

**DRIVERS TOWARDS CIRCULAR ECONOMY IN
THE FINNISH MACHINERY AND EQUIPMENT
INDUSTRY**

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JYVÄSKYLÄN YLIOPISTO

ABSTRACT

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Abstract	
<p>Issues related to sustainability have been discussed for long and it is clear that the carrying capacity of the Earth cannot meet with the increasing consumption rates. Circular economy has recently been brought up as a way to help solving the sustainability issues. Though the idea of circular economy is not new, it has now gotten more attention and in different countries goals, guidelines and policies towards the implementation of the models of circular economy have been proposed.</p> <p>To reach circular economy significant changes in current practices and economic structure are necessary. Companies need to change their processes and the way they see their business. Yet, the research of the drivers towards circular economy is limited. This study focuses on the drivers of Finnish machinery and equipment industry to adopt the models of circular economy. Machinery and equipment industry was chosen as this sector is estimated to have the most growth potential through the adoption of the models of circular economy.</p> <p>The research method used in this study was a qualitative research. Ten representatives from nine different companies in machinery and equipment industry were interviewed mostly through email interviewing. The interviews were analyzed using thematic analysis.</p> <p>The drivers recognized from the interviews were compared to drivers for corporate sustainability from the literature. Based on the study the main drivers for circular economy in the Finnish machinery and equipment industry are business potential, customer demand, increasing business value and sales, image benefits, values and principles of the company and sustainability. These drivers share some similarities with the drivers for sustainability though the drivers for circular economy seem to be more focused on the business potential. Yet, more research is necessary in order to generalize the drivers for circular economy or to reliably draw conclusions of the similarities and differences between the drivers for circular economy and the drivers for sustainability.</p>	
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TIIVISTELMÄ

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<p>Kestävyyteen liittyvistä haasteista on keskusteltu jo pitkään ja on selvää, että maapallon kantokyky ei kestä kasvavaa kulutustahtia. Viime aikoina kiertotalous on nostettu esiin yhtenä mahdollisena ratkaisuna kestävyysongelmiin. Vaikka kiertotalouden ajatus ei ole uusi, on se saanut huomiota juuri nyt ja eri maissa on ehdotettu tavoitteita, ohjeita ja linjauksia kiertotalouden mallien toimeenpanoa varten.</p> <p>Kiertotalouden saavuttamiseksi tarvitaan huomattavia muutoksia tämänhetkisiin käytäntöihin ja talousmalliin. Yritysten on muutettava prosessejaan ja liiketoiminnan ajattelutapaansa. Silti kiertotalouteen motivoivia tekijöitä on tutkittu vain rajallisesti. Tämä tutkimus keskittyy Suomen konepajateollisuuden yritysten motivaatioihin kiertotalouden mallien käyttöönottoon. Konepajateollisuus valittiin tutkimuksen kohteeksi, koska arvion mukaan kiertotalouden mallien käyttöönotto tuo tälle sektorille suurimman kasvupotentiaalimahdollisuuden.</p> <p>Tässä tutkimuksessa käytettiin tutkimusmenetelmänä laadullista tutkimusta. Kymmentä edustajaa yhdeksästä eri konepajateollisuuden yrityksestä haastateltiin pääasiassa sähköpostihaastattelun avulla. Haastattelut analysoitiin teema-analyysia käyttäen.</p> <p>Haastatteluissa tunnistettuja ajavia tekijöitä verrattiin yleisesti kirjallisuudessa tunnistettuihin yritys vastuuseen ajaviin tekijöihin. Tämän tutkimuksen perusteella Suomen konepajateollisuuden yrityksiä motivoi kiertotalouteen liiketoimintamahdollisuudet, asiakkaiden vaatimukset, liikearvon ja myynnin kasvatus, imagohyödyt, yrityksen arvot ja periaatteet sekä kestävyys. Näillä ajavilla tekijöillä on yhtäläisyyksiä kestävyteen ajavien tekijöiden kanssa, vaikka kiertotalouden ajavat tekijät vaikuttavat keskittyvän enemmän liiketoimintamahdollisuuksiin. Silti lisätutkimus on välttämätöntä ennen kuin näitä tekijöitä voidaan yleistää tai luotettavasti arvioida kiertotalouteen ja kestävyteen ajavien tekijöiden samankaltaisuuksia ja eroavaisuuksia.</p>	
Asiasanat kiertotalous, motivaatio, konepajateollisuus	
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1 INTRODUCTION

As both the population and wealth grows, so does the need for resources that are already scarce (European Commission 2014). Yet on average only 40 % of waste is recycled in a European household. (European Commission 2015a). The ecological footprint keeps growing and according to Wijkman & Skånberg (2015) in one year people use the equivalent amount of materials that the Earth produces in one and a half year. With our current consumption rate we would need 1.7 Earths to fill our resource needs. (Earth Overshoot Day 2017.) This means that we are exceeding the carrying capacity of the Earth. The ecological footprint varies significantly between countries and for example if all lived like the people in US, we would need 4 Earths to fulfil the need of resources we use in one year. (Wijkman & Skånberg 2015.)

The Waste Framework Directive provides the principles for waste management and the waste management hierarchy. According to the hierarchy prevention of waste should be the priority. Once waste is born it should be prepared for re-use, recycling or recovery. Disposal is the final resort. This is the hierarchy that each EU Member State is required to follow. To support this waste management plans and waste prevention programs should be adopted. (Directive 2008/98/EC on waste.) Though Europe's economy has benefited from improvements in resource productivity, resource productivity has not been exploited to its fullest. For example in average a European car is parked 92 percent of the time and when it comes to food, nearly third is wasted throughout its value chain. (Ellen MacArthur Foundation 2015c.)

The current economy has mainly been built on linear economy where products are discarded as waste after their use. This requires, and is based on, large quantities of low-cost and accessible materials and energy. The Ellen MacArthur Foundation (2015c) calls it the "take, make, dispose" -model. Often the product and production are designed for one use only and the recycling or waste management is separate from production. However, in this process the value of materials is not utilized to its fullest. For example in recycling the material and utilizing as energy, only five percent of the value of the raw material is collected. Also the products currently produced are underutilized. (Ellen MacArthur Foundation 2015c.) Circular economy is focused on the utilization of materials to their fullest. The goal is to utilize the value of materials and keep them circulating. A study conducted by Ellen MacArthur Foundation (2015b) together with McKinsey predicts that circular economy would provide significant possibilities to Europe's economy which would have positive effects both on the employment and GDP.

Circular economy has been increasingly discussed and researched in the recent years (Ellen MacArthur Foundation 2015c). The interest towards circular economy has grown and the focus seems to be in China as there the concept has been implemented through a national law. Also other countries have begun to make steps towards the implementation. In the 2020 strategy resource efficiency

was seen as the way for sustainable growth and after that a roadmap for Resource Efficient Europe presenting steps to reach circular economy, was published. In December 2015 European Commission presented an EU action plan for circular economy, the so called circular economy package, that includes plans, strategies, series of actions and legislative proposal to support the shift towards a more circular economy and “*closing the loops*” of product lifecycles. (European Commission 2015a; European Commission 2015b.) The European Resource Efficiency Platform (EREP) has also addressed circular economy and in their manifesto, originally published in 2012, circular economy is considered as the ultimate goal to achieve resource efficiency (European Resource Efficiency Platform 2014).

These plans are also visible in Finland. Prime Minister Juha Sipilä’s Government has chosen circular economy among the key projects. Inside this project Sitra has planned a national road map to circular economy presenting concrete steps necessary towards circular economy and some best practices and examples. The goal is to form a project plan based on the road map. (Valtioneuvoston kanslia 2017.)

1.1 Previous research on the field

Models related to circular economy such as recycling, reuse and remanufacturing have been around for long, and comprehensive concept of circular economy consisting of loops is not that new. The term still seems to have different meanings in different areas and associations.

The literature in circular economy has been rapidly increasing in the recent years and large portion is focused on the issues related to China. China’s adoption of a circular economy law has its effect on the interest of research. Yet there is also research without specific geographical focus and on other areas than China. In general the main research points are waste generation, use of resources and environmental impact while perspectives of business and economy are scarce. The lack of research focused on the business and economy might hinder the implementation of circular economy to business as clear industry specific advantages are left unclear. (Lieder & Rashid 2016.)

The research on the drivers to circular economy is limited. Only few studies have looked into specifically the drivers to circular economy. There are also some studies that have tried to identify the drivers for circular economy as one part of the whole research. Of these two could be mentioned.

The first one is the study of Heyes, Sharmina, Mendoza, Gallego-Schmid and Azapagic (2018) where they looked the drivers and barriers of circular economy in service-oriented ICT company. A new Backcasting and Eco-design for the Circular Economy framework (BECE) was tested on a micro-ICT business in UK and as part of the workshops of BECE. In the workshop four main drivers to implement circular economy models were identified. These were marketing benefits, strengthening supplier relationships, proactivity to minimize resource risks and costs and potential new revenue from new products. Yet the barriers were

considered to be too large compared to the size of the company. However this study is focused only on one company in one sector and the drivers were identified as one part of the research. Heyes et al (2018) also mentioned as limitations to their study that in large organizations the drivers and barriers identified through this method might prove to be different.

The second study is related to creating an index to measure the degree of implementation of the models of circular economy. The study was conducted by Accenture, Circle Economy, MVO Nederland and DuurzaamBedrijfsleven (2016) in Dutch companies. It found out that in Dutch companies that have integrated or begun to integrate circular economy to the strategy the main driver has been that circular economy fits to their core business. Partnerships have been seen as the most important initiative to Dutch companies though yet formal agreements with supply chain partners are still often not yet done. The index claims that circular economy is still in its early stages and large scales are still waiting to be realized. (Accenture, Circle Economy, MVO Nederland and DuurzaamBedrijfsleven 2016.)

Based on these studies it is unreliable to draw conclusions on what drives companies to implement the models of circular economy. Corporate sustainability drivers are widely researched and understanding them is seen important. Possibly the research on drivers for circular economy has been left scarce as the drivers have been considered to be similar to the ones for corporate sustainability. Perhaps circular economy has been considered as a sustainability issue to which same drivers apply. Yet it is necessary to study the drivers specifically for circular economy and the differences between sectors and companies of different size. Therefore it can be derived that currently on a larger scale the scientific literature related to the drivers for circular economy is insufficient and more research is needed in order to understand the drivers and utilize them.

1.2 Research questions and objectives

The main research question of this study is:

- What are the drivers for circular economy in machinery and equipment industry?

The sub research questions are:

- What is the current and future meaning of circular economy to the companies?
- What is the growth potential of circular economy?
- What is needed to reach the growth potential?
- What is the effect of circular economy to competitive advantage?

The aim of this study is to discover the drivers for the Finnish machinery and equipment industry to adopt the models of circular economy. These drivers

are then compared to the drivers of corporate sustainability collected from the literature to find out whether they have similarities.

To achieve the aim of the research and answer to the research questions, the theory of the thesis focuses on two aspects; circular economy and corporate sustainability drivers. It is important to understand the functions of circular economy and what its' adoption means both in general and in machinery and equipment industry. Understanding the most commonly recognized corporate sustainability drivers provides a strong base to the study to understand the nature of sustainability drivers and creates possibility to find out whether the driver of circular economy and sustainability have similarities.

2 LITERATURE REVIEW

The literature review will begin by looking into the concept of circular economy more closely by explaining the concept, its origins and the motives behind it. The models of circular economy are also opened up. Then the focus will move more into the significance to Finland and specific aspects related to machinery and equipment industry are introduced. The second section of the literature review will summarize the commonly recognized corporate sustainability drivers.

