



Challenges Faced by Global Manufacturing Companies When Implementing Circular Economy Business Models

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Abstract

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<p>This bachelor's thesis discusses the challenges of circular economy business models in large, globally operating manufacturing companies. The primary goal of this study was to understand the challenges global manufacturing companies face when implementing circular economy business models in their businesses. Circular Economy is key in tackling the climate change and other issues born from the traditional linear economy business models. A transition towards the Circular Economy is inevitable, but as of today the process is still unclear for companies. Therefore, it is important to study more in-depth the challenges faced by companies in the transition progress.</p> <p>This thesis consists of two sections, a literature review followed by an empirical study. The literature review presents and discusses the concepts of Circular Economy and its business models, its financial aspects, and the regulations based on the existing academic literature. An empirical study was conducted using a qualitative research method. Five in-depth interviews were conducted with professionals from five different large globally operating manufacturing companies. This empirical study aimed at gathering experiences, opinions, and feelings in today's business setting. This allowed the author to compare the findings from the literature review with practical examples from today's manufacturing companies.</p> <p>The literature review supported the idea that transitioning towards Circular Economy is inevitable and that it is highly advantageous. The findings from the empirical study showed that as of today, there are many challenges regarding supply chain, regulations and the financial management, which are hindering the transition. There is no clear consensus on how companies should transition. Even though literature suggests that circular economy business models would allow companies to perform better financially and grow sustainably, at the times where costs and regulations are unclear for the companies, transitioning can be seen as a big risk from the companies' perspective.</p> <p>The results of the study shed light to the challenges companies are facing in the transition towards circular economy. To overcome these challenges, a change of mindset is needed with the help of investing resources towards research and innovation in the field of circular economy. Transitioning towards circular economy is of growing importance and continuous research on the topic is needed.</p>
Key words Manufacturing, Circular Economy, Financial management, regulations, supply chain, business models.

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1 Introduction

This is a research type of a bachelor's thesis for the Degree Programme in International Business in the major specialisation in Financial Management in the Haaga-Helia University of Applied Sciences. The topic of this thesis is the financial challenges global manufacturing firms face when applying circular economy business models in their manufacturing processes.

This chapter's purpose is to introduce the background for the thesis topic, the research question, the delimitations for the thesis and the benefits of it. It also presents and defines the key concepts of the thesis.

1.1 Background

Global warming, pollution and waste are things that we are struggling with on a daily basis around the world. The humanitarian, ecological and financial losses of these are uncountable. To change the direction where we are heading, there are many different plans, treaties and agendas done by different nations and organisations. The most known ones are the Paris Agreement and the Agenda 2030. Both bring up circular economy as a solution to the challenges mentioned.

Circular economy is also big factor in the monetary market. In 2021, private investments relevant to circular economy in specific economic sectors amounted to over 120 billion euros which represents almost 1% of the European Union's (EU) Gross Domestic Product (GDP). The sector also employed over 4,3 million people in the Union's area. (European Commission 2023.)

The manufacturing industry is a huge player both economically and ecologically in the world. Manufacturing processes generate almost the third of the world's GDP and about the fourth of the United States' (US) carbon dioxide emissions. (Asif 2017, 1-2; EPA 2020.)

Despite the knowledge regarding the necessity of sustainability and circular economy, and their roles in battling the climate change, the EU's economy is still mostly linear. Secondary materials account for less than 12% of all materials used in the EU economy. (European Commission 2023.) Thus, research regarding the possible financial challenges of the progress is justified.

1.2 Research problem

This thesis aims to gather knowledge about financial challenges in circular manufacturing and the possible opportunities for organisations to transition to circular economy.

The research question of this thesis is “What are the main challenges companies face when implementing circular manufacturing business models?” This research question is divided into three different investigative questions (IQ), which are the following:

IQ 1: How aware are companies of the principles and benefits of circular manufacturing?

IQ 2: What are the primary obstacles companies encounter when transitioning from linear to circular manufacturing models?

IQ 3. What are the financial aspects that companies need to take into consideration regarding a transition to circular economy business models?

Table 1 below presents the overlay matrix of this research. It helps the reader to understand the overview of the research, its targets, the methods used and the expected results.

Table 1. Overlay matrix.

Investigative Questions (IQ)	Theoretical Framework	Research Methods	Results
IQ 1.	<ul style="list-style-type: none"> • Circular Economy • Circular Economy business models 	<ul style="list-style-type: none"> • Literature review • Qualitative interviews 	Insights on principles of Circular economy and how it affects manufacturing companies.
IQ 2.	<ul style="list-style-type: none"> • Circular Economy business models • Circular manufacturing 	<ul style="list-style-type: none"> • Literature review • Qualitative interviews 	Understanding the obstacles on transitioning towards circular economy practices.
IQ 3.	<ul style="list-style-type: none"> • Financial Management of circular economy • Costs and risks of Circular Economy 	<ul style="list-style-type: none"> • Literature review • Qualitative interviews 	Financial overview of the possible challenges regarding transitioning towards Circular Economy.

1.3 Research method

A qualitative research method is based on finding solutions to a particular problem which can be identified. A qualitative method is used to understand people's attitudes, beliefs, experiences, behaviour and interactions. The data from such research is non-numerical. Nowadays, qualitative research is recognised for its ability to add new dimensions to studies which cannot be answered by variables alone. It also helps to view the data achieved more extensively. (Pathak, Jena & Kalra 2013, 192.)

For this research, a qualitative method will be executed through one-to-one semi-structured interviews, following the principles of a mono-method qualitative study. Semi-structured interviews allow the author to be flexible with the interview flow, change the order of the questions asked and to ask new questions in the context of the research situation. (Saunders, Lewis & Thornhill 2019, 636-660.) This method is the best fit for this research because of the number of variables in the theme.

Given the international scope of the research topic, the selected interviewees should be working in globally operating manufacturing companies. All the companies should have both a linear and a circular business model to assure that they have a good understanding of the transition process. Because of the research topic being closely linked to finance in organisations, the interviewees should preferably hold a position in finance or otherwise have knowledge about the finances of the company and the operations.

The interviewees will be contacted in various of ways, through e-mails, LinkedIn and using the authors pre-existing networks in the business industry. The author's goal was to have around five interviews from five different professionals working in different companies to collect as much information about the topic as possible. This will guarantee the relevance of the collected data.

