and it can be seen as a way to set the standards. One informant said:

> "This means that we have said no to customers, and we have said no to projects. We do not want to work on projects with fossil fuel, fossil fuel or components" (Internal informant, own translation).

I see this as an inspiration to others, since they are leading the industry in a new direction that is more sustainable. Another way that COWI possibly can contribute inn this process seems to be through digitalization. Digitalization of the industry is as mentioned by one of the informants under 5.2.3.5 seen as essential for the construction industry. As shown in the theoretical framework in section 3.2.1 ICT tools like BIM, are examples that are seen as relevant for making the industry more circular. Digitalization is also mentioned in chapter 2 as important for the Circular Economy, especially in relation to product information. Digitalization is therefore seen as an important part of this transition, and a place where COWI could contribute.

The analysis shows that for COWI its important to come in early on projects so that they are able to influence the project as much as possible. Some of the ways it seems that COWI can contribute is through sharing information and inspiring their customers, digitalization, collaboration, and bringing in knowledge and competencies from their international network and R&D processes that other companies in the construction industry might not have. Their knowledge on digitalization of information also seem relevant in the transition to a circular economy. Since COWI has implemented their strategy "Future now" with demands on certain sustainability elements, they have set their own standards, and I think this can be seen as a contribution in the process of becoming more sustainable and maybe putting a pressure on others to do the same.

7.0 Conclusion

Based on the theoretical framework, the analysis of the data, and the discussion above, the thesis will now combine this into a short conclusion. This thesis has two research questions:

> RQ1: "Which drivers and barriers of environmental innovation appear as especially important in the construction industry?".
>
> RQ2: "How do these barriers and drivers appear and how do they relate to the transition to a circular economy in the construction industry?".

According to the analysis the construction industry introduces about 9% less environmental innovations that the other industries in Norway. This is in line with the theory mention in section 1.1 and the perception that they are conservative and lagging behind others. There are many possible reasons to this, but some of the barriers to environmental innovations that were significant in the statistical analysis where uncertain demand for the company's innovation ideas and lack of qualified personnel. Uncertain demand for the company's innovation seem to be an important barrier, since the market is also highlighted as important in the interviews. The market seems to affect the companies to a high degree when it comes to implementing new ideas and taking the risk that is needed for this to happen, since risk also is perceived to be a barrier for innovation. Lack of qualifications are also seen as an important barrier in the analysis and the discussion since you need the right knowledge to be able to innovate and people to do it. The business models in the construction industry is also seen as a possible barrier to innovations, and it seems that the industry need new business models that better facilitates for collaboration, innovation and the possibility to create a common goal.

The quantitative analysis showed that collaboration about innovation ideas, professional conferences and self-executed R&D were important drivers for environmental innovation in the construction

industry. Collaboration is perceived to be especially important in the quantitative and qualitative analysis. Participation as professional conferences were also seen as important in both the analysis, but there where also a focus on participation in projects as being more important. The low percentage point increase in the analysis also show that participation as conferences does not have as high percentage points as collaboration about innovation activities, even dough 75% of the industry said they participate at professional conferences and only 9% collaborated about innovation activities. The change in the society and the increasing focus on sustainability mentioned by the informants, might also seem to make it easier for the companies to talk more about sustainable solutions now than before. The digitalization of information is as discussed in this thesis seen as important by the theory in section 3.2.1, the government in section 2, and by some of the informants and creating a common circularity information platform as suggested by Yu et al., (2022) might be a good suggestion.

So, as mentioned in section 3.3.1 since environmental innovations can be seen as innovations with a positive effect on reducing environmental harm (Oltra & Saint jean, 2009, Schiederic et al., referenced in; Karttunen et al., 2021, p. 2). This can indicate that environmental innovation is relevant for the move to a more circular economy which entail reducing waste and designing sustainable solutions. According to Horbach (2013) "[…] Eco-innovation may even lead to a so called "win-win" situation characterized by both economic and environmental benefits […]"(Horbach et al., 2013). It therefore seems that introducing more environmental innovation in the construction industry could have a positive effect on the environment and for the companies finances.

De Jesus and Mendonça (2018) write "EI is considered to be an essential pathway for overcoming barriers to a CE transition"(de Jesus & Mendonça, 2018, p. 85). This is in line with this thesis, since it seems that more environmental innovations might be able to help the industry become more circular. Lack of sustainable material, too high innovation costs, and lack of knowledge is as mentioned seen as some of the barriers to the Circular economy (Wuni, 2022). The analysis and the discussion show that especially creating products that are demountable are seen as important by the informants to become more circular. This is also as mentioned one of the possible design solution by Bocken et al.,(2016, p. 311). The thesis therefore see this as an area where environmental innovation is seen as a possible solution to help create sustainable products, and especially products that are demountable as mentioned by the informants. This can therefore be seen in relation to the lack of sustainable materials and maybe help reduce this barrier for the circular economy. Based on the discussion above, I think that by developing more knowledge and skills in the industry that can lead to sustainable materials this could help create more sustainable solutions for the industry and remove some of the barriers that are mentioned. Since better quality for lower prices are seen as a driver for environmental

innovation in the qualitative analysis, I think this also can be seen in relation to the high innovation cost barrier mentioned for the circular economy. It therefore seems that producing better products at a lower price can help the move to a more circular future.

As a global full service consulting company there seems to be many ways that COWI can contribute inn this process, and some of the ways are through setting a good example, through collaborations, through sharing knowledge and information from their global network, and from their R&D and projects and experience.

According to the analysis, The market and the society seem to put restrictions on the demand in the industry, and that affects the companies innovations ideas, because it creates uncertainty about the profitability of developing something new. Profitability is perceived as important for the companies, and it therefore seems necessary to create a framework were creating innovations with environmental benefits is not seen as a burden or risk with to high innovations costs for the company, but instead make it easier for companies to invest in something that is for the good of the society and the company in the long run. The move to a circular economy for the construction industry is seen as a possible solution in the analysis, but there still seems to be some challenges that needs to be handled.

7.1 Theoretical contributions

This thesis contributes with information about barriers and drivers to environmental innovation in the construction industry in Norway. The study reveals which barriers and drivers appear as important and give a deeper understanding of them. The percentage points that are mentioned in the quantitative analysis, also show to what degree some of the barriers and drivers affect environmental innovation. This can give a sign to which areas to focus on in the future to achieve more environmental innovation. According to the results from the analysis, it seems that especially collaboration about innovation activities appear as an important driver of environmental innovation, and something the industry should work more on in the future. This study therefore contributes with information on some of the barriers and drivers that appear as important for environmental innovation in the construction industry, and possibly information about the road to a more circular future for the industry.

7.2 Practical implications

This thesis provides detailed information about barriers and drivers that appear as important for the construction industry. This is something that COWI and other consulting companies or relevant actors in Norway could use to overcome barriers and/or push the relevant drivers to environmental innovation in the construction industry. The findings indicate that especially collaboration about innovation activities and lack of knowledge is affecting environmental innovation in the construction

industry. lack of knowledge is perceived as important in both the analysis and this is something I think the industry and other actors can tackle by sharing more information and developing more new knowledge together. This could be done through sharing knowledge at professional conferences since they are seen as popular in the analysis, or maybe creating Construction-hubs as also discussed as a possible solution in one of the interviews.