2.1 Circular economy

Circular economy is a restorative and regenerative model which aims to change the current linear economic model so that the economy would no longer be dependent on finite resources. Main principle is to keep the utility and value of products, components and materials at their highest and, instead of discarding products after one use, re-use them in the most restorative way. (Ellen MacArthur Foundation 2015c; Sitra 2014; Wijkman & Skånberg 2015.) Ultimate goal is to separate the use of finite resources from the development of global economy (Ellen MacArthur Foundation 2015c). At the heart of the idea are reuse, repairing, refurbishment and recycling materials and products.

The value of materials is utilized by prolonging their lifecycle. Circular economy focuses both on the chains of biological and technical materials and aims to optimize them (Ellen MacArthur Foundation 2015c; European Commission 2014). The often used term is loops and the idea is to close the loops. This illustrates that the materials and their value are kept in circulation. Processes should be based on these closed loops of materials and energy so that minimum amount of virgin raw materials is used and unusable waste created. The waste of a certain process should be utilized to its fullest for example as a material to other process or as biological nutrient. (Ellen MacArthur Foundation 2015c; Ghisellini, Cialani & Ulgiati 2016.) Circular economy is not only a way to better waste management. This viewpoint is simply too narrow and some of the models are not suited to current waste management context. Circular economy is rather a larger concept that calls for comprehensive changes in the whole economy and way things are currently done. (Ghisellini et al. 2016.)

It is unclear where the term *circular economy* was first born and used. Some schools of thought associated with circular economy have emerged already in the 1970s but only gained attention and station in the 1990s. The origins and details of the definition differ between authors. Mainly seven schools of thought have been associated with the development of the concept. These are cradle to cradle by Michael Braungart and Bill McDonough, performance economy by Walter Stahel, biomimicry by Janine Benyus, blue economy by Gunter Pauli, regenera-

tive design by John T. Lyle, industrial ecology and natural capitalism. (Ellen MacArthur Foundation 2013; Ellen MacArthur Foundation 2015b; Ellen MacArthur Foundation 2015c.)

It seems that the combining factors between these schools of thought, and the other theories related to the origins of the concept, are efficiency, material recovery and the circular closed loop system (Ellen MacArthur Foundation 2015b; Murray, Skene & Haynes 2015). Yet, the most mentioned schools of thought, and the ones that are considered as the two pillars of circular economy, are the cradle to cradle principle and industrial ecology (European Commission 2014). In China the concept originates from industrial ecology and now closing the loops of materials and efficient use of energy and materials are the core of the concept (Park, Sarkis & Wu 2010).

The adoption of the concept and its models varies. China seems to have taken the implementation furthest as China has decided to implement circular economy as their national policy. Several regulations have been set up to support the implementation. The first one was “Cleaner Production Promotion Law” in 2003 and in 2009 the “Circular Economy Promotion Law” was taken into effect. This is the first national law in the world that claims a different economic model than the traditional linear one (Geng, Fu, Sarkis & Xue 2012; Mathews & Tan 2011). In other countries there has previously been for example an enactment of a law “Closed Substance Cycle and Waste Management Act” in Germany in 1996 and legal framework towards recycling based society enforced in Japan in 2002. Yet these have not as comprehensively adopted the circular economic model. (Su; Heshmati, Geng & Yu 2013.)

Also the implementation of circular economy seems to differ. In China circular economy is implemented with top-down practice through the national law as a development model for more sustainable economic structure (Ghisellini et al. 2016; Mathews & Tan 2011). In this structure nature and economy are in harmony and the whole society in all levels is transformed (Naustdalslid 2014). Whereas in other countries circular economy is seen as a bottom-up practice and a tool for environmental management policies. Both of these implementation practices have their own problems. In China the problem is that the civil society is poorly involved into the implementation whereas in other countries there is often the lack of national framework and legislation to promote circular economy (Naustdalslid 2014). This means that the successful implementation of circular economy needs actions and participation both from the civil society and legislative parties both in national and global level.

2.1.1 Models of circular economy

The models of circular economy aim to slow, close and narrow the loops of resources. In a key role is the design of products and utilization of materials. The products should be designed to have long lifecycles that can be prolonged for example through repair. The materials should be recyclable and the recycling system and utilization should be efficient and well organized aiming to keep the materials and their value stays in circulation. (Bocken, Pauw, Bakker & Grinten

2016.) The often mentioned models to achieve this are reuse, repair, refurbishment, remanufacturing and recycling. Logistics also have an important role in circular economy as the products and materials need to be efficiently collected for utilization.

The models of circular economy vary from using the product as it is to utilizing the material or components of the product. When product is reused it is used for the same purpose it was originally planned for making as little changes to it as possible. If the product cannot be reused it can be refurbished. In refurbishment product is returned to working condition. This can mean changing small or larger components or parts, cleaning or updating the appearance of the product. Often refurbished products are given a warranty of their operational use. Once refurbishment is no longer feasible the next possibility is remanufacturing. Remanufacturing means taking functional components or parts from an old product and using them to build a new product. The quality of the components is inspected and parts can be updated to for example more efficient ones. The final step is recycling the material of the product. The value of the materials is utilized to make new products with long lifecycle. (Ellen MacArthur Foundation 2015c.)

Efficient logistics is a key factor of enabling the models of circular economy. Especially reverse logistics and green supply chain management are models that are discussed in relation to circular economy. Green supply chain management means integrating environmental aspects into supply chain management practices. It combines practices from environmental management and supply chain management. Green supply chain management extends to design, material sourcing, manufacturing, transportation and waste management of the product and it can focus both on the internal and external logistics of a company. Green supply chain management emerged not only due to resource scarcity and environmental concerns on pollutions and waste but also due to business value on utilizing the sourced materials as efficiently as possible. (Srivastava 2007.) Some researchers also include reverse logistics into the scope of green supply chain management.

Reverse logistics focuses on efficiently recovering the parts, products and materials through waste management, recycling and remanufacturing. In addition to logistics the materials need to be sorted and stored, risks managed and the power needed in the handling created. The routes of reverse logistics are repair, refurbishment, remanufacturing, cannibalization and recycling. So the models discussed in circular economy are already included in this concept. Information transfer is also possible through reverse logistics and often the producer can receive valuable information of the product; why was the product returned or discarded and how can it be enhanced for the future. (Chan, Chan & Jain 2012; Ellen MacArthur Foundation 2015c.) The importance of reverse logistics has grown in many sectors due to legislation and sustainability concerns. Yet the reverse logistics systems of many companies can still be incomplete. (Chan et al. 2012.)

2.1.2 Rationale for adopting circular economy

Rationales for implementing models of circular economy lie in economical, ecological and social issues and solutions to them. The carrying capacity of the Earth simply cannot support with the growing rates of consumption and production. Valuable resources are becoming scarcer and it is even more economically feasible to utilize secondary raw materials. Locally and globally countries are setting goals on enhancing material efficiency and recycling rates and decreasing emissions. There are also indications of the positive impacts models of circular economy can have on the GDP, employment rates and profitability and competitiveness of companies.

Current consumption of the population is exceeding the carrying capacity of the Earth and each year the Earth Overshoot Day is met earlier and earlier. In 2017 the day was 2nd of August which is the earliest date yet. This means that on that date we have used the renewable natural resources that Earth can produce in a year. So with our current consumption rate we would need 1.7 Earths to fill our resource needs. (Earth Overshoot Day 2017.) The need to make changes in our consumption patterns is crucial as at the same time it is expected that the world population will grow by 2 to 3 billion in the coming decades along with the increase in per-capita income. The planet simply cannot meet the increasing need for resources. (Wijkman & Skånberg 2015.) The economy should be able to grow without increasing its use of energy and resources and the pressure for environment by corresponding amount (The Club of Rome 2015).

The European Union has set goals to increase the level of recycling through developing the waste collection and sorting systems and funding will be directed to these goals instead of landfilling. Recycling rate of packaging waste will be increased. (European Commission 2015a). Together with waste hierarchy and EU action plan for circular economy these goals encourage better use of materials and can be used as a driver towards circular economy as the regulatory focus is clear. Yet more specific goals and steps are still needed and research on which materials can be safely and sustainably circulated and to what extent. (Preston 2012.)

Circular economy can provide an environment where industries are less vulnerable to the volatility of material prices with a possibility to growth without bringing more pressure to the carrying capacity of the Earth (Preston 2012). Through circular economy sustainability and wellbeing can be enhanced without similar costs of raw materials and energy (Ghisellini et al 2016). As the population keeps growing and the need for resources increases, the growing prices and volatility is likely to continue (World Economic Forum 2014). Volatility of raw material prices brings difficulties to the companies as prices are less predictable. Through circular economy companies have the possibility to lower their costs and create new models of gaining revenue. The costs of manufacturing certain products would be lower if the cycle to recollect materials was efficient. (Ellen MacArthur Foundation 2015c.) Especially metals are a material that has huge potential in terms of circular economy. Metal is highly reusable as it can be reused several times without loss of quality. Mining of metals is also expensive and at

the same time the demand is growing. Cost savings can be achieved with using secondary raw materials instead of primary ones and by lowering the dependency of the volatile material prices, the company increases its own resilience. Secondary materials can be collected through recycling and even from the municipal solid waste incineration ash.

According to the study of Wijkman and Skånberg (2015) from the Club of Rome based on testing the economics of Finland, France, The Netherlands, Spain and Sweden, circular economy could provide Europe several societal benefits. The assessment focused on the effects of enhancing energy efficiency, increasing the use of renewable energy and organizing manufacturing to the principles of circular economy have on carbon emissions and job opportunities. (Wijkman & Skånberg 2015.) Utilizing the business models of circular economy have also been associated with increasing employment rates, GDP and lowering climate impacts and resource dependency (European Commission 2017; Seppälä et al. 2016; Wijkman & Skånberg 2015.) The models of circular economy are more labor intensive than the ones of linear economy. Taking care of the produced products and once sourced materials provides more work than disposing products after their use. (Wijkman & Skånberg 2015.) Developing and running models to collect, recycle and reuse materials and repair products could create new jobs and new income streams (Ellen MacArthur Foundation 2015c).

There are also suggestions that adopting environmental practices can provide competitive advantage and connect economic and environmental value creation. Park et al. (2010) provide an initial framework which presents four ways to create blended economic and environmental value in ICT sector in China. These are reducing costs through sustainable supply chain management, revenue creation through efficient life cycle management of (ICT) products, resiliency through environmentally sound management practices and taking care of the license to operate with legitimacy and image aspects.

The relationship to customers can be developed as a closer one with for example long-term contracts on leasing or repairmen services. With long customer relationships, understanding the needs of the customer and fulfilling them can be made easier. (Preston 2012.) As the goal is to move consumption habits towards service-based models it is crucial to recognize what the consumers desire. For example in transportation the use of public transportation, leasing, car sharing or other services need to be made easy and recognized where which service is needed to which extend. (Ellen MacArthur Foundation 2015a.)

McKinsey argues that the products where most economical potential can be found through the models of circular economy are the ones with a medium lifecycle. These products are used more than once but, yet their lifecycle is short enough for reuse and remanufacturing remain attractive. (Ellen MacArthur Foundation 2015c.) Several models of circularity are already economically feasible to companies and they should be provided with the visibility for other companies to realize (Seppälä et al. 2016).

2.1.3 Shift towards circular economy

Currently the key challenges are identifying and separating different materials after their use, gaining required scale of circulation to ensure the supply and maintaining the quality and purity of materials. Especially the various synthetic materials provide difficulties in terms of recycling. Some of these issues can be solved through keeping remanufacturing and recycling in mind throughout the whole production cycle beginning from the design of the product and components, while others demand for innovations and development of new techniques and materials. (Haas, Krausmann, Wiedenhofer & Heinz 2015; World Economic Forum 2014).