1.4 Delimitations

In order to keep the research more focused, the author has chosen to focus on challenges in circular manufacturing. The challenges found from the research will be analysed by their effect on the financial and economical parts of the businesses.

The thesis is delimited to research on only globally working manufacturing companies, whose main operations are to some extent based on linear economy business models. Chosen companies should also have ongoing business model operations which follow the circular economy models. Thus, companies which are operating fully on circular economy business models will be left out of the research. This ensures that the experiences of the company suit the research.

There are several studies conducted about circular economy but the majority of those focus on small and medium sized enterprises (SMEs). SMEs represent 99% of all businesses in the EU yet they are responsible for only 60% of the emissions by all companies (European Commission 2022). On the other hand, large enterprises that represent only the remaining 1% generate 36% of the employment and 48% of the total value added on the Union's area (Eurostat 2022). The European commission has determined that a business will be considered as a large enterprise once the staff headcount is above 250 employees (European Commission 2020).

Even though larger companies are the minority in the EU, they are often the ones that are most seen by the public. These companies often also have the capacity to drive and implement larger-scale changes and new processes. And it can be assumed that the larger global companies will play a key role and leading the transition of the manufacturing industry towards a more circular business model. Thus, choosing larger companies (Staff headcount >250) as a study topic will allow for a wider understanding of the capacities needed and of the current abilities of these companies to implement such a transition.

1.5 Benefits

The research will bring findings and knowledge about the financial and other challenges organisations can face when moving towards circular economy in the manufacturing industry. This knowledge can then be used in the future for the development of circular economy related business models in various organisations. In the academic world, this research will provide more information on the circular economy challenges in the context of global manufacturing companies, filling the gaps in finance-based studies. Businesses can use the findings of the research in their transition to the circular economy practices to their advantage.

For the author, the benefits are related to their growth as an academic and as a business professional in the finance industry. The area of this research is a topic of interest for the author and the learning progress and the networking possibilities during the progress will be very valuable.

1.6 Key concepts

Circular economy is a concept of production and consumption which involves reusing, repairing, refurbishing, sharing, leasing, and recycling existing materials and products as long as possible. The goal of circular economy is to slow down or even stop global challenges such as climate change, biodiversity loss, waste, and pollution. (Sitra 2022.)

Linear economy is a one-way economic model of production and consumption. In the model, goods are manufactured from raw materials, sold, used and then lastly discarded as waste. (Wautelet 2018, 3-5).

Circular manufacturing is a manufacturing concept strategy where inefficiencies in the manufacturing process are being resolved in a way that supports circular economy. Its main goal is to generate higher profits than the traditional linear way of manufacturing. (NIST 2022.)

1.7 International aspect

The theoretical framework is based on research conducted globally. The topic of this research has a strong international aspect as the study is conducted with global companies.

All the companies involved in the empirical research are operating globally which will bring an understanding of the subject of this research on an international level and across markets.

2 Circular business models as the solution to unsustainable manufacturing

In this chapter the author is presenting the theoretical part of this research. First, circular economy and its business models following it are presented. Secondly, the financial aspects of circular economy are being studied followed by manufacturing specific aspects. Lastly, regulations regarding circular economy are presented.

2.1 Circular Economy

The way the world currently designs, produces, and uses products and materials is wasting a lot of value. This justifies the need to move on from the linear manufacturing system. The aim of circular economy is to ensure that the products and materials are kept in use as long as possible, capturing the wasted value of the linear take-make-dispose system. A transition towards circular economy is a must for future innovation and for continued growth. (Sitra s.a, 5-11).

According to the Ellen MacArthur Foundation (2019), circular economy is a system solution framework designed to tackle the current problems with climate change, biodiversity loss, waste and pollution. It is based on three different principles, which are to eliminate waste and pollution, circulate materials and products at their highest value and to regenerate biodiversity and nature (Ellen MacArthur Foundation 2019).

Figure 1 below presents the circular economy system diagram, known as the butterfly diagram. It demonstrates the continuous loop of materials in circular economy. There are two different cycles, one for the technical cycle, and the other one for the biological cycle. In the biological cycle, the nutrients from biomaterials are returned to the Earth, and in the technical cycle, the raw materials and finished products are kept in circulation as long as possible. (Ellen MacArthur Foundation 2019.)