7.3 Limitations

Since this thesis only looks at the construction industry in Norway, the results are restricted to this industry and cannot be generalized to other industries. This master thesis is also restricted by time and resources, so the analysis and the conclusions have to be seen in relation to this. The thesis only uses 5 interviews, and this can be seen as a weakness in the qualitative data material. Another limitation might be that the interviews were done with a fellow student, since it could have led to other questions that were more direct about environmental innovations if they were done alone. Further research could be conducted on the barriers and drivers of environmental innovation separately and in more detail. Collaboration is perceived as an important driver with the highest percentage point, but only 9% of the companies listed that they collaborated about innovation activities, and it could therefore be interesting to investigate this more closely to find out how this can change, so that they better facilitate for collaboration and environmental innovation and the transition to a circular economy.

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9.0 Appendix

9.1 Interview guide Internal informants

Introduksjon av masteren/oppgavene

1. Hva er dine tanker om innovasjon og bærekraft?
2. Hva tenker du innovasjon og bærekraft har å si for bygg og anleggsbransjen?
3. Hvordan rådgiver dere prosjekter i bygg og anleggsbransjen når det gjelder bærekraft?
    a. Miljømessig innovasjoner - Sirkulær økonomi
    b. Ledelse og forretningsmodeller
    c. Sertifisering – BREEAM – FN's bærekraftsmål
4. Hva tror du er barrierer når det gjelder utviklingen av innovasjoner i bygg og anleggsbransjen?
    a. Hvorfor tror du dette?
    b. Er det annerledes for barrierer for Innovasjoner med miljøfordeler/miljømessige innovasjoner? I så fall, hvordan?
5. Hva tror du er drivere når det gjelder utvikling av innovasjoner i bygg og anleggsbransjen?
    a. Hvorfor tror du dette?
    b. Tror du det er annerledes for drivere for Innovasjoner med miljøfordeler/ miljømessige innovasjoner? I så fall hvordan?
6. Hva tenker du om dagnes forretningsmodeller i bygg og anleggsbransjen og overgangen til nye forretningsmodeller?
    a. Sirkulær økonomi
    b. Barrier-drivere (utfordringer)
    c. Leders/deres rolle
7. Hvordan mener du COWI bidrar med verdiskapning i dag, og hva er målet med fremtidig verdiskapning i bygg og anleggsbransjen?
    a. Innovasjoner med miljøfordeler- Sirkulær økonomi
    b. Ledelse
    c. Kunnskap
8. Hva tenker du om dagens kompetanse i bygg og anleggsbransjen når det gjelder innovasjoner og bærekraft?
    a. Kompetanse hos ledelsen
    b. Mangel på kvalifisert personell internt i bygg og anleggsbransjen kan ses som barriere til innovasjoner med miljøfordeler, hva tenker du om dette?
9. Hvordan jobber COWI med kunnskap og kompetanseheving rettet mot bygg og anleggsbransjen?
    a. Innovasjon og bærekraft?
    b. Miljømessig innovasjon?
    c. Kilden til kunnskap? Hva slags møteplasser bruker dere for å utveksle og hente inn kunnskap? Intern og ekstern (faglige Konferanser)
    d. Forskning og utvikling (FOU)?
10. Hva tenker du om samarbeid i bygg og anleggsbransjen? Og hvilken rolle har dere i dette?
    a. Samarbeid om Innovasjonsaktiviteter utenom FOU virker viktig for Innovasjoner med miljøfordeler i bygg og anleggsbransjen. Hva kan dette handle om, hvorfor er det slik?
    b. Felles verdiskaping?

11. Hvordan opplever COWI/dere at ledelse og ledelsesstrategier er i dag i bygg og anleggsbransjen? Og er de der de bør være med tanke på bærekraftig omstilling?
    a. Miljømessig innovasjon?
    b. Sirkulær økonomi
12. Hvilken rolle har COWI når det gjelder å komme med nye ideer til bærekraftige innovasjoner til bygg og anleggsbransjen? (Kommer de fra COWI eller komme de fra bransjen?
    a. Sirkulær økonomi
13. Blir det gjort noen undersøkelser på hvordan deres kunder/samarbeidspartnere opplever/bruker rådgivningen deres når det gjelder bærekraft?
    a. Hva har tilbakemeldingene vært og har det ført til gevinst/verdi?
14. Er det noe du ønsker å legge til?

9.2 Interview guide External informants

Ekstern til samarbeidspartnere/Kunder av COWI i bygg og anleggsbransjen
Introduksjon av masteren/oppgavene

1. Hva er dine tanker om innovasjon og bærekraft?
2. Hva tenker du innovasjon og bærekraft har å si for bygg og anleggsbransjen?
3. Kan du kort forklare hva slags forettingsmodell dere i dag?
4. Hva tror du er barrierer når det gjelder utviklingen av innovasjoner i bygg og anleggsbransjen?
    a. Hvorfor tror du dette?
    b. Er det annerledes for innovasjoner med miljøfordeler/miljømessige innovasjoner? I så fall, hvordan?
5. Hva tror du er drivere når det gjelder utvikling av innovasjoner i bygg og anleggsbransjen?
    a. Hvorfor tror du dette?
    b. Tror du det er annerledes for innovasjoner med miljøfordeler/miljømessige innovasjoner? I så fall hvordan?
6. Hvordan jobber dere med innovasjon og bærekraft?
    a. Miljømessig innovasjoner - Sirkulær økonomi
    b. Ledelse og forretningsmodeller
    c. Sertifisering – BREEAM – FN's bærekraftsmål
7. Hva tenker du om dagen forretningsmodeller i bygg og anleggsbransjen og overgangen til nye?
    a. Sirkulær økonomi?
8. Når søker dere ekstern rådgivning og hvordan bruker dere dette i arbeidet?
    a. Ledelse
    b. Bærekraft
    c. Innovasjon? Miljømessig innovasjon (Sirkulær økonomi)
9. Hva tenker du om samarbeid i bygg og anleggsbransjen når det gjelder innovasjon og innovasjonsaktiviteter?
    a. Samarbeid om innovasjonsaktiviteter uten om FOU viktig i bygg og anleggsbransjen? Hva tenker du om dette?
    b. Organisering internt opp mot innovasjoner
    c. Samarbeid med COWI?
10. Hvordan legges det til rette for at “alle” kan bidra med innovasjons arbeid i bedriften?
11. Hvordan jobber dere med kunnskap og kompetanseheving?

a. Innovasjon og bærekraft?
b. Miljømessig innovasjon?
c. Kilden til kunnskap? Hva slags møte plasser bruker dere (Faglige konferanser)

12. Mangel på kvalifisert personell i bygge bransjen ser ut til å være en barriere for å implementere innovasjoner med miljøfordeler. Hvorfor tenker du det er slik?
13. Hvordan jobber dere med forskning og utvikling?
    a. Forskning og utvikling i eget foretak viktig for innovasjoner med miljøfordeler
14. Hvilke utfordringer påvirker deg i som leder når det gjelder grønn omstilling i bygg og anleggsbransjen?
    a. Eksterne faktorer – ytre press – lover og reguleringer (Samfunnsansvar)
    b. Intern faktorer – kultur – ansatte
15. Er det noe du ønsker å legge til?