The transition towards circular economy requires a shift in the way things are commonly thought and setting closed-loop system as priority in business (Preston 2012). Changes are needed in micro, meso and macro levels. This means companies and consumers, eco-industrial parks and industrial symbiosis and city, region and national level (Ghisellini et al 2016.) It is crucial that companies implement the concept of circular economy into their core principles and view business through these models. Also the public sector is in a key position as policy measures, both regulation and economic instruments, are needed as the current market models and policies guiding it are not based on circular economy. (Ellen Macarthur Foundation 2015c; European Commission 2014; Ghisellini et al. 2016; Seppälä et al 2016; Sitra 2014; Webster 2013.) Last but not least the consumers need to be aware and on board in circular economy as it is a significant change in current way of consumption.

Especially in the circular economy research focused on China the focus is often on one of the levels; micro, meso or macro. In other countries the research focuses on case studies often in meso level. Yet it is important to understand the different levels and also look at them as a whole. In each level the key changes and focus point towards circular economy are in different activities. (Ghisellini et al 2016.)

In micro-level the focus is on companies and consumers. The focus of companies is in implementing the models of circular economy through reuse, remanufacturing and recycling. New business models, eco-design, extending product lifecycles, material recovery and environmental management systems are focused on. (Ghisellini et al 2016; Linder, Sarasini & Loon 2017.) Transition towards circular economy means focusing more on the models of circular economy. Implementing circular economy should start from utilizing and expanding the business models that are currently available, such as leasing, optimizing the use of resources and sharing economy. (European Commission 2014; Seppälä et al 2016; Sitra 2014). The design should focus on the product having multiple lifecycles and that the value can be recovered in an economically feasible way (Lieder & Rashid 2016).

Companies and consumers have a crucial role in the shift towards circular economy through their decisions. It would be logical for the companies to translate the models of circular economy into the practice (Elinkeinoelämän keskusliitto 2015; European Commission 2015a; Preston 2012; Sitra 2014.) In each

sector it is crucial to consider how circularity could enhance the competitiveness and the business model. The changes done towards circularity might remain scarce if the company does not understand what new value it can provide to them. For the companies it is important to understand the challenges of current production and what challenges resource scarcity brings to them in the future. As well as to understand at which phases of value chain they currently lose value and waste energy and materials. Based on this information companies can begin to plan how to enhance their models to avoid the value losses but also implement circularity into their strategy and core principles. (Sitra 2014.)

After including circularity into the strategy, the companies need to move the vision into concrete actions in their business (Sitra 2014). This is the meso level and the activities focus on developing eco-industrial parks and industrial symbiosis. (Ghisellini et al 2016). Companies can focus on their internal loops and enhance production processes towards lower use of materials and production of waste. Key is to form collaborations to utilize each other's byproducts. Creating new partnerships and enhancing new collaborative business models can widen the perspective and provide new ideas. The materials that are waste to other company can be materials to other. (Elinkeinoelämän keskusliitto 2015; Lieder & Rashid 2016.) So basically the companies need to consider how they can add value into their business and what changes it requires (Sitra 2014).

Yet it is clear that innovations and new alternative materials to replace nonrenewable ones are needed (Maio & Rem 2015; Preston 2012). Also new ways to use materials and replace the use of fossil ones are necessary. For example the minerals of the fly ash created in the waste incineration plants can be used in construction to replace some of raw materials in concrete mixtures. The new collaborations can be utilized to develop these new ideas.

Creating new business ideas and innovations to come up with new ways of doing business and using materials more efficiently are important and have their challenges (Preston 2012). Yet this is the area that has the biggest potential when it comes to creating new kind of businesses. (Sitra 2014.) Of course new business know how is necessary to create the best available techniques and practices for integrating the models of circular economy into business and society. Not only the production models need to be reconsidered but also the collection and recycling of materials (Ellen MacArthur Foundation 2015c).

To achieve resource efficiency more attention needs to be given to the whole lifecycle of products. Products often have more value in reuse or refurbishment than in recycling the materials and making new products out of them. Also less energy is needed. (Sitra 2014.)

In consumer sector the focus is on consumption habits and responsibility of a consumer (Ghisellini et al 2016). As the idea is to move from ownership towards sharing and leasing, a change in attitudes and behavior is crucial and encouragement towards this change is necessary. A shift is needed in the attitudes and consumption habits so that remanufactured products are seen as valuable and good products. (Sitra 2014, 68.) Performance of products and their suitability for use should be priority instead of just the product itself (Lieder & Rashid 2016).

This change in attitude does not only concern the consumers but rather the whole society, companies and public sector.

In macro level entire cities and regions are developed to form closed loop systems where energy, water and materials circulate. There are for example some eco-city projects in Europe and China which aim to zero emissions by fully utilizing materials. (Ghisellini et al 2016.)

The regional and national authorities operate as enablers for the change. EU as whole needs to support the change through regulatory frameworks, long term targets and creating the atmosphere for innovation and involvement (European Commission 2015a). Therefore in public sector the focus should be on enhancing the understanding of circular economy, developing their own processes, purchases and regulation and enhance the cooperation between sectors and support the research to commercialize circular economy (Preston 2012;Sitra 2014).

In order to be able to utilize recycled materials as raw material, barriers related to their use need to be solved. (Haas et al. 2015). To provide the information throughout the production and consumption chain, the recycled material and products could be provided with an easily understandable label of their quality and environmental factors (Seppälä et al. 2016). In terms of implementation of circular economy a clear framework is necessary. The focus should be more in economic aspects and benefits instead of waste management. (Lieder & Rashid 2015.)

To produce new operation models channels and possibilities to create them are necessary (Elinkeinoelämän keskusliitto 2015). Policy interventions are needed to create circular economy starting from introducing the principle all the way to product design and economic incentives to encourage investments and changes. In addition targets and ways to stimulate new business models are necessary. Wijkman & Skånberg (2015) also propose a shift in taxation from taxing labor to taxing more heavily the use of nonrenewable resources stating it would encourage to circular economy "*which is low-carbon and resource efficient in nature*". The need for policy incentives will however be dependent on the development of the commodity prices which are for example affected by the scarcity, pollution taxes and extraction prices (Wijkman & Skånberg 2015).

Investments in the infrastructure, construction and manufacturing are necessary to create the possibilities for circularity in the society. (Wijkman & Skånberg 2015, 44.) These business ideas need to also appeal to the consumers and they need to be interested in the idea of circularity (Preston 2012). The topic has been in seminars and education lately and efforts to raise awareness have increased (Lieder & Rashid 2016).

Clear tools to identify the potential to the company and industry will support the decision-making and create possibilities to accelerate implementation (Lieder & Rashid 2016). Being able to measure circularity at a product level is important as measuring something makes it easier to manage and develop. The metrics can also be used to communicate to the customer of the circularity of the product. (Linder, Sarasini & Loon 2017.) Currently the tools to measure improvements towards circularity are scarce and the use of the term is diverse (Haas et al. 2015; Preston 2012).

Some metrics exist for measuring macro- and meso-level circularity. There is no clear metrics to measuring circular economy at the micro-level though there are attempts to develop it. Life Cycle Analysis (LCA) and material flow accounting (MFA) have been used to measure circularity. For example Haas et al (2015) have used MFA model as a base and aim to measure economy wide circularity. The MFA model has also been used to build a metrics for circularity in meso level. Also models to measure specifically circular economy have been proposed. Maio and Rem (2015) propose a model of Circular Economy Index (CEI) to present the effectiveness of gaining value from recycled materials. The model is still in its early stages and does need data to operate.

Accenture, Circle Economy, MVO Nederland and DuurzaamBedrijfsleven (2016) have together begun developing circular economy index to understand the position of circular economy in Dutch companies. The Ellen MacArthur Foundation is also developing a Material Circularity Indicator (MCI) to measure circularity in a product level. However each of these metrics have their problems often either in reliability, transparency or possibility to generalize in different industries and products. (Linder, Sarasini & Loon 2017.) The problems can also be related to costs, availability of data and the aspects that can be considered through these tools (Maio & Rem 2015).

2.1.4 Circular economy in Finland

Some of the principles of circular economy, such as resource- and energy efficiency, have already been utilized in Finland and some companies have implemented models of circularity in their operations. These economically viable practices and their benefits should be openly marketed in the public in order to support their implementation also in other companies. (Seppälä et al. 2016; Sitra 2014.) The current policy measures in material efficiency are strongly focused on waste. While it is crucial to develop solutions in this area, another important area is the planning and production of products in accordance with the practices of circular economy. (Seppälä et al 2016.) Finland is also affected by the increase in resource prices caused by scarcity and increasing demand caused by population growth, increase in wealth in developing countries and urbanization. The willingness of other countries and the decision and policies of the European Union (EU) to enhance circular economy has an effect for Finland to fully achieve circularity (Sitra 2014).

In 2014 Finland produced almost 94 million tons of waste. Compared to other member states of the EU and proportionated to the population, the amount is the third largest. Large portion of the waste comes from mining, factories and construction and it has to be noted that Finland is among the five largest producers of mining waste in the EU. Community waste forms only 3 % of the amount of waste created. The amount of waste produced has been steadily growing in the 21st century. On average the community waste amount per Finnish person per year is 500 kilograms. (Laaksonen, Pietarinen & Salmenperä 2017.)

From the beginning of 2016 placing biodegradable and organic waste into the landfills has been banned in Finland (Vna 2.5.2013/331). This means that the

waste should be utilized in other ways, such as material or energy. Since the beginning of 2016 also the collection of plastic from consumer packaging has begun nationwide in Finland through producer responsibility. The collected plastic is processed into raw material for new products. (Finnish packaging recycling Rinki LTD 2017.)

The National Waste Plan 2023 was published early in 2018 and the four focus points on preventing waste are construction waste, biodegradable waste, community waste, including packaging waste, and e-waste. Circular economy is strongly included into the plan and actions are estimated to increase the research and experiment on circular economy. Among the main objectives is that waste management has high standards and is part of sustainable circular economy. (Ympäristöministeriö 2018.) These decisions and goals are already guiding towards the implementation of the models of circular economy and seems that among the aims of the policymakers is to lead Finland towards circular economy.

The Finnish economy has three specific features that need to be considered when discussing about circular economy. Firstly, most of the raw materials that are produced, for example from mining and paper industry, are exported for upgrading. Secondly, from consumables only food is mainly produced in Finland. And thirdly, the production has increasingly moved to other countries whereas the industries in Finland are more focused on the immaterial aspects of the value chain. These points dictate to which areas it is most reasonable to focus on when it comes to creating circular economy in Finland. (Sitra 2014.)

As the consumption on paper industry is mainly outside Finland, the focus should be given to side flows in this industry. Whereas in food chain the circularity can be enhanced throughout the chain as both the production and consumption mainly happens in here. In manufacturing circularity can be enhanced to increase global competitiveness. As the focus is on production machines, which have longer useful life, products still have a significant amount of value at the end of their life cycle and innovations do not occur that often, circularity can be embedded with the possibilities of leasing, modularity and remanufacturing. (Sitra 2014.)

In Finland the resource- and energy efficiency has still a lot of potential for development and though some side streams are already utilized and researched, a lot remains available. (Sitra 2014; Wijkman & Skånberg 2015.) As forestry country Finland already uses a significant amount of biomass in their energy mix. Yet the residue materials still offer a great potential to develop biofuels. The use of biofuels would increase the use of renewable materials and decrease the emissions. (Wijkman & Skånberg 2015.)

Sitra (2014) has estimated that for Finland circular economy can provide a value potential of 1.5 to 2.5 billion euros by the year 2030. This estimation is based on the potential of five sectors that were considered to have the most economic value and potential for circular economy. These sectors are manufacture of machinery and equipment, the forestry-wood chain, from forest management to paper production, the food chain, from agriculture to retail and restaurant services, construction and private consumption. The evaluation does not take into consideration any other sectors or the potential currently unknown technologies might

provide. Seppälä et al (2016) estimate that for Finland the largest potential for innovations on circular economy are in the field of bioeconomy. Another sector with potential is metallurgy. However, estimating the full potential of circular economy is difficult as all the possibilities cannot be evaluated and the different evaluation methods in general have their shortages. Seppälä et al (2016) estimate that in short term the most beneficial focus point would be in replacing harmful materials in material loops with those that are not harmful.