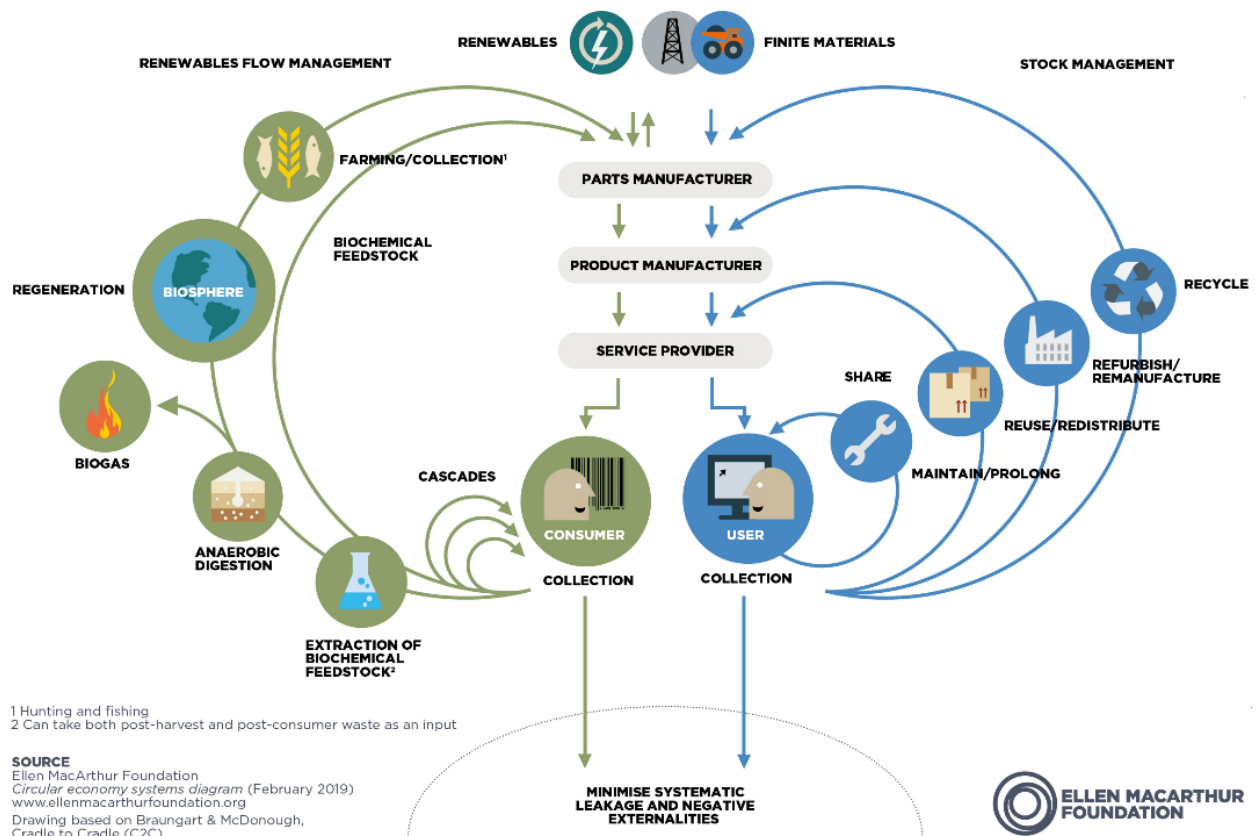


Figure 1. Circular economy systems diagram (Ellen MacArthur Foundation 2019).

2.2 Circular Economy business models

According to the OECD (2018), circular business models represent different ways of producing and consuming goods and services from linear business models. Their key characteristic is to use already existing materials and products as inputs, therefore lowering the environmental footprint. The OECD (2018) also highlights market penetration as one of the problems in CE business models. The market share of the CE business models is rather limited since recycling, remanufacturing, and repairing only account up to 15% of the production in any given sector (OECD 2018).

The World Economic Forum (2022) has gathered five different ways of defining CE business models. Those five models are circular inputs, sharing economy concept, products as a service (PaaS), product use extension, and resource recovery. The WEF (2022) also highlights that born-circular companies have a superior business model advantage compared to the traditional linear economy companies transforming to circular economy.

Even though circular economy business models are seen as the future of doing business, they do possess some risks in them (Arasu & al. 2020, 1-3). According to the OECD (2018), even though

the environmental potential of circular business models is clear there are still some risks. For example, the increased use of bio-based materials could stimulate land changes and add pressure on ecosystems and biodiversity. (Arasu & al. 2020, 3-5.) Secondly, if there are no controls and regulations set, widespread material recovery and recycling could increase exposure to harmful chemical substances. Lastly, collaborative modes of consumption could lower the use of greener substitutes. (OECD 2018.)

SITRA (s.a, 20) has chosen five most important circular business models for manufacturing companies in order to reduce the linear inefficiencies and to create real profit when implemented. These three key actors of the circular economy discussions share similar understandings of the benefits and risks of a transition to a circular business model. These circular business models are circular supply chain, sharing platform, product as a service, product life extension and recovery and recycling. These same business models were also described in the research conducted by Arasu & al. (2020, 4-7). In the coming sub chapters the circular supply chain, sharing platforms, Product as a Service (PaaS) and product life extension business models are presented.

2.2.1 Circular supply chain

In the manufacturing sector, where the supply chain is often long and complicated, being able to control the supply chain efficiently has proven to be a large factor in reducing the environmental footprint of manufacturing companies. Many of the improvements made in the supply chain (SC) have benefits not only on sustainability, but also on the financial side of the supply process. An efficient SC reduces the emissions and costs in transportation, the delays, and also reduces the costs of the emissions. Many of these processes do not only have an effect on emissions and sustainability, but also on the company's profit and loss. (Gonzalez-Sanchez, Settembre-Blundo, Ferrari & Garcia-Muina 2020, 2.) Farooque, Zhang, Thürer, Qu & Huisinigh (2019, 883) define circular supply chain as the integration of circular economy models and mindset into the management of traditional supply chains. It methodologically regenerates biological materials and restores technical materials with a goal towards zero-waste from all aspects of the supply chain, involving all stakeholders in the process (Farooque & al. 2019, 884-889). This aligns perfectly with the model presented by Ellen MacArthur Foundation (2019) in Figure 1.

Circular supply chains are based on the idea of the circular economy, where the products are reclaimed back to the manufacturers' supply chain, and thus can be re-used. This process is mostly done by using reverse logistics and returns management. (Forbes 2021; Roy & al. 2022, 113-115.)

Previous research on the topic has proven that achieving truly sustainable supply is very challenging (Roy & al. 2022, 114-115). A study by Esfahbodi, Zhang & Watson (2016, 12) found out that in

manufacturing firms, especially in China and Iran, sustainable supply chains were initiated mostly because of regulatory and customer pressure. This would mean that the latter would have positive effect in the company's sustainability, but not necessary in the company's finances. The study recommended that companies should initiate sustainable supply chain systems in a sense that does not harm their financial performance.

2.2.2 Sharing platform

Another aspect to circular economy is the role of sharing platforms. Sharing platform, or sharing economy, is an extension of circular economy as it is seen to slow down resource loops. Indeed, sharing might increase the usage of the product and even extend the products lifecycle. (Bocken & al. 2015, 1-5.) Curtis and Mont (2020, 1-2) also define sharing economy as a socio-economic system that leverages technology to allow temporary access to goods and assets which are underutilised, tangible and in high demand.

2.2.3 Product as a Service

Product as a Service (PaaS), sometimes referred to as Product Service Systems (PSS), is one important part of the circular economy. Through this concept, products are not only being sold, but as well offered as service. (Mont & Tukker 2006, 1451-1453.) This business model is often associated not only as a more sustainable way of using products and services, but also as a shift from ownership-based consumption to more subscription-based usage (Reim, Parida & Örtqvist 2014, 61). Integrating service and product offerings could potentially improve efficiency, leading to positive environmental and economical effects in societies and industries (Mont & Tukker 2006, 1452-1454.)