9.3 Tables from statistical analysis

9.3.1 VIF Scores

Table over VIF scores: VIF-Results performed after linear regression analysis in Stata

Variabel name	**VIF scores**
Lack of Qualified/Skilled personnel in the company	2.43
Source of information/knowledge (Professional conferences, meetings, fairs and exhibitions)	1.04
Collaboration about innovation activity	1.14
Self-executed R&D	1.21
Uncertain demand for the companies innovation ideas	2.72
Lack of public funding and innovation support	2.00
Logansatte	1.11
Mean VIF	1.66

9.3.2 Chronbach alpha

Table over results from Cronbach's α performed in STATA

Cronbach's α from

Variables from CIS Data	Obs.	Item-test correlation	Item – rest Correlation	Average Inter-item covariance	Cronbach's alpha
Environmental benefits inside the company					
Reduced material, raw material or water consumption per unit	6427	0,7413	0,6762	0,0966565	0,8910
Reduced energy consumption or reduction of over all CO2-emissions	6427	0,7343	0,6641	0,960826	0,8916
Reduced noise pollution or pollution/emissions to soil, water or air	6427	0,7305	0,6517	0,0946206	0,8927
Replaced material use with a less pollution or harmful alternative	6427	0,6858	0,6235	0,1012531	0,8940
Replace the use of fossil energy with renewable energy sources	6427	0,6787	0,6088	0,1001979	0,8944
Recycling of waste, water or materials for own use or sale	6427	0,6869	0,6149	0,0992556	0,8941
Other environmental benefits within the company	6427	0,7046	0,6382	0,991836	0,8930
Environmental effects for customers or end user					
Reduced energy consumption or reduction of overall CO2-emissions	6427	0,6580	0,5882	0,1014865	0,8954
Reduced energy consumption or reduction of over all CO2-emissions	6427	0,7066	0,6458	0,100244	0,8929
Arranged for recycling/reuse of the company's products	6427	0,6871	0,6144	0,0991192	0,8941
Extended product life through more durable or long lasting products	6427	0,6965	0,6252	0,0987416	0,8936
Other environmental benefits for customers or end user	6427	0,6204	0,5388	0,1017143	0,8978
Test scale				**0,990463**	**0,9017**

Se sub-question 1-12 under question 20 in the CIS data for the variables that are used in this test. (See appendix 9.5. Question 20, Own translation).

9.4 Processing of Personal data - Sikt

Sikt

Meldeskjema / Towards a more circular economy for the construction industry / Vurdering

Vurdering av behandling av personopplysninger

Referansenummer	Vurderingstype	Dato
869021	Standard	03.03.2023

Prosjekttittel
Towards a more circular economy for the construction industry

Behandlingsansvarlig institusjon
Høgskolen i Innlandet / Handelshøgskolen Innlandet - Fakultet for økonomi og samfunnsvitenskap / Institutt for organisasjon, ledelse og styring

Prosjektansvarlig
Anne Jørgensen Nordli

Student
Kristi Strøm Lie

Prosjektperiode
28.02.2023 - 31.08.2023

Kategorier personopplysninger
Alminnelige

Lovlig grunnlag
Samtykke (Personvernforordningen art. 6 nr. 1 bokstav a)

Behandlingen av personopplysningene er lovlig så fremt den gjennomføres som oppgitt i meldeskjemaet. Det lovlige grunnlaget gjelder til 31.08.2023.

Meldeskjema

Kommentar
Vår vurdering er at den planlagte behandlingen i dette prosjektet er lovlig, hvis den gjennomføres slik den er beskrevet i meldeskjemaet med dialog og vedlegg og vurderingen her.

OM VURDERINGEN
Sikt har en avtale med institusjonen du forsker eller studerer ved. Denne avtalen innebærer at vi skal gi deg råd slik at behandlingen av personopplysninger i prosjektet ditt er lovlig etter personvernregelverket.

FØLG DIN INSTITUSJONS RETNINGSLINJER
Vi har vurdert at du har lovlig grunnlag til å behandle personopplysningene, men husk at det er institusjonen du er ansatt/student ved som avgjør hvilke databehandlere du kan bruke og hvordan du må lagre og sikre data i ditt prosjekt. Husk å bruke leverandører som din institusjon har avtale med (for eksempel ved skylagring, nettspørreskjema, videosamtale eller liknende).

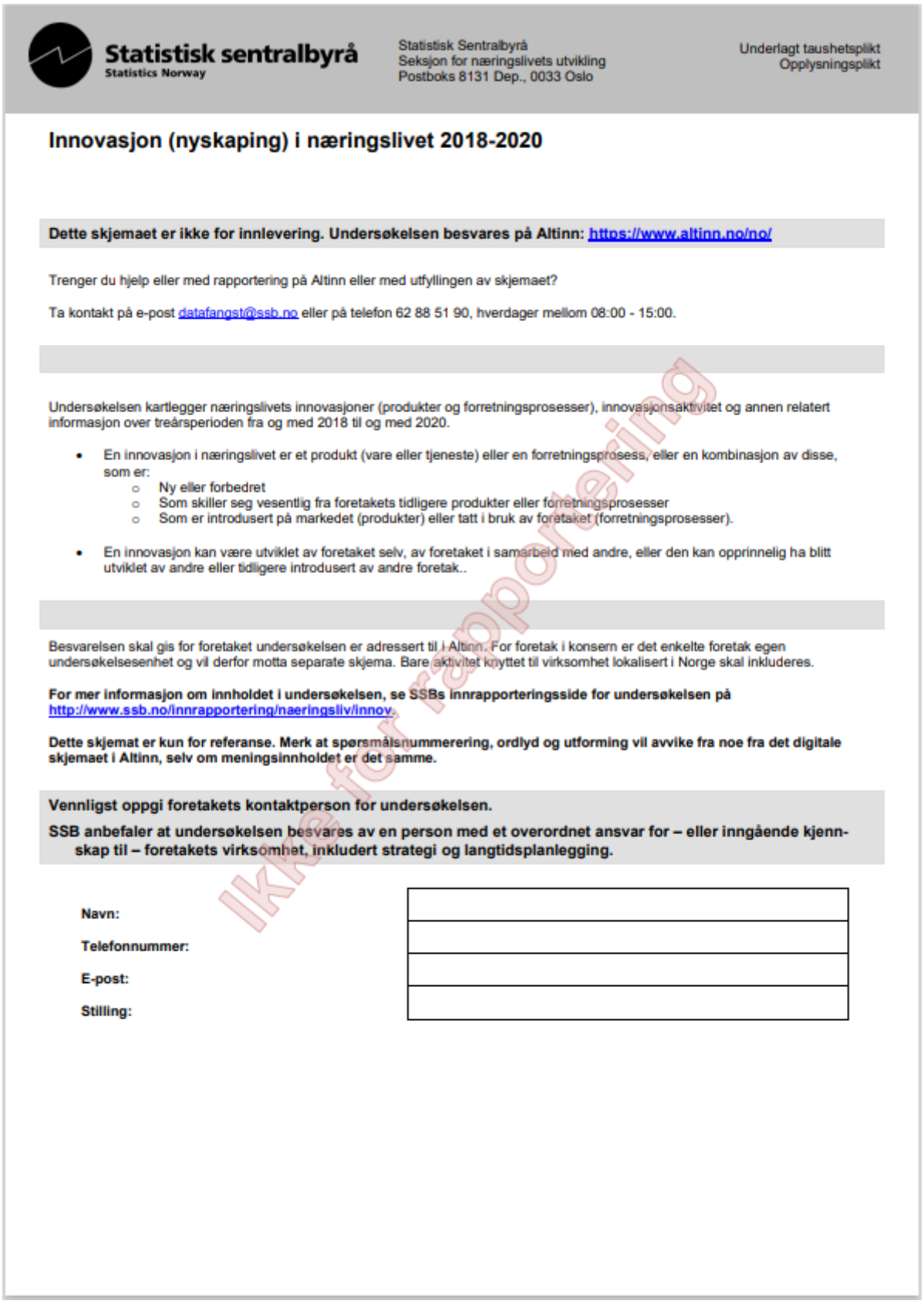
Personvernтjenester legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