In order to achieve circular economy countries need to invest yearly until year 2030 around 3 percent of their GDP to development of circular economy models. This investment is in addition to normal investments. In Finland this means around 6 billion euros. The sectors where the investments should be primarily guided are related to developing bio-based products, infrastructure, sustainable energy sources, energy- and material efficiency, maintenance, repair, re-manufacturing, recycling, engineering services and education. This investment package would not only have a positive effect on the employment of the country engaging to the package but also to other EU countries due to open-market trading-zone. (Wijkman & Skånberg 2015.)

As the building blocks to create circular economy Sitra (2014) lists knowledge and skills in planning production and products to make the models of circular economy possible, new business-models and innovations, knowledge on creating reverse logistics and loops and enhancing cooperation between sectors for example to understand the value of materials in different sectors. Sitra (2014) also states that lightening the regulations of the public sector has an important role in achieving circular economy.

3 CORPORATE SUSTAINABILITY DRIVERS

Corporate sustainability or corporate social responsibility (CSR) means meeting the needs of current stakeholders without compromising the ability to meet the needs of the future stakeholders. This includes both the direct and indirect stakeholders. (Dyllick & Hockerts 2002.) Carroll (1979) divides the responsibilities and activities of a company into four categories. These are economic, legal, ethical and discretionary. These are the multiple obligations the society gives to a company. Each of the responsibilities and actions of a company can have motivations related to either or several of these categories.

Corporate sustainability is something that has been in the discussion for a long time and companies have put effort into it and reporting their activities. Yet the sustainability activities have often just been considered as additional costs and not been seen beneficial for business. Porter and Kramer (2006) have argued that by analyzing and understanding the positive and negative effects the company has to the society, it can best prioritize the most relevant CSR areas to invest in and what activities and practices to implement to achieve results. By focusing on the relevant issues, the efforts can offer possibilities, innovations and competitive advantage instead of being just a cost.

Corporate sustainability drivers are the factors that motivate companies to adopt practices for corporate sustainability. By understanding the motives for sustainability, predicting the behavior of organizations in adopting ecologically responsive practices becomes easier. It also provides a better understanding on the efficiency of different commands and controls to enhance sustainability in corporations. (Bansal & Roth 2000.)

Companies are motivated by different factors which can be dependent on several factors. The pressure each company receives and how they perceive it is different. For example the size of the company, its position in value chain or the industry sector all have a role in which factors the company recognizes and which issues are seen as the most pressing ones. Often the drivers for corporate sustainability are mixed making it difficult to recognize the most dominant one. Responding to the different drivers is a challenge to the companies and recognizing which ones to prioritize can be difficult. The factors in general have relationships and are therefore not independent. (Bansal & Roth 2000; González-Benito and González-Benito 2006; Lozano 2015.)

Yet some drivers rise over others in the literature and are brought up by several different authors. Some of the most mentioned ones are stakeholder pressure, top management, governmental factors, competitiveness and cost savings and company image. The drivers, short description of what they deal with and examples of authors that have recognized the driver are presented in Table 1.

Driver	Aspects related to the driver	Examples of authors that have recognized it
Stakeholder pressure	external and internal, primary and secondary, customers, someone inside the company driving towards sustainability	Aguinis & Glavas 2012; Dummett 2006; FIBS 2017; Garcés-Ayerbe et al. 2012; González-Benito & González-Benito 2006; Henriques & Sadorsky 1996; Lozano 2015; Madsen and Ulhøi 2001; Moon 2007
Top management	motivations, attitude	Banerjee et al. 2003; Dummett 2006; FIBS 2016; FIBS 2017; Hemingway & Maclagan 2004; González-Benito & González-Benito 2006; Lozano 2015
Company features	size, internationalization, position in value chain, goals and missions of the company	Chapple & Moon 2005; FIBS 2017; González-Benito & González-Benito 2006; Lozano 2015
Governmental factors	regulation, legislation, incentive policies	Aguinis & Glavas 2012; Banerjee 2003; Bansal & Roth 2000; Campbell 2007; Dummett 2006; González-Benito & González-Benito 2006; Henriques & Sadorsky 1996, Lozano 2015; Madsen and Ulhøi 2001; Moon 2007; Paulraj 2009; Williamson et al. 2006
competitiveness and cost savings	savings e.g. in energy costs increase long-term profitability, more with less	Banerjee et al 2003; Bansal & Roth 2000; Dummett 2006; FIBS 2016; Garcés-Ayerbe et al. 2012; Kasim and Ismail 2011; Williamson et al 2006
company image	brand protection, risk avoidance, response to accidents	Dummett 2006, FIBS 2016; FIBS 2017; González-Benito & González-Benito 2006

Table 1. Drivers for corporate sustainability.

3.1 Stakeholder pressure

Stakeholder pressure rises from the literature among the most important drivers and in general firm's engagement to CSR and the CSR initiatives seems to be affected by the firms stakeholders (Aguinis & Glavas 2012; Garcés-Ayerbe, Rivera-Torres & Murrillo-Luna 2012; González-Benito & González-Benito 2006; Henriques & Sadorsky 1996; Lozano 2015; Madsen & Ulhøi 2001; Moon 2007). González-Benito and González-Benito (2006) argue that stakeholder pressure is the central determinant factor as it seems other factors affect its importance, influence and intensity. There are indications that the strength of the stakeholder pressure has a positive effect on proactive environmental strategy. (Garcés-Ayerbe et al. 2012).

In management literature stakeholders are commonly defined through Freeman's (1984) stakeholder theory. According to the theory stakeholder is the group or individual that can affect the company or be affected by the actions of the company. The theory divides stakeholders into two groups; primary and secondary stakeholders as well as internal and external ones. Customer, investors and employees are seen as the primary stakeholders while competitors and other groups are seen as secondary ones. In corporate sustainability literature especially the employees are seen to have increasing importance as their awareness to balance the values of their personal life and work increases (Moon 2007). Though personnel is also mentioned as a driver for corporate sustainability in large Finnish companies the role of customers, business owners, investors and financiers is yet mentioned more often (FIBS 2017).

Companies need to be able to deal with the conflicting interest of the stakeholders and the question of salience comes up. The salience of stakeholders builds on their power, legitimacy and urgency (Mitchell, Agle & Wood 1997.) Based on salience it can be evaluated what is the significance of each stakeholders group and how much attention the company should give to their demands. In legitimation activities such as institutional norms and regulations are seen crucial and the main focus is on reacting to regulations in avoidance of penalties rather than proactive activities. Most influential stakeholder with the strongest voice to address legitimacy issues are given especial focus. (Bansal & Roth 2000.)

According to FIBS (2016) among large Finnish companies customers, owners and investors have increased significantly their importance as a driver for corporate sustainability. Yet it seems there is a gap between opinions on responsibility of products and the actual consumption habits. So the voiced demands don't necessarily reflect the actual actions and choices of the customers. (Moon 2007.) This is something that creates challenges to companies. It is difficult for the company to know will the action on a certain demand eventually benefit the company and is the customer actually willing to for example pay a higher price on a more responsible product or will the price eventually be the determinant factor.

Dialogue with stakeholders effects positively on the likelihood of the company to behave in environmentally responsible way. (Campbell 2007.) Dialogue

with stakeholder might help to evaluate what are the main desires of the stakeholders and by discussing them with the company, a better understanding of each sides desires and possibilities can be achieved. With open discussion common goals can be set and a better understanding reached.

3.2 Top management

Leadership can be seen as the most important internal driver in implementing sustainability initiatives (Lozano 2015). Among large Finnish companies top management is still recognized as the main driver to corporate sustainability operations (FIBS 2016; FIBS 2017). According to Banerjee, Iyer and Kashyap (2003) the commitment of top management was the most important factor on adopting environmental corporate strategies and incentives.

The managerial attitude and strategic attitude have a key role in recognizing perception of the pressure to adopt corporate sustainability practices. Eventually it is the management that makes the decisions on which activities are the ones to invest in. Even though the initiative would come elsewhere, the commitment and support of the top management ensures the access of necessary resources. Often co-operation between several divisions and departments is needed and the approval, support and management from the top management makes it easier to reach. (González-Benito & González-Benito 2006).

The interests of a manager seems to make a difference to one way or another on the environmental practices implemented as they have the possibility to influence projects. Also the commitment of employees needs support from top management and without support from the top management it is difficult to implement any new practices. The managerial attitudes gives a clear message to the employees on whether or not some practices should be followed. (Banerjee 2001; Hemingway & Maclagan 2004). Nevertheless, a committed person inside the company is an important driver whether it is the manager or someone else (Dummett 2006).

3.3 Company features

Company factors such as size, internationalization, position in value chain and company culture have an effect on environmental proactivity. Larger companies are considered to have more resources available to invest into environmental management, gain more attention and pressure from its environment including the governments and NGO's, have the possibilities to invest into environmental management and have an effect and be affected by larger number of consumers. (González-Benito & González-Benito 2006.) FIBS (2017) noticed in their study that in large Finnish companies it seems that the size of the company correlates with

the corporate responsibility management practices. So in larger companies there is a higher number of management practices related to corporate responsibility.

Internalization of a company can also bring on similar effects on the company but also being a part of an international company provides pressure to environmental management through the adoption of common practices throughout the company and the need to meet the requirements of the strictest country they operate in (González-Benito & González-Benito 2006). According to Chapple and Moon (2005) international companies seem to be more sensitive on their corporate sustainability activities. This makes sense as larger companies often receive more observation and feedback from the stakeholders due to their size.

The position in value chain determines to which parties the company is most visible and where the highest pressure comes from. According to González-Benito and González-Benito (2006) the company closest to the consumer often receives the highest consumer pressure. Lozano (2015) noted that company's culture was recognized among main driver to corporate sustainability.

Some industries have higher environmental impacts and are more visible to the public and therefore receive more pressure to develop their environmental commitment. Polluting industries often receive more public attention and concern as well as higher regulation. Public concern for environmental aspects might drive companies to seek for green image to respond to the environmental concern. The public concern can be presented or made visible for example by NGOs. (Banerjee et al. 2003)

3.4 Governmental factors

Governmental factors are regulations and legislation that oblige companies as well as standards, certification and different incentive policies that governments may have. They often play an important role in the operations of a company. Legislation provides the minimum standards the companies need to reach. Governmental drivers can also be encouragements from government to CSR actions through endorsements, policies, initiatives and other ways to encourage responsible practices (Moon 2007). Strong regulations and monitoring from NGOs or other independent organizations are among factors that increase the likelihood of companies to behave in a responsible ways. (Campbell 2007.)

Legislation or the threat of it is seen among main drivers to act in a more environmentally responsible way (Campbell 2007; Dummett 2006; Henriques & Sadorsky 1996; Madsen and Ulhøi 2001; Paulraj 2009). The extent and type of actions towards CSR as well as policies chosen by the company may be affected by legislative factors (Aguinis & Glavas 2012). Williamson et al (2006) state in their study that the small and medium sized enterprises in manufacturing industry are mainly driven by regulative factors and it is unlikely that they engage into voluntary sustainability actions. Therefore, for these companies the pressure from the regulation is especially important as a driver towards implementation of CSR activities.

Legislation is often focused on preventing environmental harm and pollution and are often more focused on the industries that pollute the most. In these industries the role of regulation is highlighted. Industries operating in sectors with higher environmental impact have previously been more likely to have environmental strategies and management systems. (Banerjee 2003; González-Benito & González-Benito 2006.)