2.2.4 Product life extension

Extending the products' life is desirable from the circular economy point of view. The reason for that is the possibility to make the product and materials to remain in the economy for longer periods, reducing the need for new resources (Jang, Lee, Kwon, Lim & Kwon 2020, 2; Slade 2007, 10-15.) Including the product life extension business models in manufacturing processes is a huge change in the mindset of the manufacturing industry (Maitre-Ekern and Dalhammar 2016, 381). Since the 1930s, planned obsolescence of products has been a strategy from manufacturing companies to boost consumption (Slade 2007, 5). Maitre-Ekern and Dalhammar (2016, 379-380) define planned obsolescence as the purposeful strategy of producing consumer goods that swiftly become obsolete, requiring almost immediate replacement. There are three main ways to encourage consumption: reducing material durability, complexify the repairing of the product, and lastly affect the psychological aspects of fashion and design of the product (Maitre-Ekern and Dalhammar 2016, 379-382).

According to the OECD (2019) there are three different mechanisms involved when applying product life extension related business models. First, rethinking the design process of new products to shift to longer service time. Secondly, implementing reuse and repairing business models to ensure that the products are not prematurely discarded. And thirdly, remanufacturing products in order to give them new service life. (OECD 2019; Jang & al. 2020, 1-2.)

However, there are also concerns regarding product life extension. When products are meant to last longer, there are fears that these products will then reduce the sales of the new products. When the products are viable for longer and they have possibility to be repaired and maintenance if needed, it will have a negative effect on the future product sales. This poses a clear financial challenge for the manufacturers and can even make them favour the linear system of manufacturing. (Roy & al. 2022, 123.)

2.3 Financial management of circular economy

Companies transitioning towards circular economy in their businesses are facing several financial challenges which might be different, or even non-existent in traditional linear economy. Some of these concepts are ESG investing, accounting for intangible assets, corporate social responsibility (CSR) reporting and life cycle costing (LCC). These concepts help companies to track their financial performance and sustainability when enforcing strategies regarding circular economy (Rodriguez-Gonzalez, Maldonado-Guzman, Madrid-Guijarro & Garza-Reyes 2022, 2) and will be discussed here after.

2.3.1 ESG-investing

Environmental, Social and Governance (ESG) investing is a form of investing where investors are applying factors which are not purely financial into their analysis process (CFA Institute 2023). According to Giese, Lee, Melas, Nagy & Nishikawa (2019, 69) ESG investing can be divided into three different areas. These areas are ESG integration, values-based investing, and impact investing. In ESG integration, the main goal for the investor is to improve the risk-return characteristics of a portfolio. Values-based investing is an activity where an investor tries to arrange their portfolio according to their personal values and beliefs. Lastly, impact investing, where an investors' main goal is to produce change for social or environmental purposes by using their capital. (Giese & al. 2019, 69; PWC 2022; CFA Institute 2023.)

Recent research has shown that ESG-investing is a large and important topic for companies because of the speed at which it has been growing during recent years. A report from PwC (2022) reveals that ESG related assets under management are expected to increase to USD 33,9 trillion by 2026. There has also been a significant rise in debt capital market activity regarding circular

economy opportunities (Bocconi University, Ellen MacArthur & Intensa Saopalo 2021, 5). This forces companies to change their strategies and ways of working to be sure that they are seen as ESG-investment worthy for the increasing amount of investors. Supporting this idea of ESG-investing, a research conducted by Bocconi University & al. (2021, 12) found out that the higher level of circularity of a company reduces its risk of defaulting on debt and increases the risk-adjusted returns on its stock.

2.3.2 CSR reporting

Corporate Social Responsibility (CSR) reporting is a tool to provide information about company's performance and actions concerning the environment, social issues, company's employees, human rights and tackling corruption and bribery. It is also seen as a strategic approach to conquer and overcome the negative impacts the business operations' have towards the environment (Islam & al. 2020, 3). Certain large and listed companies operating in European Union are obligated to have yearly CSR reports published (Ministry of Economic Affairs and Employment of Finland s.a.).

Research has shown that CSR activities and reporting have mixed results regarding the effect on a firms' financial performance. A study by Okafor, Adeleye & Adusei (2021, 9) found out that revenue growth and amounts spent on CSR activities have a clear collusion. Also, stock value and firms return on assets had positive impact from CSR activities (Ortas, Etxeberria & Zubeltsu 2017, 3).

2.4 Sustainable manufacturing

Sustainable manufacturing can be described as the integration of systems and processes capable to manufacture high quality goods and services using less resources, being safer to the environment and being able to minimise its environmental impacts thought the whole life cycle. (Machado, Winroth & Ribeiro Da Silva 2020, 3).

The benefits of the sustainable manufacturing include resource efficiency, leading to cost reduction, regulatory compliance, improved brand image, access to new markets, and access to new financing and capital through ESG investing. (Machado & al. 2020, 3).

On top of that, there are several other studies of the financial benefits of the sustainable manufacturing. Already in 2010 in the United Kingdom (UK), a survey showed that 56% of the UK based SMEs were investing in sustainable technologies and strategies, and that the global market for these products was over USD 5 trillion, and constantly growing. (OECD s.a). Secondly, the OECD (s.a) found that sustainable and green reputation drives up the companies' financial valuation and that 96% of workers aged between 18 to 45, prefer employers which are environmentally friendly.

The OECD (s.a) argues that sustainable manufacturing models can have a clear and positive effect on a company's profits. The OECD has divided the sustainable manufacturing benefits in three different categories: Financial performance, business excellence and relationships with stakeholders. The financial performance category includes the benefit of increased sales by fulfilling social and environmental expectations from the market. By reducing resource use and waste, companies can cut extra variable and fixed costs of their operations. The business aspect is coming from having better control over the capital by staying ahead of regulations, reducing environmental risks, through research and development. (OECD s.a.)

2.5 Circular manufacturing

Manufacturing activities are essential for economic growth and they account for almost a fifth of the world's GDP (Worldbank 2022). Traditional manufacturing also raises concerns of the overwhelming consumption of natural resources and generation of waste. Therefore, circular manufacturing, also known as "resource conservative manufacturing", "closed-loop manufacturing", or as "green manufacturing" has been trendy topic in the industry. There is also a clear business case to be found for individual manufacturing companies. (Atlas and Florida 1998, 1-3.) A study by the European Commission (2020) found that manufacturing companies in the union's area spend on average 40% of their capital on materials, circular practices in the form of closed loop models. This can increase the profitability of the companies by cutting their costs. Closed loop models have also the potential to protect the firms from fluctuations on resource prices. (European Commission 2020.)