MELD VESENTLIGE ENDRINGER
Dersom det skjer vesentlige endringer i behandlingen av personopplysninger, kan det være nødvendig å melde dette til oss ved å oppdatere meldeskjemaet. Se våre nettsider om hvilke endringer du må melde: https://sikt.no/melde-endringar-i-meldeskjema

OPPFØLGING AV PROSJEKTET
Vi vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Lykke til med prosjektet!

9.5 Community Innovation survey CIS: By Statistics Norway



Statistisk sentralbyrå
Statistics Norway

Statistisk Sentralbyrå
Seksjon for næringslivets utvikling
Postboks 8131 Dep., 0033 Oslo

Underlagt taushetsplikt
Opplysningsplikt

Innovasjon (nyskaping) i næringslivet 2018-2020

Dette skjemaet er ikke for innlevering. Undersøkelsen besvares på Altinn: https://www.altinn.no/no/

Trenger du hjelp eller med rapportering på Altinn eller med utfyllingen av skjemaet?

Ta kontakt på e-post datafangst@ssb.no eller på telefon 62 88 51 90, hverdager mellom 08:00 - 15:00.

Undersøkelsen kartlegger næringslivets innovasjoner (produkter og forretningsprosesser), innovasjonsaktivitet og annen relatert informasjon over treårsperioden fra og med 2018 til og med 2020.

- En innovasjon i næringslivet er et produkt (vare eller tjeneste) eller en forretningsprosess, eller en kombinasjon av disse, som er:
  - Ny eller forbedret
  - Som skiller seg vesentlig fra foretakets tidligere produkter eller forretningsprosesser
  - Som er introdusert på markedet (produkter) eller tatt i bruk av foretaket (forretningsprosesser).
- En innovasjon kan være utviklet av foretaket selv, av foretaket i samarbeid med andre, eller den kan opprinnelig ha blitt utviklet av andre eller tidligere introdusert av andre foretak..

Besvarelsen skal gis for foretaket undersøkelsen er adressert til i Altinn. For foretak i konsern er det enkelte foretak egen undersøkelsesenhet og vil derfor motta separate skjema. Bare aktivitet knyttet til virksomhet lokalisert i Norge skal inkluderes.

For mer informasjon om innholdet i undersøkelsen, se SSBs innrapporteringsside for undersøkelsen på http://www.ssb.no/innrapportering/naeringsliv/innov.

Dette skjemat er kun for referanse. Merk at spørsmålsnummerering, ordlyd og utforming vil avvike fra noe fra det digitale skjemaet i Altinn, selv om meningsinnholdet er det samme.

Vennligst oppgi foretakets kontaktperson for undersøkelsen.

SSB anbefaler at undersøkelsen besvares av en person med et overordnet ansvar for – eller inngående kjennskap til – foretakets virksomhet, inkludert strategi og langtidsplanlegging.

Navn:	
Telefonnummer:	
E-post:	
Stilling:	

Foretakets marked og strategier

1. I hvilke geografiske markeder solgte foretaket sine varer eller tjenester i perioden 2018-2020? Sett kryss for hvert marked. Hvilket er det viktigste markedet? Sett ett kryss i siste kolonne.

	Hvilke markeder (Flere kryss mulig)	Viktigste marked (Kun ett kryss)
Lokalt/regionalt i Norge	☐	☐
Norge for øvrig	☐	☐
Andre EU-/EFTA – land[1]	☐	☐
Verden for øvrig	☐	☐

Hvis foretaket kun har kunder i Norge, gå til spørsmål 2.

1.1 Anslagsvis hvor stor andel av foretakets omsetning i 2020 kom fra:

Kunder lokalt/regionalt i Norge	, , %
Kunder i Norge for øvrig	, , %
Kunder i EU-/EFTA – land[1]	, , %
Kunder i verden for øvrig	, , %
Total omsetning i 2020	1 ,0 ,0 %

[1] *Følgende EU-/EFTA-land: Belgia, Bulgaria, Danmark, Estland, Finland, Frankrike, Hellas, Irland, Island, Italia, Kroatia, Kypros, Latvia, Litauen, Luxembourg, Malta, Montenegro, Nederland, Polen, Portugal, Romania, Slovakia, Slovenia, Spania, Storbritannia, Sveits, Sverige, Tsjekkia, Tyskland, Ungarn og Østerrike.*

2. Hvor viktige var de følgende strategiene for foretakets økonomiske resultater i perioden 2018-2020?

	Svært viktig	Nokså viktig	Lite viktig	Ikke viktig
Forbedring av eksisterende varer og tjenester	☐	☐	☐	☐
Utvikling og lansering av helt nye varer og tjenester	☐	☐	☐	☐
Lav pris på varer eller tjenester (prisledende strategi)	☐	☐	☐	☐
Høy kvalitet på varer eller tjenester (kvalitetsledende strategi)	☐	☐	☐	☐
Å tilby et bredt tilfang av produkter eller tjenester	☐	☐	☐	☐
Fokus på en enkelt eller noen få sentrale produkter eller tjenester	☐	☐	☐	☐
Prioritere å betjene etablerte kundegrupper	☐	☐	☐	☐
Forsøk på å nå nye kundegrupper	☐	☐	☐	☐
Standardiserte/faste produkter eller tjenester	☐	☐	☐	☐
Utvikling av kundespesifikke løsninger	☐	☐	☐	☐

3. Gikk foretaket i løpet av perioden 2018-2020 til anskaffelse av maskiner, utstyr eller programvare basert på:

	Ja	Nei
Tilsvarende eller oppdatert teknologi som allerede var i bruk i foretaket	☐	☐
Ny teknologi som ikke allerede var i bruk i foretaket	☐	☐

4. For å møte brukerbehov, tilbød eller leverte foretaket varer eller tjenester som var utviklet på noen av de følgende måtene i løpet av perioden 2018-2020?