Simply being driven by governmental factors might mean that the company will only engage to the obligatory actions to meet the demands and the actions remain symbolic (Aguinis & Glavas 2012; Bansal & Roth 2000). However, Dummett (2006) notes that in his study the interviewees seemed to desire a more active role from the government especially through a legislation that would be based on performance. Among these actions are incentive policies to guide desired business action.

3.5 Competitiveness and cost savings

Considerations on enhancing competitiveness and business performance and achieving cost saving through adopting corporate sustainability activities are also present in the literature. Some companies are driven to implement corporate sustainability practices to achieve increased long-term profitability (Bansal & Roth 2000) whereas others seek to appeal to green consumers by implementing sustainability strategies. (Banerjee et al. 2003).

Cost savings in energy, water and waste management are among the mentioned driving factors related to increasing long-term profitability. Companies also seek to increase their output without increasing their input. (Banerjee et al 2003.) According to Williamson et al. (2006) manufacturing SMEs are driven to sustainability activities to achieve cost savings and satisfy the needs of the customers as they seek to find profitability to their company. Green marketing and ecoproducts to answer to the desires of the customer and increase the competitiveness are also something other companies are driven by (Banerjee et al. 2013.)

Garcés-Ayerbe et al. (2012) noted that as the drivers of the company to environmental activities are associated with competitiveness, the environmental strategy of the company is more proactive though the influence is much smaller than that of stakeholder pressure. However, it seems that in highly polluting companies competitive advantage does not operate as a strong driver towards environmental proactivity whereas in less polluting companies the driver has more significance.

Yet not all companies directly mention cost savings as a driver. For example in the study of Dummett (2006) interviewed business leaders did not mention costs savings as a driver to environmental aspects before directly asked about it. This might be related to social desirability and avoiding giving a certain image of the company.

3.6 Company image

The desire to avoid risks and accidents to protect the company image as well as the philosophy of a company and the brand promise play an important role in decisions. (Dummet 2006; FIBS 2016). The desire to keep license to operate, in other words legitimation of the company, is also a driver to environmental activities. Repairing damaged image once it has been stained is extremely difficult and therefore it is desirable to maintain the current one and avoid negative publicity.

Some industrial sectors receive more attention and are therefore have a higher image risk. These can be for example companies operating in a highly polluting fields. (González-Benito & González-Benito 2006) The consumers and NGOs desire proof behind the image and brand promises and open communication is necessary. Therefore building on brand promises without actual actions is dangerous.

Image benefit has also been seen as the most important benefit of corporate sustainability in large Finnish companies from 2013 to 2015 (FIBS 2016). However, in 2016 the role of reputation dropped significantly from previous years and risk management and “ensuring future operating prerequisites” were seen as the most important reasons to invest to corporate responsibility. This might indicate that corporate responsibility is now seen more as a long-term business opportunity rather than a short term one. (FIBS 2017.)

4 METHODOLOGY

This study aims to find out the drivers for circular economy in the Finnish machinery and equipment industry. In this chapter the scope of this research is explained as well as the research method, data collection and data analysis.

4.1 The scope of the research

This research focuses on the Finnish machinery and equipment industry. This scope was chosen as Sitra (2014) estimates this industrial sector to have the most growth potential through the models of circular economy. This industry has also had, and still has, a key role in the Finnish economy. In this industry the products often have long lifecycles and a lot of valuable materials, such as metals, are used in the manufacturing.

Machinery and equipment industry has a key role in Finnish economy. It is among major exporting industries of Finland and after the decline of mobile phone industry its role has increased. The industry produces machinery for the use of other sectors and in Finland especially machinery to pulp and paper industry have traditionally had a high demand. The large Finnish companies in machinery and equipment industry have utilized the possibilities of globalization and have good competitiveness. (OECD 2017; Pajarinen, Rouvinen & Ylä-Anttila 2012; Sitra 2014.) In machinery and equipment industry production volume, size, disassembly and the life cycle of the products are the main factors differentiating it from other sectors. (Sitra 2014)

Steel, components and engineering are the key costs of the companies in this sector. Scarcity of resources is a major issue that affects manufacturing industry as well as fulfilling the requirements of legislation with as low costs as possible. With large machinery, it is especially important to carefully consider the safety aspects to ensure the safe use for the customer. As the production of the machinery is expensive and they often have to endure heavy use, the quality of the materials and production are crucial. (Lieder & Rashid 2016; Sitra 2014.)

The Finnish machinery and equipment industry is based on ten major companies and their subcontractors. These companies mainly produce machinery for the use of pulp and paper and mining industries. Equipment is also needed for the cargo industry. These companies are highly focused on quality and their expertise is focused. Typical lifespan of equipment and components is 5-25 years and already 30-50 percent of the turnover of the companies comes from maintenance services. (Sitra 2014.) The orders are often long projects and the customers might be far away from the machinery's production country (Karvonen, Jansson, Vatanen, Tonteri, Uoti & Wessman-Jääskeläinen 2015). Acquisition of large machinery is always a significant investment that the companies have to

carefully consider. The costs of investing into the necessary machinery might often act as a barrier for new companies to enter this sector.

Sitra (2014) estimates that in machinery and equipment industry circular economy could provide the growth potential of 300-450 million euros through additional sales from the business models of circular economy. The machinery often still has high value at the end of its lifecycle which could be captured. The most potential circular models in this industry are leasing, repair, remanufacturing, refurbishment and increased modularity. As the production of the large machinery in this industry often requires a lot of work and materials, it is beneficial for the company to use the materials as efficiently as possible and utilize the value of the once produced product to its fullest.

Leasing is a good option and often products that can be remanufactured are leased (Karvonen et al. 2015). Through leasing the machinery and equipment industry's companies can change their pricing towards performance-based and develop the product according to it and seek new customer sectors. For customers leased product lowers the investment need in starting point or when acquiring new machinery. This creates more stability. For example in emerging markets the risks to invest into high cost equipment might operate as a barrier to begin or grow business. This can be solved through leasing. (Sitra 2014.)

As the heavy machinery of machinery and equipment industry have long lifecycles and withstand time and consumption, these are especially suitable for refurbishment and remanufacturing. Refurbishment and remanufacturing have already been done to some extent in Finland and in global companies. It has been focused on certain components and parts. The key questions are developing the models, finding out what is required to extend them and seek the long-term possibilities. Each of these models provides companies the possibility to utilize the value of the once produced products longer. (Karvonen et al. 2015; Sitra 2014.)

In some sectors the demand for used products is high and the products are sold forward. By getting involved into the sale of used products and developing refurbishment, the companies can still follow their products and make sure they are in the condition suitable for their brand. After refurbishment the products meets the same requirements as a new one and the old technique of a machine can be updated to newer one that consumes less energy and produces less emissions. In this way companies avoid the negative image that might be caused if the unfollowed forwarded product has flaws. Another important benefit is business value which can be received from the products again without producing a new one. (Karvonen et al. 2015; Sitra 2014.) All products cannot be refurbished and to utilize the possibilities of remanufacturing the product planning should take it into consideration. (Karvonen et al. 2015.)

Extending modularity throughout the process of the product benefits both the company and the customer. As modularity is taken into consideration already in the design of the product, it is easier to implement the models of circular economy. Some of the parts and components can be designed as universal ones that can be easily separated and recombined. This brings costs saving to the production company in manufacturing and for the customer in the maintenance and

service costs. Combining the use of leasing, modularity and remanufacturing offers the companies possibilities to follow their products, adjust their design and reusability and enhance their competitiveness (Sitra 2014).

4.2 Research method

For this research a qualitative research method was chosen. Qualitative research is often associated with human perception and understanding and producing non-numeric data (Saunders, Lewis & Thornhill 2012; Stake 2010). The aim is in contextual understanding, interpretation and achieving understanding of the operators' views. (Glesne and Peshik 1992 as cited in Hirsjärvi & Hurme 2008). It is suited for example in situations when the interest is in the details of an event or causal relationships rather than in general division (Metsämuuronen 2011).

However, this division is not that clear and both qualitative and quantitative methods can be used side by side. For example questionnaires might involve open questions in addition to choosing from given choices or the data might be analyzed with the other research method. (Metsämuuronen 2011; Saunders et al 2012.)

The most common methods of qualitative research are observation, interviewing and examination (Stake 2010). Transcription is also often used. These methods can also be used in quantitative research but in a different meaning and often not to solely analyze the data. (Metsämuuronen 2011).

In qualitative research the analysis often begins already during the data collection as the researcher can already notice some similarities and categories as well as specialties. There are only few standardized techniques in analyzing qualitative data and therefore the ways of analyzing vary. (Hirsjärvi & Hurme 2008.) However the main steps are analyzing and synthesizing. In analyzing the data is allocated and sorted and in synthesizing the goal is to present the larger picture and present the topic in a new perspective. (Hirsjärvi & Hurme 2008; Stake 2010.)

Analyzing often begins with describing the data as it is the foundation of the research and it seeks to answer to questions who, where, when, how much and how often. Ways to describe the data vary and the researcher should find the balance between presenting too many and too few details. The reader should be provided with enough details to understand the context but yet the interpretation should not be left to the reader as the researcher knows the data best. (Hirsjärvi & Hurme 2008.)

Next step is coding the data. The data is coded to topics, themes and relevant issues related to the research. Coding can be begun as soon as some data is collected or it can be begun as all data is collected. The base and the frame to interpretation and simplifying the data is created in coding and the categories often get more focused as more data is analyzed. (Hirsjärvi & Hurme 2008; Stake 2010.)

Coded data is then combined. This means that common features between the categories are sought. This is the so called inductive phase and sometimes it

is enough to leave the analysis here. Yet often it is beneficial to continue to deductive phase where the goal is to diversely understand the topic and possibly create a theoretical viewpoint or model. (Hirsjärvi & Hurme 2008.)

4.3 Data collection

Data collection is an important part of the research. The data collection method should be chosen based on the research question and what is the best method to collect reliable data that answers to the research question (Stake 2010). For this study, data was collected through interviewing. The interviews were email interviews, skype interview and a phone interview.

4.3.1 Interviewing

Interviewing is the most commonly used way of collecting data. It is a very flexible way of obtaining data and provides a possibility to find out the motives behind the answers and change the order of the questions depending on the interview. (Hirjärvi & Hurme 2008.) In the context of research interview, interviewing is simply asking purposeful questions that the interviewee is willing to answer. The aim is to collect valid and reliable data to answer to the research questions and objectives. (Saunders, Lewis & Thornhill 2012.) The goal is to present the interpretations, opinions and feelings of the interviewees. (Hirjärvi & Hurme 2008.)

The type of an interview can be strictly structured and formal and even standardized or unstructured in-depth interview. In one interview different types of structures can be mixed and the type is often chosen based on the purpose of the interview and the research. (Saunders et al 2012.) Less structured interviewing and use of open ended questions is increasingly popular (Hirjärvi & Hurme 2008).

Reasons to use interviewing are multiple. It can be used when the researcher finds it difficult to predict the structure of the answers. (Hirjärvi & Hurme 2008.) The interviewee might have some unique information the researcher is interested in or the researcher seeks to find information on something that cannot be found through observation. (Stake 2010.) The flexibility of interviewing provides the possibility to ask more detailed questions to clarify the answers or broaden the information or interpretations by finding out the motives behind the answers and putting the answers into larger context. (Hirsjärvi & Hurme 2008.)