Generally, green manufacturing connects manufacturing processes which are relatively low in environmental impacts, which are remarkably efficient, with very little generation of waste and pollution. Green manufacturing relies on source reduction, recycling, and green product design (Atlas and Florida 1998, 1-3). Source reduction could be defined as any action which reduces the waste generated. Recycling includes actions such as reusing or using waste as ingredients in a manufacturing process. Green product design is based on products who's design, composition, and usage minimises their environmental impacts thought their lifecycle. (Atlas and Florida 1998, 1-3.)

2.5.1 Source reduction

Source reduction is at the heart of sustainable manufacturing. Committing to waste reduction at the source is recognised as desirable in managing resources. According to Jang & al. (2020, 1-2) waste minimisation is described as the reduction of waste at source, recognising that it would be cheaper to not produce waste at all. Waste minimisation covers various activities aimed at reducing the waste from ingredients and raw materials used, product loss, water usage, packaging, energy consumption (Jang & al. 2020, 1-2).

2.5.2 Cost and risk of circular manufacturing

The transition from linear manufacturing to circular manufacturing is far from simple and easy. The implementation of more strict policies and environmental laws regarding sustainability are forcing manufacturing companies to execute changes and improvements in their circular economy practices. However, those Circular Economy (CE) practices do not always lead to better financial performances. (Rodriguez-Gonzalez & al. 2022, 2.) They found that the whole business model of the company might often have to be redesigned to fit the circular manufacturing model. The process might change from the very beginning of remodelling the product, supply chain management, and the manufacturing. Arasu & al. (2020, 4-7) found in their research a total of 31 different risks in seven different categories regarding circular manufacturing. These different categories are operational risks, financial risks, environmental risks, strategic risks, quality risks, reputational risks and compliance risks.

In the majority of the supply chains in manufacturing, there are two major goals: performance by specialisation of parts and economic efficiency by economies of scale. These goals have been achieved by centralised production and increasing amounts of product parts. The supply chains already in use have been optimised for these goals. Thus, adopting the circular supply chain business model in the future is going to be complicated and expensive for the companies. (Soufani & Loch 2021.) The collection systems used to recycle and remanufacture products and components would need to stretch globally to retain the materials back to the location of manufacturing (Soufani & Loch 2021).

Soufani and Loch (2021) argue that in the short time future, achieving circular supply chain, manufacturing companies must sacrifice some of their profits and optimised operations for better environmental sustainability. According to their study, most companies might not be willing to do that at the moment, therefore pressure from consumers and policymakers is required. The main driver for government authorities regarding implementation of environmental regulations is actually coming from global competition. Governments and countries need to maintain a certain level of competitiveness in the field to attract capital and foreign direct investments. (Arasu & al. 2020, 4.) It seems that one of the largest challenges for adopting circularity in manufacturing is the lack of, or unclear financial cases. The need for clear business cases is crucial for the business model. Especially the challenge of value measurement in material/products life cycle was found to be challenging by Arasu & al. (2020, 4-7). According to Adams & al. (2017, 7), cost and associated profit are the dominant parts in any decision-making process regarding circular economy business models.

However, the responsibility of transitioning towards CE is not only on the shoulders of the policymakers and governments, but a lot of actions are also required from companies themselves. In

their study, Manavalan and Jayakrishna (2019) concluded that the transition towards CE involves companies and their business partners to acknowledge the process and make actions to achieve it. In fact, the changes that are happening not only in the climate, but also in pollution, and consumer expectations, are forcing companies to create supply chains that improve environmental sustainability (Govindan & Hasanagic 2018, 13).

2.6 Circular Economy regulations

Regulations in the field of circular economy are in constant change and the effects of environmental regulation on competitiveness are under constant debate for practitioners and policymakers (Iraldo, Testa, Melis & Frey 2011, 11-12). Environmental regulations can be divided into three sections: Direct regulation, economic instruments and soft instruments (Iraldo & al. 2011, 10). Direct regulation consists of standards, commands, and prohibitions related to outputs, inputs, and processes. Economic instruments include various duties like taxes and charges and tradable emission permits. Lastly, the soft instruments, which are voluntary, include industry agreements, environmental certifications (ISO 14001) and green procurement strategies. (Testa, Styles & Iraldo 2012, 1.)

There are two schools of thoughts regarding the effects of environmental policies (Dechezlepretre and Sato 2017, 183). These hypotheses are the pollution haven theory and Porter hypothesis. Pollution haven theory, which is based on trade theory, expects that tighter environmental policies in certain areas will increase operating costs and over time shift pollution heavy production to lower cost regions, creating "pollution havens". In the other hand, the Porter hypothesis argues that stricter policies could have a positive impact on firms because of cost-cutting policies and efficiency improvements. (Dechezlepretre and Sato 2017, 184.)

3 Empirical Research

This chapter will discuss the choices for research method used in this study, key findings from that research, the population and sampling used and lastly the data collection and analysis.

3.1 Research Methods

In this thesis, a qualitative study was conducted as empirical research, and in-depth interviews were chosen as the primary data collection method. A qualitative study will allow the researcher to study a few cases more in depth and focus on experiences, opinions, feelings and insights (Saunders & al. 2019, 639-640).

For this research qualitative method will be executed through one-to-one semi-structured interviews, following the principles of mono method qualitative study. A semi-structured interview method allows the author to be flexible with the interview flow, change the order of the questions asked and to ask new questions to adapt as the interview progresses (Saunders & al. 2019, 434-445). This method is the best fit for the research, because of the number of variables in the topic.

3.2 Data collection

The purpose of this empirical research was to understand how business professionals see circular manufacturing and its relations to financial challenges. To achieve this, it is necessary to collect data. The data used in this research was collected from interviews with employees of global manufacturing companies. The author had created a framework for the interviews with themes and questions for the participants. In this study a purposive sampling was used as the purpose was to find participants who are relevant to the research. (Bryman & Bell 2015, 400.)