	Ja	Nei
Kunden/brukeren hadde en aktiv rolle i konseptualisering, design og utvikling av varen eller tjenesten (samskapt av kunder/brukere, co-creation)	☐	☐
Designet og utviklet av foretaket selv, særskilt for å møte behovene til spesifikke kunder/brukere (spesialutviklet for kunder/brukere). Ekskluder tilpasset skreddersøm og annen kundetilpasning av standard varer eller tjenester	☐	☐
Tilpasset skreddersøm (mass customization) eller annen tilpassing av standard varer eller tjenester	☐	☐

Immaterielle rettigheter (IPR)

5. Utførte foretaket i løpet av perioden 2018-2020 noe av det følgende:

	Ja	Nei
Søkte om et patent	☐	☐
Søkte om registrering av et design	☐	☐
Søkte om registrering av et varemerke	☐	☐
Benyttet seg av hemmelighold/forretningshemmeligheter	☐	☐
Gjort krav på eller hevdet retten til et åndsverk (copyright)	☐	☐

6. Utførte foretaket i løpet av perioden 2018-2020 noe av det følgende:

	Ja	Nei
Solgte eller tilordnet et patent, en designrettighet, opphavsrett eller et varemerke til andre	☐	☐
Lisensierte ut rettighetene til å benytte et patent, en designrettighet, opphavsrett eller et varemerke til andre	☐	☐
Inngikk avtaler om deling av immaterielle rettigheter (pooling, krysslisensiering, etc.)	☐	☐
Kjøpte eller anskaffet lisens[1] til et patent, en designrettighet, opphavsrett eller et varemerke fra private foretak eller individuelle rettighetsholdere	☐	☐
Kjøpte eller anskaffet lisens[1] til et patent, en designrettighet, opphavsrett eller et varemerke fra universiteter, høyskoler, offentlige forskningsinstitutter eller andre offentlige rettighetshavere	☐	☐

[1] *Ekskluder lisenser for standard (ikke-spesialutviklet) programvare og eksemplaranskaffelse av utgitt materiale omfattet av copyright.*

Kunnskap og organisering

7. Brukte foretaket i løpet av perioden 2018-2020 noen av de følgende kanalene/metodene til å skaffe kunnskap?

	Ja	Nei
Faglige konferanser, møter, messer og utstillinger	☐	☐
Faglige/vitenskapelige tidsskrifter eller publikasjoner	☐	☐
Bransjeorganisasjoner	☐	☐
Offentlig tilgjengelige databaser over patenter og patentsøknader	☐	☐
Publiserte standarder, dokumenter fra standardiseringskomitéer, etc.	☐	☐
Sosiale nettverk, nettdugnader (crowdsourcing), etc.	☐	☐
Åpne plattformer, programvare med åpen kildekode, åpne forretningsnettverk, etc.	☐	☐
Eksisterende produkter eller tjenester, inkludert omvendt konstruksjon (reverse engineering) etc.	☐	☐

8. Hvor viktige var de følgende metodene for organisering av arbeidet for foretaket i perioden 2018-2020?

	Svært viktig	Nokså viktig	Lite viktig	Ikke viktig
Stillingsrotasjon av ansatte til andre stillingsfunksjoner eller -områder	☐	☐	☐	☐
Regelmessig bruk av idédugnader (brainstorming) blant ansatte for å foreslå forbedringer eller nye ideer	☐	☐	☐	☐
Bredt sammensatte arbeidsgrupper/team på tvers av stillingsfunksjoner og -områder	☐	☐	☐	☐
Tid avsatt til videreutdanning, kompetanseheving og opplæring internt i foretaket	☐	☐	☐	☐

Innovasjon i varer eller tjenester (produktinnovasjon)

En produktinnovasjon er en ny eller forbedret vare eller tjeneste som er vesentlig annerledes enn foretakets tidligere varer eller tjenester og som har blitt gjort tilgjengelig på markedet.

- Produktinnovasjoner må ikke nødvendigvis være nye for markedet.
- Det er ikke avgjørende om innovasjonen er utviklet av eget foretak eller av andre.
- Rent videresalg av produkter som er utviklet og produsert av andre omfattes ikke.
- Endringer i design som utelukkende er av en estetisk art omfattes ikke.

Det er mulig for foretaket å ha introdusert både vare- og tjenesteinnovasjoner.

9. Har foretaket i løpet av perioden 2018-2020 introdusert innovasjoner i form av:

	Ja	Nei
Vareinnovasjoner: Nye eller forbedrede varer.	☐	☐
Tjenesteinnovasjoner: Nye eller forbedrede tjenester.	☐	☐

Hvis nei på begge, gå til spørsmål 10.

9.1 Ble noen av disse innovasjonene introdusert som en direkte følge av situasjonen rundt COVID-19? I.e. innovasjoner foretaket sannsynligvis ikke hadde introdusert i en normal situasjon.

	Ja	Nei
Vareinnovasjoner	☐	☐
Tjenesteinnovasjoner	☐	☐

Hvis nei på begge, gå til spørsmål 9.3.

9.2 Ventes noen av innovasjonene som ble introdusert som en følge av COVID-19 å vedvare i foretaket, også etter at en normal situasjon er gjenopprettet?

	Ja	Nei
Vareinnovasjoner	☐	☐
Tjenesteinnovasjoner	☐	☐

9.3 Hvem utviklet disse innovasjonene?

Dersom foretaket introduserte flere innovasjoner i løpet av perioden, kryss av for alle alternativene som passer.

	Vareinnovasjoner	Tjenesteinnovasjoner
Eget foretak alene	☐	☐
Eget foretak i samarbeid med andre foretak i eget konsern	☐	☐
Eget foretak i samarbeid med øvrige foretak eller organisasjoner[1]	☐	☐
Eget foretak ved å kopiere, tilpasse eller modifisere varer eller tjenester opprinnelig utviklet av andre foretak eller organisasjoner	☐	☐
Andre foretak eller organisasjoner	☐	☐

[1] Inkl. konkurrenter, tekniske tjenesteytere, forskningsinstitutter, universiteter, høyskoler, ideelle organisasjoner, offentlig sektor m.fl.

9.4. Var noen av disse innovasjonene nye for foretakets marked?

	Ja	Nei
Bare nye for foretaket (like eller liknende produkter var allerede tilgjengelig fra konkurrenter eller andre foretak i foretakets markeder)	☐	☐
Nye for foretakets marked (produktet fantes ikke eller foretaket var først til å introdusere det til sine markeder)	☐	☐

Hvis produktinnovasjonene kun var nye for foretaket, gå til spørsmål 8.5.

9.5 For hvilke markeder var disse innovasjonene nye?

Kryss av for det mest vidtrekkende markedet. Om foretaket har hatt flere innovasjoner kan det settes flere kryss.

- Lokalt/regionalt i Norge ☐
- Norge for øvrig ☐
- Andre EU-/EFTA – land[1] ☐
- Verden for øvrig ☐

[1] *Følgende EU-/EFTA-land: Belgia, Bulgaria, Danmark, Estland, Finland, Frankrike, Hellas, Irland, Island, Italia, Kroatia, Kypros, Latvia, Litauen, Luxembourg, Malta, Montenegro, Nederland, Polen, Portugal, Romania, Slovakia, Slovenia, Spania, Storbritannia, Sveits, Sverige, Tsjekkia, Tyskland, Ungarn og Østerrike.*

9.6 Fordel etter beste skjønn foretakets omsetning[1] i 2020 på:

Innovasjoner (varer og tjenester) introdusert i løpet av perioden 2018-2020, som var **nye bare for foretaket**.	, ,	%
Innovasjoner (varer og tjenester) introdusert i løpet av perioden 2018-2020, som var **nye for foretakets marked**.	, ,	%
Produkter (varer eller tjenester) som var **uforandret eller lite endret** i løpet av perioden 2018-2020, inkl. videresalg av varer og tjenester utviklet og produsert av andre.	, ,	%
Total omsetning i 2020.	1 ,0 ,0	%

[1] *For kredittinstitusjoner: Renteinntekter og tilsvarende inntekter; for forsikringsselskaper: Brutto premieinntekter*

9.7 Forventningene til foretakets innovasjoner i varer og tjenester introdusert i 2018-2020 var at de ville være:

Sett under ett, med tanke på foretakets evne til å nå sine mål og oppnå økonomiske resultater.