The challenges of interviewing are related to the expenses and experience of the researcher. The interviews can be time-consuming and require traveling. Mistakes and misunderstandings can happen both to the interviewer and the interviewee and it is crucial to keep the questions clear and easy to understand. In order to get most out of the interview, the researcher should be experienced and trained. The interviewer should be able to recognize when it is best to change the

structure of the interview, when to ask more and when to change the topic. Especially in delicate topics recognizing the uneasiness of the interviewee is crucial. There is also a potential that the answers are guided by social desirability. (Hirsjärvi & Hurme 2008.) The positive or negative reactions of the interviewer can affect the answers of the interviewee causing bias to the answers. Therefore it is important that the interviewer stay objective. (Saunders et al 2012.)

In this research the interviews were mostly conducted as email interviews. The interviewees were contacted through email and were asked to answer a set of questions. If no answer to the email was received in around ten days, a friendly reminder and a petition to answer was sent. One of the email interview was supplemented with a Skype-interview to receive more in-depth answers. In addition one interview was conducted as a phone interview as this suited the interviewee better and was considered to provide comprehensive answers. The types of the interviews are presented in Table 2 below.

Interviewee	Type of the interview
Interviewee 1	E-mail
Interviewee 2	E-mail
Interviewee 3	E-mail
Interviewee 4	E-mail
Interviewee 5	E-mail
Interviewee 6	E-mail
Interviewee 7	E-mail + Skype
Interviewee 8	E-mail
Interviewee 9	Phone
Interviewee 10	E-mail

Table 2: Types of the interviews

Most of the interviews were conducted in Finnish and only one of the interviews was in English. The introduction to the topic and the questions sent to the interviewees are visible in the appendices. To preserve the anonymity of the companies and the interviewees, the companies contacted for this study are not listed.

4.3.2 Email interview

Email interviews have been used especially to deal with delicate issues that are difficult to discuss in a face-to-face interview. Other reasons to use email interviewing can be tackling with the often time-consuming and costly nature of interviewing. (Bampton & Cowton 2002; Mann & Stewart 2000.) However, it needs to be noted that depending on the delay between answers, the interview might last for quite long and the nature of the interview can change along the way (Ruusuvoori & Tiittula 2005).

In unstructured email interview the questions are emailed to the interviewee in sets of questions and another set is emailed once the first ones have been answered (Bampton & Cowton 2002; Mann & Stewart 2000). The amount of questions sent at the same time needs to be carefully considered to avoid sending too many questions at the same time. (Bampton & Cowton 2002.)

As in an email interview the interviewer and interviewee do not need to be in a same place at the same time, the costs and time used for travelling are eliminated. (Bampton & Cowton 2002; Mann & Stewart 2000.) The distance and anonymity between the interviewer and interviewee can provide courage for the interviewee to discuss delicate matters and express critical and strong opinions (Ruusuvuori & Tiittula 2005).

As email interview is asynchronous, both the interviewer and the interviewee have the possibility to answer once they have time. (Mann & Stewart 2000). This provides the possibility for both to structure their answers into desired way and the interviewer to present specifying questions. However, the answers are often less spontaneous and the interviewee has time to search for information and structure the answer carefully to provide a desired impression. This is something that has to be kept in mind while analyzing the results. However, the lack of spontaneity is not necessarily entirely negative aspect as in this way the answers are more coherent and might better communicate the meaning of the interviewee. (Bampton & Cowton 2002.) The whole interview is also already in a written form and there is no question who said what (Mann & Stewart 2000).

A general problem is that the email interview lacks non-verbal communication. This increases the risks of misinterpretation and the possibility for the interviewer to re-evaluate the presentation of questions when noticing signs of uneasiness or reluctance in the interviewee. This and the asynchronous nature bring a problem that the interviewer does not know whether the interviewee is going to answer to the questions or the delay is caused by some other reason. In case of delays the interviewer might consider sending a carefully structured remainder. (Bampton & Cowton 2002.)

For this study email interviewing was chosen as the researcher was working full-time and the possibilities to conduct other types of interviews was considered limited. The email interviewing was considered suitable due to its less time-consuming nature and the possibility both for the interviewee and the interviewer to return to topic when the time was the most convenient. For this research the lack of spontaneity was not considered a negative aspect as the models of circular economy might be hard to grasp and being able to return to the questions once something more comes to mind was reflected a possibility.

Yet the lack of response has to be mentioned as a drawback. It was impossible to know had the interviewee read the email or was the person going to answer to the questions as from some chosen for the sample no answer was received even after the reminder email. In this sense contacting through phone might have been a good idea.

4.4 Thematic analysis

According to Guest, MacQueen and Namey (2012) thematic analysis is the most often used method in qualitative research. In thematic analysis common themes arising from the data are analyzed. The type of the analysis is determined by what the research seeks to find out, what are the research objectives and the type of the data. The researcher might seek to analyze the text or discussion or how the theory builds based on the research data. (Guest et al. 2012; Hirsjärvi & Hurme 2008.) With thematic analysis the conclusions can be separated from single people and transferred to a more general level (Metsämuuronen 2011). For this research thematic analysis was chosen.

In thematic analysis the researcher needs to make more interpretations to find the relevant themes from the data (Guest et al. 2012). In order to reliably do this the researcher needs to be familiar with the data. The researcher should carefully get familiar with the material before beginning any analysis. By knowing the material, the researcher can more reliably recognize the themes and the context of each answer. The themes are based on the interpretations of the researcher of the interviewees or of their answers. Different interviewees rarely answer in completely same way. (Hirsjärvi & Hurme 2008.)

The answers can be grouped into themes already while transcribing the interviews. This is often convenient when there is no need to transcribe the interviews word to word. The goal is to collect the key content of the answer. Transcribing is a careful process and the researcher needs to be careful with presenting interpretations. The researcher has to recognize when the interviewee is speaking of the theme. Same theme can be present in different parts of the interview and the answers are put together under the theme. Sometimes this is difficult and the context of the answer should be preserved when necessary. The researcher also need to consider when to present the answer word to word. (Hirsjärvi & Hurme 2008.)

In this study the phone and skype interview were first transcribed. After this all the answers were read through multiple times to make sure they were understood correctly. The interviews were built around six themes based on the research questions. These were motivations to circular economy, current meaning of circular economy, meaning of circular economy in the future, estimation of growth potential, changes needed to achieve the potential and the effect to competitive advantage.

The answers related to each of these main themes were collected in different documents to more closely analyze the themes arising from them. Under each main theme parts dealing with different themes were marked in different color and returned to later on to make sure the meaning was understood correctly. In some interviews it was noticed that some of the main themes were brought up later on in the interview as well and discussed more closely for example through examples. These were also collected under the main theme it was more closely related to. Also some answers were related to several themes.

The number of themes arising under each main theme varied. In the answers to one question there were only two clear themes under which the answers could be themed to. On the other hand in one question there were seven different themes to be found. In this question, the interviewees often brought up several themes in their answers instead of just one.

4.5 Reliability and validity

Reliability and validity are concepts that are used to evaluate the quality of the research. The idea of reliability and validity is that the researcher aims for objectivity and objective truth. (Hirjärvi & Hurme 2008.) These two concepts are often connected and it is unlikely that if the data of the research is valid the results of the research would be unreliable. Validity is recognized as more important one. (Guest et al. 2012).

Validity evaluates the data and has multiple subtypes that different authors refer to. Most mentioned ones are face, content, construct, criterion and external or internal validity. (Guest et al. 2012; Metsämuuronen 2011.) For qualitative research face and external validity are most often applicable. Face validity evaluates the suitability of the indicator based on the literature in the researched field. External validity deals with the generalization of the research and how relevant the findings are. (Guest et al. 2012.)

Reliability is focused on the repeatability of the research and assessments in the study. So if the research is repeated how similar or different would the results be. (Guest et al. 2011; Metsämuuronen 2011.) If valid data does not produce similar results when repeated, the researcher should look into the studied phenomenon or the context of the data collection for changes (Guest et al. 2012).

Thematic analysis relies more on the interpretations of the researcher and the reliability of the data is often more questioned than for example in a more numeric data (Guest et al. 2012).

In terms of the interviewing method, in less standardized interviewing methods there is also three types of bias that might affect the reliability of the interviews. These are interviewer bias, interviewee or response bias and participation bias. Interviewer bias is when the non-verbal communication or responses of the interviewer affect the responses of the interviewee. (Saunders et al 2012.)

Interviewee or response bias may be due to the interpretation of the interviewee of the interviewer or the unwillingness or uneasiness of the interviewee to answer for example due to sensitivity of some themes or questions of the interview. This is also related to social desirability as the interviewee might seek to present the answers in a more socially desirable way. (Saunders et al 2012.)

Participation bias is related to the time-consuming nature of the interview in a way that some the researcher planned to interview do not participate into the interview. This affects to the sample and needs to be carefully considered. (Saunders et al 2012.)

5 THE RESEARCH

The data for this research was collected by interviewing ten people working in the large Finnish companies in machinery and equipment industry. The interviews were mainly conducted as email interviews. In this section the data is presented, transcribed and analyzed.

The research was a qualitative research and the aim was to understand what Finnish equipment and machinery industry companies think of circular economy and what drives them to circular economy business models. These drivers are compared to the drivers of corporate sustainability. Other themes of the interviews are current meaning of circular economy, meaning of circular economy in the future, estimation of growth potential, changes needed to achieve the potential and the effect of circular economy to competitive advantage

At first the focus was on the CEOs of the companies but soon the interview was expanded to the people working with sustainability aspects. Some CEOs also preferred that the answers were provided by person working with sustainability.

The machinery and equipment industry was chosen as Sitra (2015) estimates that the industry has the largest growth potential, 300-450 million euros, through the additional business from the models of circular economy. In Finland the machinery and equipment industry is basically build on around 10 largest companies and their subcontractors (Sitra 2014). For this research the 14 largest companies were contacted and a total of ten answers were received from nine different companies.

5.1 The interviews

Finnish machinery and equipment industry is mainly build on ten large companies and their subcontractors. The original plan was to interview the CEOs of 14 companies in machinery and equipment industry. However as the contacting was begun it was soon noticed that some of the CEOs directed the inquiries to the people responsible for sustainability in the company. It was decided that the data can be collected from these people.

Eventually the material of the thesis consist of ten interviews with people from machinery and equipment industry. This means that from the originally planned 14 companies, five the answers were failed to collect despite kindly reminding of the interview.

Eight of the interviews are entirely email interviews, one a phone interview and one an email interview which was broadened with a skype interview. Most of the interviews were conducted in Finnish, yet one interviews was conducted in English. The introduction to the topic and the questions sent to the interviewees in Finnish is visible in Appendice 1 and in English in Appendice 2. To

preserve the anonymity of the companies and the interviewees, it was decided that the companies contacted for this study are not listed in this study.

5.2 Findings

The phone and skype interviews were transcribed and analyzed using thematic analysis. The answers of each question were constructed into main themes. The themes were motivations to circular economy, current meaning of circular economy, meaning of circular economy in the future, estimation of growth potential, changes needed to achieve the potential and competitive advantage of circular economy.

The number of themes identified in each main theme varied. In some of the answers the themes were clear to recognize and they were mentioned by most of the interviewees, whereas in others the variety was wide. When asked about the meaning of circular economy in the future only two clear themes were identified whereas in the motivations to circular economy seven themes could be recognized. Under other main themes the number of themes recognized varied from three to six.

The themes identified from each question are presented in Table 3 in the next page to provide an overview of the answers. In this chapter each main theme is presented and the themes of the answers described. Some relevant quotes from the interviews are also presented.

The research question	Themes
What motivates to circular economy?	business potential
	increase in business value and sales
	resource efficiency
	customer demand
	company values and principles
	image benefits
What is the current meaning of circular economy to the company?	sustainability
	already part of operations
	definition to operations
	sustainability
	continuously growing impact
What do you think circular economy will mean to the company in the future?	a new perspective
	importance will continue to grow
	practical case examples and regulations will guide towards implementation
How realistic do you see the growth potential estimated by Sitra?	larger potential
	potential but monetary value hard to evaluate
	realistic
	smaller potential
What is needed to reach the growth potential?	changes in companies and business atmosphere
	new technologies
	changes in customers' attitudes
	support to develop circular economy
	more opportunities to the models of circular economy
	co-operation
How will circular economy affect competitive advantage?	new business models and solutions
	increase competitiveness
	significant competitive advantage to forerunners
	circular economy a way forwards in long term

Table 3. The research questions and themes from the answers.