In total, five interviews were conducted as part of the research. Because this research was focusing on circular manufacturing, it was important to find interviewees from various companies and industries to get a good representation from the field of manufacturing. The data was collected from business professionals from various internationally operating manufacturing companies. Three of the interviewees were from finance roles and the remaining two were from sustainability and manufacturing roles. All the interviewees had more than ten years of business experience. The interviewees were all to some extent familiar with the concept of the circular economy and also understood their company's business model. All the respondents had higher education either from university or from university of applied sciences.

The interviews were conducted between the 11th of August and the 25th of September 2023. Three of the interviews were conducted on Teams, one on face to face and one over the phone.

One to one interviews were chosen over group interviews, since the topic of the research was closely linked to the financial matters of the companies. Financial matters might be sensitive information and group formation might have had an impact on the interviewees' willingness to open up fully and share their experiences (Saunders & al. 2019, 437-439).

All five interviews were conducted in Finnish. All the interviewees gave permission to record the interviews and a smartphone was used for that. During the interviews, supplementary notes were taken by the author as suggested by Saunders & al. (2019, 438). The interviews lasted between 29 minutes and 40 minutes and were all transcribed into text. Details about the interviews can be seen from table 2 Below.

Table 2. Interview details

Interviewee	Date	Length	Method	Role of the interviewee	Company size	Industry
Interviewee 1	11.8.2023	29 min	Face-to-Face	Finance	>5000	Consumer products
Interviewee 2	18.8.2023	38 min	Teams	Sustainability	500-1000	Gardening and growing
Interviewee 3	24.8.2023	36 min	Teams	Technical	250-500	Food
Interviewee 4	11.9.2023	40 min	Phone	Finance	>5000	Steel
Interviewee 5	25.9.2023	39 min	Teams	Finance	>5000	Sports and fashion

3.3 Reliability and validity

Reliability refers to the consistency and the replicability of the study, whereas validity refers to the suitability of the measure used, the accuracy of the analysis and the generalisability of the findings (Saunders & al. 2019, 515-518).

The reliability of the research is ensured by following the steps of qualitative research by Bryman & Bell (2015). The author chose the research method and followed it consistently. The interviews were conducted the same way through all five interviews. The open-ended questions allowed the respondents to answer the questions how they wanted. The consistency of the study fills the requirements for internal reliability (Saunders & al. 2019, 515-518).

To ensure the validity of the research, the research design was made to fill the requirements of external validity. External validity ensures that the findings from the study can be generalised to other relevant contexts (Saunders & al. 2019, 515-518).

3.4 Data Analysis

For analysing the data, the author has chosen a thematic analysis approach. The essential purpose of a thematic approach is to search and find themes and patterns which occur throughout the dataset, in this case the interviews. A thematic analysis offers a systematic way of analysing qualitative data, as it provides a logical path to the analysis. The flexibility of the method comes from its possibility to analyse both larger and smaller datasets while still achieving a broad range of explanations and descriptions. (Saunders & al. 2016, 651-659.) A thematic analysis method allows the author to comprehend large amounts of qualitative data drawn from different transcripts. It helps to identify key points, allows to test theories and to draw conclusions from the dataset. (Saunders & al. 2016, 651-655.)

A thematic analysis can be divided into two different approaches, an inductive approach and a deductive approach. A deductive approach allows the researcher to determine the themes of the research based on the data collected rather than having pre-set themes as in a deductive approach. (Terry, Hayfield, Clarke & Braun 2017, 5.) In this research the author has chosen to proceed with an inductive approach. The thematic analysis can also be distinguished further between a semantic approach and a latent approach. The main difference between them is that in semantic approach, the analysis is based on the stated opinions of the interviews, whereas in a latent approach, the analysis is based on the subtext and assumptions underlying the gathered data. (Terry & al. 2017, 38.) Semantic approach has been decided to be used in this research, as in the empirical research, the data collected was based on experiences, feelings and opinions.

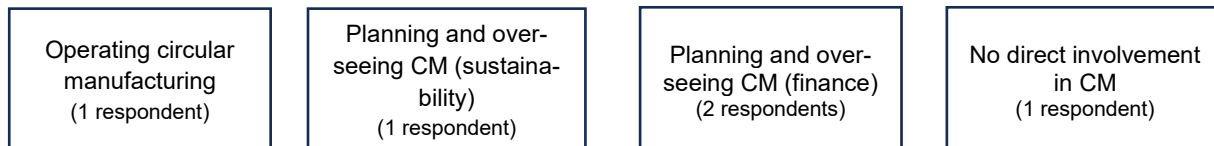
4 Data and results

This chapter presents the data collected and the results of the research. The chapter is divided into three subchapters, where each one discusses the findings of one investigative question (IQ).

4.1 IQ1. How aware are companies of the principles and benefits of circular manufacturing?

In the study, the respondents were holding positions in different areas of circular manufacturing, yet they shared very similar views on the topic and had similar understanding of what circular manufacturing meant for their organisation as well as its potential benefits to the business.

From the interviews conducted, all five respondents had a clear understanding of the principles of circular manufacturing and the main benefits achieved from it. Four of the respondents mentioned that their current or previous roles have had some sort of link to the circularity aspect of their company. The responsibilities of the respondents can be categorised in 3 main categories. These were: operating and planning circular manufacturing, planning and overseeing circular business models from sustainability point of view, and from a financial point of view. One of the respondents mentioned that they are not directly or regularly involved circular manufacturing business models. In the graph 1 below, the distribution between the different responsibilities is presented.



Graph 1. Distribution between the respondents.

All respondents were unified on their feelings towards circular manufacturing and circular economy as a whole and all of them described it as an important topic that would only rise in the future. This aligns with how OECD's (s.a) identified the importance of sustainability driven business was already visible in 2010. They reminded that in 2010, the global market for sustainable technologies and strategies accounted for over USD 5 trillion. Similarities with the respondents and the theoretical research results were for example the understanding of the importance of circularity on manufacturing industry and the possible financial benefits of it.

All of the respondents described circular economy and circular manufacturing as a current and future opportunities rather than liabilities. In order to gain financial advantage, many of them stressed

the importance of being a forerunner on circular manufacturing in their company's operating industry. This view was also shared by the World Economic Forum (2022) that saw born-circular companies to have a superior business model advantage compared to the traditional linear economy companies.