- Svært viktig for foretaket ☐
- Nokså viktig for foretaket ☐
- Lite viktig for foretaket ☐
- Ikke viktig for foretaket ☐
- For tidlig å si ☐

9.8 I hvilken grad hadde disse innovasjonene oppfylt foretakets forventninger ved utløpet av 2020?

- Bedre enn forventet ☐
- Som forventet ☐
- Dårligere enn forventet ☐
- Ikke i det hele tatt ☐
- For tidlig å si ☐

Innovasjon i forretningsprosesser (forretningsprosessinnovasjon)

En innovasjon i forretningsprosesser er en ny eller forbedret forretningsprosess, for en eller flere driftsfunksjoner, som skiller seg vesentlig fra foretakets tidligere forretningsprosesser og som har blitt implementert/tatt i bruk i foretaket.

- Foretaket må ikke nødvendigvis være den første til å ta i bruk denne prosessen.
- Det er ikke avgjørende om innovasjonen er utviklet av eget foretak eller av andre.

10. Introduserte foretaket i løpet av perioden 2018-2020 innovasjoner i form av nye eller forbedrede prosesser/ metoder for:

	Ja	Nei
Vare- eller tjenesteproduksjon, inkludert metoder for å utvikle varer/tjenester	☐	☐
Levering, distribusjon eller logistikk	☐	☐
Informasjonsbehandling eller kommunikasjon	☐	☐
Regnskapsføring eller andre administrative formål	☐	☐
Organisasjonsprosedyrer eller organisering av eksterne relasjoner	☐	☐
Ansvarsfordeling, beslutningstaking eller behandling av menneskelige ressurser (HRM)	☐	☐
Markedsføring, presentasjon, emballasje, produktplassering eller ettersalgstjenester	☐	☐

Hvis nei på alle, gå til spørsmål 11.

10.1 Ble noen av innovasjonene introdusert som en direkte følge av situasjonen rundt COVID-19? I.e. innovasjoner foretaket sannsynligvis ikke hadde introdusert i en normal situasjon.

	Ja	Nei
Vare- eller tjenesteproduksjon, inkludert metoder for å utvikle varer/tjenester	☐	☐
Levering, distribusjon eller logistikk	☐	☐
Informasjonsbehandling eller kommunikasjon	☐	☐
Regnskapsføring eller andre administrative formål	☐	☐
Organisasjonsprosedyrer eller organisering av eksterne relasjoner	☐	☐
Ansvarsfordeling, beslutningstaking eller behandling av menneskelige ressurser (HRM)	☐	☐
Markedsføring, presentasjon, emballasje, produktplassering eller ettersalgstjenester	☐	☐

Hvis nei på alle, gå til spørsmål 10.3.

10.2 Ventes noen av innovasjonene som ble introdusert som en følge av COVID-19 å vedvare i foretaket, også etter at en normal situasjon er gjenopprettet?

	Ja	Nei
Vare- eller tjenesteproduksjon, inkludert metoder for å utvikle varer/tjenester	☐	☐
Levering, distribusjon eller logistikk	☐	☐
Informasjonsbehandling eller kommunikasjon	☐	☐
Regnskapsføring eller andre administrative formål	☐	☐
Organisasjonsprosedyrer eller organisering av eksterne relasjoner	☐	☐
Ansvarsfordeling, beslutningstaking eller behandling av menneskelige ressurser (HRM)	☐	☐
Markedsføring, presentasjon, emballasje, produktplassering eller ettersalgstjenester	☐	☐

10.3 Hvem utviklet disse innovasjonene?

I tilfelle foretaket introduserte flere innovasjoner, kryss av for alle alternativene som passer.

- ☐ Eget foretak alene
- ☐ Eget foretak i samarbeid med andre foretak i eget konsern
- ☐ Eget foretak i samarbeid med øvrige foretak eller organisasjoner[1]
- ☐ Eget foretak ved å kopiere, tilpasse eller modifisere varer eller tjenester opprinnelig utviklet av andre foretak eller organisasjoner
- ☐ Andre foretak eller organisasjoner

[1] Inkl. konkurrenter, tekniske tjenesteytere, forskningsinstitutter, universiteter, høyskoler, ideelle organisasjoner, offentlig sektor, m.fl.

10.4 Forventningene til foretakets innovasjoner i forretningsprosesser introdusert i 2018-2020 var at de ville være:

Sett under ett, med tanke på foretakets evne til å nå sine mål og oppnå økonomiske resultater.

- ☐ Svært viktig for foretaket
- ☐ Nokså viktig for foretaket
- ☐ Lite viktig for foretaket
- ☐ Ikke viktig for foretaket
- ☐ For tidlig å si

10.5 I hvilken grad hadde disse innovasjonene oppfylt foretakets forventninger ved utløpet av 2020?

- ☐ Bedre enn forventet
- ☐ Som forventet
- ☐ Dårligere enn forventet
- ☐ Ikke i det hele tatt
- ☐ For tidlig å si

Aktiviteter for å utvikle eller introdusere innovasjon i produkter eller forretningsprosesser

11. Utførte foretaket forskning og utviklingsarbeid (FoU) eller kjøpte FoU-tjenester i perioden 2018-2020?

FoU er kreativ virksomhet som utføres systematisk for å skaffe til veie ny kunnskap eller bruk av kunnskap til å finne nye anvendelser eller til å redusere vitenskapelig eller teknisk usikkerhet.

FoU skal inneholde et nyhetselement og at det skal være en viss form for usikkerhet knyttet til resultatet. Usikkerhet foreligger når løsningen på et problem ikke er åpenbar på forhånd, selv for en person med grunnleggende kunnskap på området. Resultatet bør også kunne reproduseres eller overføres til andre. Inkluder programvareutvikling som oppfyller disse kriteriene.

	Ja	Nei
Egenutført forsknings- og utviklingsarbeid (FoU) i foretaket	☐	☐
Kjøp av FoU-tjenester fra andre	☐	☐

Hvis foretaket ikke hadde egenutført FoU, gå til spørsmål 11.

11.1 Hvilken av disse beskrivelsene passer best på foretakets egenutførte FoU-aktiviteter?

- ☐ Foretaket utfører FoU kontinuerlig og har egne ansatte med faste FoU-funksjoner.
- ☐ Foretaket utfører FoU sporadisk og organiserer FoU-aktiviteter etter behov.

12. Hadde foretaket i løpet av perioden 2018-2020 innovasjonsaktiviteter som ikke har resultert i en innovasjon i produkter eller forretningsprosesser fordi:

Innovasjonsaktivitet omfatter alle utviklings-, organisatoriske-, finansielle- eller forretningsmessige aktiviteter, inkludert FoU, som er utført med tanke på å utvikle, ta i bruk eller introdusere en innovasjon i produkter eller forretningsprosesser.

	Ja	Nei
Aktivitetene er ferdigstilt, men innovasjonen er ennå ikke introdusert eller tatt i bruk	☐	☐
Aktivitetene ble avbrutt eller utsatt før ferdigstillelse	☐	☐
Aktivitetene fortsatt var pågående ved utgangen av 2020	☐	☐

12.1 Var noen av disse aktivitetene utsatt, avbrutt, uferdig eller ikke introdusert/tatt i bruk som en følge av situasjonen med COVID-19

Ja	Nei
☐	☐

Hvis nei på alle alternativer i spørsmål 9, 10, 11 og 12; gå til spørsmål 15.