5.2.1 Current meaning of circular economy

Based on the interview the current meaning of circular economy to the companies can be divided into five themes. These are already part of operations, definition to operations, megatrend that affects through customers, continuously growing impact and new perspective.

In all of the interviews it was brought up that the models or challenges of circular economy are already a part of the operations in one way or another. Some companies have already for long been offering maintenance and modularity services related to circular economy and even made a concept out of the models now associated with circular economy. Maintenance, modularity and services to prolong the lifecycle of products were mentioned to be part of the whole service package and are offered to customers. The idea is to offer a comprehensive service to the customer so that all necessary operations are available through the manufacturing company. Expertise, good practices and examples of circular economy are already found among some of the interviewed companies. Circular economy was also considered to fit the operations of the company and be visible in values and strategy.

“Circular economy is in our business idea and values so the technologies of circular economy fit well to the operations of our company. The company also has strong expertise in this area.”

Translated by the researcher

“Our model of operation has always been very compatible with circular economy, and now it is in the core of our operation as all of our traditional and more new business areas and models fit the circles of Circular Economy concept.”

Another important meaning of circular economy was definition to actions. Some of the answers related to the theme “already part of operations” can also be seen to be related to this theme as several companies mentioned to already have been utilizing the models of circular economy. In some of the companies the operations associated with circular economy have already been in place and the term circular economy just provides an outlining definition for them. It was brought up that for example recycling and maintenance services would be done even without the concept itself. Yet there was also a mention that the operations have partially accustomed to follow the practices of circular economy.

“Our company has already for long utilized the possibilities to reuse components and materials and recycle them.”

Translated by the researcher

Circular economy was also associated with sustainability and some interviewees mentioned sustainability and environmental aspects while asked about the current meaning of circular economy. Sustainability was mentioned to have high importance for the company and circular economy was considered to be a

part of sustainability. Commitment to continuously improve environmental performance and implement environmental thinking into the whole production process as well as acting in a responsible way towards people and environment were also seen as crucial aspects associated and to be achieved through models of circular economy.

Several interviewees brought up that they considered the meaning of circular economy to be growing. The meaning might have been already recognized at the time of the interview but the belief was that its importance is currently growing as for example importance of recycling has been recently growing. One interviewee specified:

“The meaning is still minor but for example recycling has strengthened both in terms of instruments of production and packaging materials as well as in waste raw materials.”

Translated by the researcher.

Circular economy was also seen as a way to look at the operations from a new perspective and vision how to develop all processes. Enhancing the operations of the company and resource efficiency were mentioned as key point to receive new perspective to.

5.2.2 Meaning of circular economy in the future

The future meaning of circular economy was seen with a more straightforward view. Two main themes arising from the interviews were continuously growing meaning in the future and implementation through regulation and practical examples.

Most recognized the meaning of circular economy to be growing in the future in business and some also mentioned the society. It was estimated that the models of circular economy will be utilized more and they will strengthen both in business and society. There were also hopes that the importance of circular economy would grow in b-to-b sector and co-operation between different companies in the value chain would be achieved. Resource scarcity was mentioned to be a driving force towards closing loops and creating pressure to achieve more with less. Increasing business in environmentally friendly fields and offering sustainable solutions to other fields was considered important. Some even mentioned circular economy as the only way forward in the long term and the need for companies to support the society in this change. The companies sticking with linear economy were estimated to deteriorate.

“We see CE as the only way forward in improving our customers’ safety and productivity in material handling also in the future.”

Some interviewees pinpointed the need for more practical case examples in different fields and encouragement and guidance through regulation. More practical case-examples bound to companies were considered to increase the im-

plementation of the models of circular economy. Estimation was that in the future more business and regulation would be seen in this field. Regulation guiding waste management, composition of waste and design of products was seen to have a great impact on the operations as well as implementation of circular economy.

“However I believe that in the near future more practical case examples tied to the operations of a company will multiply which supports the implementation of the concept of circular economy into the companies.”

Translated by the researcher

5.2.3 What is the growth potential of circular economy?

When moving on to the topic of growth potential, the interviewees were first presented with an estimation by Sitra: *“Sitra provides an estimation in their report The opportunities of a circular economy for Finland (2015): ‘A conservative estimate suggests that the circular economy represents growth potential of EUR 300–450 million for the machinery and equipment industry (in Finland). This estimate is based on the additional sales generated by new business models using the circular economy approach.’”* The interviewees were then asked to estimate how realistic they consider this potential. The four clear themes recognized in the answers were larger potential, potential but monetary value hard to evaluate, realistic and smaller potential.

Most recipients considered the potential either realistic or even too small. One interviewee saw the estimation realistic in around three to four years and in global scale even earlier. It was also stated that based only on one company’s business related to circular economy in recent years, the estimation should be considerably larger. It was evaluated that due to the size of Finland’s machinery and equipment industry, and the global scale of the industry, the potential is larger than what Sitra has estimated in their report.

“The growth potential is even larger as companies globally are searching for new circular economy possibilities to ensure the sufficiency of resources.”

Translated by the researcher

Some considered that estimating the exact potential through monetary value is extremely difficult but recognized that new business models do bring growth potential. At least the companies in the forefront of implementing the models of circular economy were seen to have possibilities to benefit from the growth potential.

Yet objection to the estimation did rise and one interviewee considered the estimation of the growth potential slightly too large.

5.2.4 What is needed to reach the growth potential?

Continuing with Sitra's estimation, the interviewees were asked what they consider is needed to reach the growth potential. Though the problem of industry specific needs was brought up, the answers pointed out clear areas where changes were considered necessary. The themes were changes in companies and business atmosphere, new technologies, changes in customers' attitudes, support to develop circular economy, more opportunities to the models of circular economy and co-operation.

The most mentioned change needed to reach the growth potential was the need for changes inside the business environment. The change was considered necessary in the whole business culture, attitudes and practices from design to sales and marketing. Internal communication and education were also brought up. Changing the thinking from producing a new product to producing operations to support and enhance the value chain instead is a huge difference. Producing quality maintenance and services to support the value chain was also considered to be a question of culture and habit. It is important to bring up the value that can be achieved through prolonging lifecycles. This value should be clearly communicated both inside the company and to the customers.

"Companies need to learn to think in a new way. This is a huge change and affects everything we do: product design, lifecycle of products, business models, sale, marketing etc."

Translated by the researcher.

Customers' attitudes were also considered among the key factors. Understanding of the concept and its value must be enhanced as well as the overall consumption behavior and the way of thinking. Education of being able to look at things from the perspective of circular economy is necessary. Yet interestingly one interviewee evaluated that as long as the value of circular models and their benefits can be communicated to the customer, they will buy and most likely savings to both parties can be achieved.

Support to develop the models and innovations was also brought up. The models need to become easier to understand and implement as well as more profitable. Economic instruments to support development are needed so that companies are encouraged to implement these models. Supporting and commercializing innovations as well as marketing and branding are necessary. Also support to research and development for example through corporate taxing was mentioned. Changing the cost structure of machinery and equipment industry so that more resources could be directed to development would bring competitive advantage also to global markets.

"Research and development work has to get operation models through which corporate taxing would be relieved in investments so that it encourages to invest in development and innovativeness."

Translated by the researcher.

Opportunities to models of circular economy were also longed for. This means that opportunities of changing products into services and sharing are needed. If there are no opportunities, there is no interest to develop or invest into these types of models.

Co-operation between operators was also recognized as a way to reach the potential. Collaboration throughout the value chain as well as with new partners was mentioned. The global solutions and markets need to be taken into consideration while planning. In order for Finnish solutions to enter larger and global markets, strong networking and joint marketing are necessary.

5.2.5 What is the effect of circular economy to competitive advantage?

In terms of competitive advantage the answers were straightforward. All interviewees considered that circular economy has a positive effect to competitive advantage. These answers can be divided into three themes; new business models and solutions increase competitive advantage, significant competitive advantage to forerunners and circular economy as a way forward in the long run.

The models of circular economy were considered to enhance competitive advantage. Especially rental and maintenance services and good technical and economical solutions were seen to have a positive effect. Some of the interviewees mentioned that the company they represent is already offering these services and recognized the development of these models as a factor increasing competitiveness through increased sales and demand. The benefits of circular economy were also seen to be realized through easing development and growth for example through effectiveness and reliability of quality. Also good technical and economical solutions were seen to increase competitiveness.

*“Helps development and growth so will surely effect competitiveness.
For example in the enhancement of efficiency and reliability of quality.”*

Translated by the researcher

Forerunners were mentioned to be among the ones gaining significant competitive advantage. Those interviewees considering their company among forerunners in circular economy recognized their competitive advantage and evaluated it visible in technological solutions in resource efficiency, product development, customer satisfaction, high quality and speed in maintenance and modernization of products. Yet one answer brought up that models of circular economy are increasingly implemented also in the competitors operations and the supply of similar services is increasing. Therefore, the competition in the services related to circular economy is increasing and the advantage the forerunners had might be threatened.

Circular economy was not seen as the only selling point to a company but rather a solution to support all operations. It was seen as a long term commitment that companies should support the society in. It was mentioned that short term massive economic benefits were not believed in but yet circular economy was seen as the way forwards in the future.

“It does increase our competitiveness but it is not our only unique selling point. The circular economy business model has been very profitable and we see this as the only way forward in improving our customers’ safety and productivity in material handling also in the future.”

5.2.6 What are the drivers for circular economy in machinery and equipment industry?

The interviewees were asked what motivates the company towards the models of circular economy. The motivation mentioned the most was business potential. Other often mentioned drivers were customer demand, increasing business value and sales and resource efficiency. In addition image benefits, company values and principle and sustainability were mentioned.

Most of the interviewees considered the models of circular economy to have positive business potential which motivates the company toward implementation. Circular economy was considered to open new business possibilities both in current areas of business and in cyclical areas. It was considered that sales would be increased through entering to new business areas and reaching new customers. Especially maintenance services were seen as an area which has the most business potential through the models of circular economy.

“Circular economy is a large business possibility as a concept specifically in maintenance services”
Translated by the researcher

Increasing business value and sales was recognized as an important motivation. It was mentioned to be important to make the most out of own supply and create added value to the stakeholders. These were seen to be possible through models of circular economy. The increase in sales was considered to be created through environmentally friendly solutions as well as increasing sales through acquisition of new business areas and customers. Utilizing environmentally friendly solutions and creating revenue in these new branches was even mentioned to be a part of a company’s strategy.

“Our company continuously seeks new business areas through utilizing environmentally friendly solutions so part of our company’s strategy is increasing our revenue widely also in these business areas.”
Translated by the researcher

Customer demand was seen as a motivation towards circular economy as well. Circular economy was seen to affect the company especially through customers and one interviewee mentioned that as customers find it important it is also important to the company. The importance of being able to answer to changing needs and desires of current customers was brought up. It was seen that resource efficiency is something that customers want and through circular models it can be enhanced and provided to them. One interviewee however brought up that these models to prolong the lifecycles of products and enhance resource efficiency are something customers desire during economically trying times. Some companies already offer circular models to customers especially in their key products with long lifecycles.

“Our key products, such as motors, have very long lifecycles by the end of which, based on the desire of the customer, we offer a possibility for full refurbishment of a motor.”