Reasons mentioned for that were brand image, readiness for future regulatory changes but most importantly, the circularity actions being considered in the firms' everyday operations, values, and visions. Besides the expectations of financial performance, the respondents stressed that the main driver for transitioning towards circular economy and sustainability is coming from the customers and consumers. This aligns with the conclusion made by Esfahbodi & al. (2016, 12) that gave the example of manufacturing firms in China and Iran initiating a transition to sustainable supply chains because of regulatory and customer pressure. Regulations were seen as well as a large contributor towards the change, however they are also considered as a possible obstacle as will be discussed in chapter 4.2. These answers from the respondents were aligned with the findings from the theoretical framework regarding the importance of circular economy and manufacturing.

This study showed that businesses today have a good understanding of the benefits and principles of circular economy and circular manufacturing. The potential benefits that the interviewees mentioned align perfectly with the findings of the research conducted by Machado & al. (2020, 3).

Machado & al. (2020, 3) had indeed found similar benefits to sustainable manufacturing than the respondents. They had also discussed the importance of regulations, brand image as well as the financial investments needed in order to achieve a transition to a circular economy business model.

4.2 IQ2. What are the primary obstacles companies face when transitioning from linear to circular manufacturing models?

Respondents were asked about the main obstacles they had experienced in their current firms in terms of circular economy business models. The themes mentioned the most were supply chain and regulations. The main themes and topics are presented in table 3 below, with additional quotes from the interviews.

Table 3. Main themes and topics.

Theme	Topic	Quote(s) from the interviews.
Supply chain	Material availability	“The supply and the demand regarding the circular materials also seems to never be in balance.” (Interviewee 4.)
	Material Quality	“There is the question of quality in circular materials, and how harmonised the quality actually is.” (Interviewee 1.)
Regulations	Material regulations	“When we are talking about non-virgin materials, the laws and regulations are constantly changing. It is very different in each country, and we cannot always use same materials in all our countries where we have operations.” (Interviewee 2.)
	Company regulations	“There is the dilemma, that at the same time we should be able to reduce our emissions, but also to grow our business by selling more products.” (Interviewee 5.)

4.2.1 Supply chain

All five respondents mentioned supply chain as the number one challenge. The process of acquiring circular materials for production was seen as a limiting factor in their circular manufacturing operations. Especially respondents working on production of consumer goods or in the later stages of supply chain, where the products tend to be more complex, had major issues with the supply of the circular materials. According to them, as of today, there simply is not enough circular materials available for their large volume production and thus they are still heavily dependent on virgin materials. This dependency was portrayed by the OECD (2018) as an environmental risk with the increased use of bio-based materials that could add pressure on ecosystems and biodiversity.

On a larger scale, there was also clear consensus of the complexity of the supply chain when comparing circular materials and virgin materials that goes beyond the environmental risks.

During the research, there were also supply chain obstacles that were identified. As interviewee 2 explained: “When using circular economy materials, the process is much more complex and there are more stakeholders involved, and thus the forecasting regarding the supply of circular materials can be difficult”. The interviewees explained that with virgin materials, the company’s demand can

be fulfilled sometimes with just one supplier, whereas in circular materials the supply chain was mentioned to be longer and more complex. The reason for this was said to be number of stakeholders in the supply chain. These views are conflicting with the theoretical findings regarding circular supply chain, where the consensus was that circular supply chain would be more efficient compared to traditional supply chain. For instance, Atlas and Florida (1998, 2) have defined green manufacturing processes as “relatively low in environmental impacts, which are remarkably efficient, with very little generation of waste and pollution.”

Another concern for four of the respondents was the quality of the circular materials. Arasu & al. (2020, 4-7) had material quality as one of the main risks in circular manufacturing. The respondents explained that controlling the quality of circular materials was said to be much more complex mainly because each firm has such unique needs in the terms of material quality, ingredients, and mixture. The nature of circular materials being uneven in terms of quality was said to be large concern in the process. This was explained by interviewee 1 that stated as mentioned in the table that “There is the question of quality in circular materials, and how harmonised the quality actually is.”

4.2.2 Regulations

The second theme that came up from the respondents’ answers, is regulations regarding circular economy. The answers could be divided into two different topics of regulations: regulations and restrictions about circular materials, and into regulations demanding certain level of circularity and sustainability from the firm. Material regulations were seen as a challenge especially with respondents working in the food industry. Safety regulations regarding circular materials were said to change in fast pace and often, and the regulations between countries differ a lot. Different regulations between different operating countries were mentioned to hinder the manufacturing process where materials and products are made in different countries.

Regulations, initiatives and restrictions regarding the companies’ levels of sustainability and circular economy produced mixed results from the respondents. Respondents stressed the need of regulations to accelerate the transition towards more sustainable ways of working but it was seen also as a challenge to follow as a company. The criticism for the said regulations were about the constant change of the regulations, the speed at which they are introduced, and the thought that regulations are not “pure” from the capitalism point of view. The differences in how the respondents saw regulations, were aligned with how advanced they were in their circular economy implementation journey. More advanced ones viewed regulations more positively than the ones whose circular models were still small part of their business as a whole.

However other actors such as the OECD (2018) see regulations as a mandatory tool for a sustainable and safe development. The OECD (2018) explained for instance that the lack of controls and regulations related to materials and recycling could lead to an increased exposure to harmful chemicals. The organisation also argues that staying ahead of regulations could allow companies to cut extra costs to their operations (OECD 2018). This aspect was however not mentioned by the interviewees.

Roy & al. (2022, 124) argue that despite government and organisations' attempts at pushing for sustainable manufacturing, the current lack of regulation and the lack of standardisation make it harder for companies to transition to a circular manufacturing business model.

On the topic of regulations, there are two conflicting views. Academic studies show the potential and the need for regulations for a sustainable transition to circular manufacturing. The studies also cover the potential risks of lack of regulations. On the contrary, the interviewees see the regulations as a potential risk to developing their businesses. One of the most discussed aspect was the lack of standardisation in regulations worldwide, which is a challenge for global companies as interviewee 2 explained: "When we are talking about non-virgin materials, the laws and regulations are constantly changing. It is very different in each country, and we cannot always use same materials in all our countries where we have operations."

4.3 IQ3. What financial aspects companies face in adopting circular manufacturing?

Financial matters regarding the transition from linear to circular manufacturing were many. Respondents mentioned possible variations in the valuation of circular products from the customers' side. Four out of five respondents mentioned that their customers around the world have very different views on circular economy and sustainability, and how they value those.