Kostnader til innovasjon i produkter og forretningsprosesser

13. Hvor store kostnader/investeringer hadde foretaket til sine innovasjonsaktiviteter i 2020?

Dette inkluderer personalkostnader og kapitalkostnader, samt innkjøp av forbruksvarer og eksterne tjenester, samt all FoU.

Oppgi anskaffelseskostnad, ikke avskrivinger. Hvis foretaket ikke har nøyaktige tall tilgjengelig er et kvalifisert anslag tilstrekkelig.

	Kostnader til aktivitet utført i 2020 Hele tusen kroner
Eget forsknings- og utviklingsarbeid (FoU) Alle driftskostnader (inkludert lønns- og personalkostnader) samt alle investeringer og kapitalvarer anskaffet spesifikt for FoU.	000
Kjøp av FoU-tjenester fra andre	000
Øvrige lønns- og personalkostnader for den tiden ansatte har arbeidet med innovasjonsaktivitetene Ekskluder kostnader til FoU	000
Tjenester, materialer, forbruksutstyr, etc. kjøpt fra andre og brukt i forbindelse med innovasjonsaktivitetene Ekskluder kostnader til FoU	000
Kapitalvarer/investeringsvarer. Kjøp av maskiner, utstyr, programvare, immaterielle rettigheter og bygninger for innovasjon Ekskluder kostnader til FoU	000
Alle andre kostnader knyttet til utvikling og introduksjon av nye varer, tjenester eller forretningsprosesser Ekskluder kostnader til FoU	000

13.1 COVID-19 har påvirket foretakets kostnader/investeringer til innovasjonsaktiviteter i 2020 ved at de var:

- ☐ Høyere enn de ellers ville ha vært
- ☐ Lavere enn de ellers ville ha vært
- ☐ Liten eller ingen endring

14. Hvordan forventes foretakets samlede innovasjonskostnader å endre seg i 2021 og 2022?

2021 i forhold til 2020

- ☐ Øke — *Hvis ja, anslagsvis hvor mye* ☐☐☐ %
- ☐ Forbli på om lag samme nivå (+/- 5%)
- ☐ Reduseres — *Hvis ja, anslagsvis hvor mye* ☐☐☐ %
- ☐ Ingen innovasjonskostnader planlagt
- ☐ For tidlig å si

2022 i forhold til 2021

- ☐ Øke
- ☐ Forbli på om lag samme nivå (+/- 5%)
- ☐ Reduseres
- ☐ Ingen innovasjonskostnader planlagt
- ☐ For tidlig å si

Samarbeid med andre foretak eller organisasjoner

Med samarbeid menes aktiv deltagelse sammen med andre foretak eller organisasjoner. Det er ikke en forutsetning at partene oppnår en økonomisk eller kommersiell gevinst av samarbeidet. Rent kontraktarbeid hvor det ikke eksisterer et aktivt samarbeid fra begge parter omfattes ikke.

15. Hadde foretaket samarbeid med andre foretak eller organisasjoner i løpet av perioden 2018-2020?

	Ja	Nei
Samarbeid om FoU	☐	☐
Samarbeid om andre innovasjonsaktiviteter, utenom FoU	☐	☐
Samarbeid om øvrige forretningsaktiviteter, utenom FoU og innovasjon	☐	☐

Hvis ja på samarbeid om FoU eller andre innovasjonsaktiviteter, gå til spørsmål 15.1; ellers gå til spørsmål 16.

15.1 Hvilke typer av samarbeidspartnere har foretaket hatt for FoU- eller innovasjonsaktivitet og hvor er disse partnerne geografisk lokalisert?

Flere svaralternativer er mulig. Angi også den viktigste samarbeidspartneren (ett kryss i siste kolonne)

	Lokalt/ regionalt i Norge	Norge for øvrig	Norden	Andre EU-/EFTA-land[1]	Verden for øvrig	**Viktigste partner for inno-vasjon**
Andre foretak i samme konsern	☐	☐	☐	☐	☐	☐
Konsulenter, kommersielle laboratorier /FoU-foretak	☐	☐	☐	☐	☐	☐
Leverandører av utstyr, materiell, komponenter eller programvare	☐	☐	☐	☐	☐	☐
Kunder i privat sektor	☐	☐	☐	☐	☐	☐
Konkurrenter eller andre foretak i din bransje	☐	☐	☐	☐	☐	☐
Andre foretak	☐	☐	☐	☐	☐	☐
Universiteter eller høyskoler	☐	☐	☐	☐	☐	☐
Offentlige eller private forskningsinstitutter	☐	☐	☐	☐	☐	☐
Kunder i offentlig sektor	☐	☐	☐	☐	☐	☐
Ideelle organisasjoner	☐	☐	☐	☐	☐	☐

[1] *Følgende EU-/EFTA-land: Belgia, Bulgaria, Estland, Frankrike, Hellas, Irland, Italia, Kroatia, Kypros, Latvia, Litauen, Luxembourg, Malta, Montenegro, Nederland, Polen, Portugal, Romania, Slovakia, Slovenia, Spania, Storbritannia, Sveits, Tsjekkia, Tyskland, Ungarn og Østerrike.*

Hindrende eller hemmende faktorer for innovasjonsaktivitet

16. Hvor viktige var følgende faktorer for hindre eller hemme foretakets oppstart av innovasjonsaktivitet eller for å hindre eller hemme gjennomføringen av pågående innovasjonsaktivitet i løpet av perioden 2018-2020?

	Svært viktig	Nokså viktig	Lite viktig	Ikke viktig
Mangel på finansiering innen foretaket eller konsernet	☐	☐	☐	☐
Mangel på kreditt eller annen privat kapital	☐	☐	☐	☐
Problemer med å skaffe offentlig finansiering eller innovasjonsstøtte	☐	☐	☐	☐
For høye innovasjonskostnader	☐	☐	☐	☐
Mangel på kvalifisert personell i foretaket	☐	☐	☐	☐
Mangel på samarbeidspartnere for innovasjon	☐	☐	☐	☐
Manglende tilgang på ekstern kunnskap	☐	☐	☐	☐
Usikker etterspørsel for foretakets innovasjonsideer	☐	☐	☐	☐
For sterk konkurranse i foretakets marked	☐	☐	☐	☐
Andre prioriteringer i foretaket	☐	☐	☐	☐

Finansiering og støtte

17. Forsøkte foretaket å skaffe seg noen av de følgende formene for finansiering i løpet av perioden 2018-2020?

Inkluder all finansiering, ikke bare finansiering for FoU eller innovasjon.