Translated by the researcher

In terms of resource efficiency, cost savings in energy, lowered water consumption and more efficient recovery of valuable materials were aspects that were brought up. Achieving resource efficiency and productivity were mentioned as key factors. In machinery and equipment industry metals play a key role and due to their high monetary values they have already been recycled for a long time. It was also seen important to react to increases in material prices. If the price of a certain material is increasing, thinking of new ways to utilize the materials have to be considered. The focus should be extended from the use of this material to the whole purchase chain and the design and construction of the products where this material is used.

Image benefits were also mentioned. It was mentioned that as circular economy is currently seen so interesting and trendy phenomenon one way of achieving this positive image and publicity is taking actively part to discussions and offering solutions to the challenges of circular economy.

Other themes arising from the answers were circular economy as part of company's core values and principles and sustainability. Circular economy was recognized as part of the principles and values of the company currently and in the future. One interviewee mentioned that circular economy is the future of their business and has been that for a long time. One recipient straightforwardly recognized sustainability as main driver for circular economy.

6 DISCUSSION AND CONCLUSION

Sustainability issues are currently something that touch each company whether it is based on the regulations, reporting obligations, internal or external pressure or the material prices. The increasing resource scarcity and volatility of material prices has raised interest to enhance efficiency in different sectors. Circular economy has been presented as a way to enhance the use of materials and work towards sustainability. The concept has received increasing attention lately and policy-makers have set guidelines and goals to implement it. However, circular economy requires more than just implementing new practices, it is a different way to think and see the whole economy which requires huge changes in practices and the way things are currently done.

To achieve this economy-wide change, the whole society has to shift their way of thinking and acting. Companies have been raised into the center of this transition as they are in the key position to adopt the models and ideas of circular economy into their practices and values. However, what drives companies to implement these models has been scarcely studied. Yet, understanding the drivers is crucial in order to find the ways to encourage and help companies in this change.

The aim of this research was to discover the drivers for circular economy in Finnish machinery and equipment industry. The secondary objective was to see are there similarities when compared to the drivers for corporate sustainability.

Based on this research the drivers for circular economy are business potential, customer demand, increasing business value and sales, image benefits, values and principles of the company and sustainability. In literature the key drivers for sustainability are stakeholder pressure, top management, company features, governmental factors, competitiveness and image. It can be noticed that the drivers have similarities. Image, competitiveness and customers are visible both in drivers for circular economy and sustainability. Slight differences in nuances can however be recognized.

In drivers for sustainability the focus is on stakeholder pressure and it is even argued to be the determinant factor which affects all the other factors (González-Benito and González-Benito 2006). Different stakeholder are recognized and each has their own importance depending on the company. However, only customer demand and building value to shareholders were recognized among the key drivers for circular economy while other stakeholders were not mentioned. This might be seen that the focus is only in these stakeholder groups and other groups are at least not yet seen to have an interest towards circular models. However, the industry and the scale of the research need to be noted before making more interpretations.

In drivers for circular economy the most mentioned driver was the business potential. It was estimated that the forerunners in this field have the best

potential to achieve business through the models of circular economy. The business potential is something that was not collected from the literature for sustainability drivers. Yet, there are studies concerning the business cases for sustainability though the aspects brought up are often more related to enhancing competitiveness and achieving cost savings. However, based on this study the business potential of circular economy is more seen to concern the implementation and expanding the use of the models of circular economy.

When it comes to image as a driver, the circular economy driver is focused on the benefits whereas sustainability driver also brings out the desire to protect the company image. So the actions are not only seen to bring image benefit but they are also something that have to be done in order to avoid negative image. It could be considered that as circular economy has not yet gained that much of a footing, the actions are considered as voluntary actions for forerunners. There is a lack of clear implemented guidelines and obligations towards circular economy. Whereas sustainability practices are expected from several companies and regulation already sets the obligations for minimum practices. There are cases when unsustainable behavior or accidents have led into massive negative publicity and loss of image. Stakeholders also understand the aspects related to sustainability and know what to ask for whereas in terms of circular economy even the definition of the whole concept might be vague and hard to understand.

In terms of competitiveness, similar aspects are mentioned in both the drivers for sustainability and circular economy. These are cost savings, enhancing long term profitability and stepping into new business branches or customer sectors. Specifically to the machinery and equipment industry the efficient use and recycling of materials is highlighted due to the high use of materials that are expensive to acquire yet highly recyclable.

Perhaps the largest differences are that in circular economy drivers top management was not mentioned whereas in literature of sustainability it is often brought up. In sustainability drivers the top management is seen to have a crucial role in recognizing the pressure for sustainability and implementing the practices. In the interviews it seemed clear that the interviewees had recognized the pressure for circular economy actions as it was seen as megatrend or the future of the business.

Another difference is that legislative aspect were not brought up as a driver for circular economy whereas in sustainability drivers governmental factors such as regulations are often seen to play an important role in setting the minimum standard. The interviewees mentioned no such thing in the interviews rather in other parts of the interviews there were indications that for reaching the potential of circular economy the largest barrier is the attitude and changing the attitude in industries and in the whole society was mentioned as an important factor.

In conclusion it seems that the drivers for sustainability and the drivers for circular economy have similarities. Yet, the drivers for circular economy are more focused on the benefits achieved through the models of circular economy. It could be argued that the current lack of regulations and obligations guiding towards circular economy has its effect to this viewpoint. It also seems that the drivers for sustainability have more depth and angles than the drivers for circular

economy. This is understandable as the drivers for circular economy are only collected from this study and from a limited number of interviews whereas the sustainability drivers presented in this study are summarized from multiple research. In order to make more interpretations more research is necessary.

6.1 Limitations of the study

This study is conducted based on a limited sample in one sector and therefore, the generalization of the results should be questioned. Though nine of the main 14 companies in machinery and equipment industry in Finland were interviewed, the sample is still small. In order to be able to draw more reliable conclusions on the drivers for circular economy or of the similarities or differences between the drivers for circular economy and the drivers for sustainability, more research is needed of the drivers for circular economy both in this sector and others.

6.2 Future research

Future research should be focused on thoroughly recognizing the drivers for circular economy both in machinery and equipment industry and in other sectors. In the sector of machinery and equipment industry, the future research should include more companies. Of course this would mean including companies in a global scale from different countries. Most of the companies in machinery and equipment industry are already global and perhaps also the differences between the drivers in different countries could be researched.

The research should also be expanded to other sectors to see are the drivers similar and have the other sectors similar or differing viewpoints on circular economy. Though there are indications that the drivers for circular economy and sustainability have similarities, this should be confirmed in other sectors as well. Though circular economy has recently been visible, the understanding of the term could differ between sectors and it would be interesting to find out how much the global nature of the industry and the materials used in the sector affect the interpretations and attitude on circular economy.

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APPENDICES

Appendix 1. The interview question in Finnish

Hei,

teen ProGradu-tutkielmaani Jyväskylän yliopiston kauppakorkeakouluun konepajateollisuuden motivaatioista kiertotalouteen. Olen kiinnostunut siitä, mitä teillä [*yrityksen nimi*] ajatellaan tästä aihepiiristä. Toivon, että teillä olisi aikaa vastata alla oleviin kysymyksiin. Antamanne vastaukset ovat luonnollisesti luottamuksellisia, eivätkä ne ole työssäni yhdistettävissä yritykseen tai henkilöön.

Mikäli teillä on kysymyksiä kyselyyn tai itse työhön liittyen, vastaan niihin mielelläni. Kiitos jo etukäteen!

Aluksi lyhyt kuvaus kiertotaloudesta, jonka jälkeen ovat itse kysymykset. Voit vastata kysymyksiin niiden perään.

Kiertotalous on talouden malli, jossa resurssien käyttö on suunniteltu mahdollisimman kestäväksi ja jätteen synty minimoitu. Jo suunnitteluvaiheessa huomioidaan, että materiaalit pidetään kierrossa, tuotteiden elinkaaret ovat pitkiä ja materiaalit ja komponentit voidaan hyödyntää uudelleen. Tuotteiden ja materiaalien arvo säilytetään mahdollisimman pitkään huoltojen, uudelleenkäytön ja uudelleenvalmistuksen avulla jätteenä hyödyntämisen sijaan. Tavoitteena on saavuttaa suljettu prosessi, jossa kaikki materiaalit hyödynnetään mahdollisimman tehokkaasti. Mallin taustalla vaikuttavat neitseellisten raaka-aineiden rajallisuus ja resurssien viisaampi käyttö.

Kiertotalouteen voit tutustua paremmin esimerkiksi seuraavien lähteiden kautta:

<http://www.sitra.fi/ekologia/kiertotalous>

<https://www.ellenmacarthurfoundation.org/>

1. Oletko tutustunut kiertotalouden ajattelumalliin aikaisemmin? Mitä kautta?
2. Millainen merkitys kiertotaloudella on yrityksellenne tällä hetkellä?
3. Miten uskot kiertotalouden merkityksen muuttuvan tulevaisuudessa?
4. Sitra arvioi vuonna 2014 julkaistussa selvityksessään Kiertotalouden mahdollisuudet Suomelle: *"Kiertotalous tarjoaa konepajasektorille varovaisesti arvioituna 300–450 miljoonaa euron kasvupotentiaalin. Tämä arvio perustuu kiertotalousajatteluun pohjautuvien uusien liiketoimintamallien tuomaan lisämyyntiin"*
 - a. Kuinka realistisena pidät tätä arviota?
 - b. Mitkä ovat mielestäsi suurimpia muutoksia, joita tämän kasvupotentiaalin saavuttamiseksi tarvittaisiin?
5. Mitkä tekijät motivoivat yritystänne kiertotalouden toimintamalleihin?
6. Koetko yrityksenne sidosryhmien olevan kiinnostuneita kiertotaloudesta?

7. Millaisena näet valtion roolin kiertotalouden edistämässä?
8. Uskotko kiertotalouden vaikuttavan yrityksenne kilpailukykyyn? Millä tavalla?

Tässä olivat kaikki kysymykset. Kiitos ajastanne ja vastauksistanne!

Appendix 2. The interview questions in English

Hi,

I am currently working on my thesis for Master's degree in Corporate Environmental Management for the University of Jyväskylä. The topic for my thesis is Drivers towards circular economy in the machinery and equipment industry and I am conducting an email interview to the companies in the industry. I hope you have the time to answer to my questions. It would help me to gain a more comprehensive picture of the industry. The answers you provide are naturally confidential and cannot be connected to a single company or respondent. If you have any questions related to the questions or the thesis in general, I'll be happy to answer.

First a short overview of what I mean by circular economy.

Circular economy is an economic model where the resources are utilized to their fullest as sustainable as possible and the creation of waste is minimized. Closing the loops of materials, long lifecycles and reuse, remanufacturing and recycling are at the heart of the concept and should be taken into consideration already in the design of the products. The value of the products and materials is kept high for as long as possible through maintenance, reuse and refurbishment instead of utilization as waste. The drivers behind the concept are scarcity of raw materials and resource efficiency. More information about circular economy for example from <https://www.ellenmacarthurfoundation.org/>

1. Are you familiar with the concept of circular economy? In what connections?
2. What does circular economy currently mean to your company?
3. How do you think the meaning will change in the future?
4. Sitra provides an estimation in their report *The opportunities of a circular economy for Finland (2015)*: "A conservative estimate suggests that the circular economy represents growth potential of EUR 300–450 million for the machinery and equipment industry (in Finland). This estimate is based on the additional sales generated by new business models using the circular economy approach."
 - a. How realistic do you consider this estimation?
 - b. What are, in your opinion, the largest changes that are needed to achieve this potential?
5. What motivates [*the company*] to the models of circular economy?
6. Are the stakeholders of [*the company*] interested in circular economy?
7. What in your opinion is the role of the government in working towards circular economy?
8. Do you believe circular economy affects the competitiveness of [*the company*]? In what way?

That was the last question. Thank you for your time!