	Ja	Nei
Finansiering til gjengjeld for eierskap i foretaket (risikokapital, venturekapital, emisjonskapital, etc.)	☐	☐
Finansiering foretaket må betale tilbake (bank, privat lånekapital, obligasjonsfinansiering, etc.)	☐	☐

17.1 Hvis ja i spørsmål 17, lyktes foretaket med å skaffe slik finansiering?

	Ja	Nei
Finansiering til gjengjeld for eierskap i foretaket (risikokapital, venturekapital, emisjonskapital, etc.)	☐	☐
Finansiering foretaket må betale tilbake (bank, privat lånekapital, obligasjonsfinansiering, etc.)	☐	☐

17.2 Hvis ja i spørsmål 17.1, ble noen del av finansieringen brukt til FoU eller andre innovasjonsaktiviteter?

	Ja	Nei
Finansiering til gjengjeld for eierskap i foretaket (risikokapital, venturekapital, emisjonskapital, etc.)	☐	☐
Finansiering foretaket må betale tilbake (bank, privat lånekapital, obligasjonsfinansiering, etc.)	☐	☐

18. Mottok foretaket noen form for offentlig finansiell støtte i løpet av perioden 2018-2020?

Inkluder støtte via direkte tilskudd, subsidierte lånetilsagn og lånegarantier, etc. Inkluder all støtte, ikke bare for FoU eller innovasjon. Ekskluder kontraktarbeid utført for offentlig sektor som en del av ordinær drift i foretaket. SkatteFUNN omfattes ikke.

	Ja	Nei
Lokale/regionale myndigheter eller myndighetsdrevne organisasjoner	☐	☐
Nasjonale myndigheter eller myndighetsdrevne organisasjoner	☐	☐
EU-myndigheter eller EU-institusjoner, inkludert EUs 7. rammeprogram for forskning og utvikling og EUs program «Horisont 2020» for forskning og innovasjon	☐	☐

18.1 Hvis ja i spørsmål 18, ble noen del av støtten brukt til FoU eller andre innovasjonsaktiviteter?

	Ja	Nei
Lokale/regionale myndigheter eller myndighetsdrevne institusjoner	☐	☐
Nasjonale myndigheter eller myndighetsdrevne institusjoner (ekskluder SkatteFUNN)	☐	☐
EU-myndigheter eller EU-institusjoner, inkludert EUs program «Horisont 2020» for forskning og innovasjon	☐	☐

Effekter av situasjonen rundt COVID-19

19. I hvilken grad passer følgende utsagt med foretakets opplevelse av de endrede forutsetningene som oppsto i forbindelse med COVID-19 pandemien og den samfunnsmessige situasjonen rundt håndteringen av denne?

	I stor grad	I noen grad	I liten grad	Ikke i det hele tatt
Foretaket prioriterer å ha nødvendig kunnskap og ferdigheter for å håndtere eksterne sjokk og endrede økonomiske forutsetninger	☐	☐	☐	☐
Foretaket manglet kunnskap eller ferdigheter som kunne ha redusert de økonomiske konsekvensene av situasjonen rundt COVID-19 for foretaket	☐	☐	☐	☐
Foretaket har styrket sin posisjon relativt til sine konkurrenter grunnet situasjonen rundt COVID-19	☐	☐	☐	☐
Foretaket har tapt konkurransekraft grunnet situasjonen rundt COVID-19	☐	☐	☐	☐
Foretaket har hatt kommersiell vinning som følge av situasjonen rundt COVID-19	☐	☐	☐	☐
Foretaket har opplevd økonomiske konsekvenser som følge av situasjonen rundt COVID-19 som vil påvirke foretaket negativt på lang sikt.	☐	☐	☐	☐
Foretaket har søkt nye markeder eller kundegrupper som en følge av situasjonen rundt COVID-19	☐	☐	☐	☐
Foretaket har søkt nye leverandører eller andre eksterne relasjoner grunnet situasjonen rundt COVID-19	☐	☐	☐	☐
Foretaket har blitt mer effektivt som følge av situasjonen rundt COVID-19	☐	☐	☐	☐
Foretaket har varig endret sin forretningsdrift som følge av situasjonen rundt COVID-19	☐	☐	☐	☐

Innovasjoner med miljøfordeler (grønn innovasjon)

En innovasjon har en miljøfordel hvis den har en positiv – eller mindre negativ – påvirkning på miljøet i forhold til foretakets tidligere produkter og prosesser, eller i forhold til andre produkter som allerede er tilgjengelig på markedet.

Miljøfordelen kan enten være det primære formålet med innovasjonen eller et biprodukt av andre egenskaper eller formål med innovasjonen.

Miljøfordelen ved innovasjonen kan oppstå enten i produksjonen av en vare eller tjeneste, når en prosess tas i bruk, eller når et produkt konsumeres, forbrukes eller anvendes av sluttbruker. Brukeren kan her være individer, andre foretak, organisasjoner eller offentlige myndigheter.

20. Introduserte foretaket innovasjoner med noen av de følgende miljøfordelene I løpet av perioden 2018-2020? Hvis ja, var bidraget til miljøet /effekten av miljøfordelene av en betydelig eller begrenset grad?

	Ja, med betydelig/ signifikant effekt	Ja, med begrenset/ en viss effekt	Nei
Miljøfordeler innad i foretaket			
Redusert material-, råvare eller vannforbruk per produsert enhet	☐	☐	☐
Redusert energiforbruk eller reduksjon av samlede CO2-utslipp	☐	☐	☐
Redusert støyforurensing eller forurensning/utslipp til jord, vann eller luft	☐	☐	☐
Erstattet materialbruk med mindre forurensende eller skadelige alternativer	☐	☐	☐
Erstattet bruk av fossil energi med fornybare energikilder	☐	☐	☐
Resirkulering av avfall, vann eller materialer for egen bruk eller salg	☐	☐	☐
Andre miljøfordeler innad i foretaket	☐	☐	☐
Miljøeffekter for kunder eller sluttbrukere			
Redusert energiforbruk eller reduksjon av samlede CO2-utslipp	☐	☐	☐
Redusert støyforurensing eller forurensning/utslipp til jord, vann eller luft	☐	☐	☐
Tilrettelagt for resirkulering/gjenbruk av foretakets produkter	☐	☐	☐
Forlenget produktlevetid gjennom mer holdbare eller varige produkter	☐	☐	☐
Andre miljøfordeler for kunder eller sluttbrukere	☐	☐	☐

Hvis ja på noen av alternativene i spørsmål 20, gå til spørsmål 21.

21. Foretakets innovasjoner med miljøfordeler var innenfor:

Kryss av for alle alternativer som passer.

Varer	☐
Tjenester	☐
Forretningsprosesser	☐

22. Hvor viktig var de følgende faktorene for å påvirke foretakets beslutninger om å introdusere innovasjoner med miljøfordeler?

	Svært viktig	Nokså viktig	Lite viktig	Ikke viktig
Eksisterende miljølovgivning eller andre lover og reguleringer	☐	☐	☐	☐
Eksisterende miljøavgifter eller andre skatter og avgifter	☐	☐	☐	☐
Forventninger om fremtidige miljøavgifter eller andre skatter og avgifter	☐	☐	☐	☐
Offentlige tilskudd, subsidier eller andre offentlige økonomiske insentiver	☐	☐	☐	☐
Eksisterende eller forventet etterspørsel for innovasjoner med miljøfordeler	☐	☐	☐	☐
Forbedre eller bygge foretakets omdømme	☐	☐	☐	☐
Bransjestandarder for miljømessig god praksis eller andre frivillige tiltak	☐	☐	☐	☐
Høye kostnader for materialer, råvarer vann eller energi	☐	☐	☐	☐
Tilfredsstille leverandørkrav for å delta i offentlige anskaffelsesprosesser	☐	☐	☐	☐