These views affect the customers' willingness to pay premium for the more circular or sustainable products. The greatest difference in values was reported by the respondents to be between European and Asian customers. According to the interviewees, European customers valued circularity of the product more than the Asian customers. This forces firms to evaluate their product portfolios and even differentiate them for different customer segments. It could also be a slowing factor in transitioning to circular economy if firms' main business market would be in Asia.

Challenges regarding product costs were also mentioned several times by the respondents. Challenges regarding supply chain and regulations mentioned earlier are increasing the costs of operating, which makes it harder to generate profit for the companies. There were hopes from respondents for future innovations and evolvement of said challenges, which would allow circular products to have lower production costs compared to products made from virgin materials. The European

Commission (2022) also argues that 40% of the spending of manufacturing companies in the EU goes towards materials. They conclude similarly to the interviewees that a circular business model would help to bring these costs down while saving more virgin materials.

There was also a mention about contradictions on customers' behaviour. One respondent mentioned that customers are demanding more circular and ethical products but are not willing to pay any extra for them. This might make the transitioning period of moving towards circular manufacturing harder for many companies, when the circular products are generating less revenue than the products made from virgin materials.

When respondents were asked about financing the transition to circular economy, most of the respondents mentioned that the transition process can be quite costly. New tools and machinery, re-defining supply chain and the cost of launching new business models were the most mentioned costs. On the other hand, all of the respondents had noticed the change in acquiring financing from the banks and financial institutions. If their projects had a sustainability or a circular economy aspect, the terms of the loans had been better compared to projects which do not have the sustainability aspect. One of the respondents said that the difference in the terms was so small that it did not have a decisive effect on the projects. The other four respondents mentioned however that the difference certainly had a positive effect on the project planning.

Accounting was also an aspect that a few of the respondents brought up. Those respondents brought up uncertainties in accounting standards regarding how waste and material side-streams should be accounted. Also, business models related to firms buying back their own products and reselling had caused some challenges in accounting. This was especially related to the valuation of second-hand products and materials.

5 Conclusions

In this last chapter of this research, author is presenting the key findings of the research, recommendations for the transitioning towards circular economy in manufacturing industry, further research, and lastly authors reflection on learning about this research project.

5.1 Key findings

The research question (RQ) of this study was “What are the main challenges companies face when implementing circular manufacturing business models?” The RQ was then divided into three investigative questions (IQs).

Key findings from this research are several different challenges and obstacles what globally operating manufacturing companies face. The findings can be divided into three main themes. These themes are supply chain, regulations, and financial management. In supply chain, the supply and demand of the circular materials, and the quality of said materials, was seen as main obstacle for companies. In the worst-case scenario, this can even prevent companies from transitioning their businesses to follow the circular economy practices. On the bright side, well managed supply chain following the circularity aspect can be a real asset for the company. With strategies regarding the usage of production side-streams, recycling, and other aspect of circular supply chain, many companies could widen their fronts in terms of business models and value streams.

Regulations were the second theme that caused problems for the respondents. Globally operating companies must deal with constantly changing regulations in several different countries. Uncertainty of the constantly changing regulations and laws is having negative impact on operating in circular manner. In the larger picture, regulations were mostly seen as positive matter regarding the transition towards circular economy, by providing guidance and limits for the companies.

In terms of financial management, most challenges were about making circular economy related business models in manufacturing financially viable. The costs of operating circular manufacturing business models were found to be currently higher compared to the traditional linear operating system. There were also challenges regarding customer and market segments: globally operating firms are struggling to find the balance between different customers' needs and values. There are also gaps in accounting standards regarding circular economy. It was not clear for the respondents how different aspects of circular economy should be taken into consideration in accounting and financial reporting.

To ensure the smooth transition towards circular economy business models in context of manufacturing, challenges mentioned should be solved accordingly, but the findings from the literature

review and through empirical research suggests, that as of today, there are no clear solutions to these challenges. Because of that, companies are forced to make the transition without clear guidelines. This research was made in the context of international business, and therefore the most important goal for companies as of today, is still the ability to perform financially and to generate profit.

5.2 Recommendations

Main recommendations according to this research are as part of the transitioning toward circular economy, a change of mindset is needed. The value of the company should not only be judged by the monetary benefits they bring to their shareholders, but also from how sustainable they are.

Future innovations are mostly like going to play a big part in circular economy, and therefore investment towards research and development are needed.

5.3 Further research

This study was investigating how familiar large, global manufacturing companies are with circular manufacturing business models, and what are the main challenges they face when implementing said models. The research was made by interviewing business professional from variety of companies, and industries. For future research, more specific study focusing on only one industry could be made, to gather in-depth knowledge about specifics on that industry. There could be also potential in comparing businesses in different stages of their transition towards circular economy.

Since this study was conducted using qualitative methods, research made with quantitative methods could present us more information in terms of numerical data. Whereas this study was focusing mostly on the challenges, there could be potential to research in detail the possible benefits of the circular economy business models in manufacturing industry.

5.4 Reflection on learning

The topic of the research was relevant in terms of current world situation, and it was also in the centre of authors personal interests and aspirations on field of financial management, sustainability, and circular economy.

This thesis process was great learning experience for the author. During the process, author learnt various of new skills, and developed current ones. Project management, research, and analysis skills of the author were put to the test. In the start of the process, progressions were quite slow. Schedule wise, this forced a lot of pressure in the later stages of the project which could have been avoided with better allocation of times and resources towards the research. In terms of the

empirical research, the interview questions used could have been constructed in a way that financial management related issues would be more present.

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Appendices

Appendix 1. Interview Guide.

Background questions:

1. What is your background in the field of finance? Education, years of experience, roles etc.
2. What is your current role and industry?

Circular Economy business models and manufacturing:

3. Are you familiar with circular economy and how it is linked into manufacturing? The difference with traditional manufacturing business models?
4. Does your current company have business models following the principles of circular economy? Why/why not?
5. Have you been part of planning or launching business models of circular manufacturing? If yes, how does the early stages differ financially from traditional manufacturing business models?
6. What are the motives to run a circular manufacturing business model?
7. In your opinion, what are the major challenges that companies may encounter when transitioning to circular manufacturing, and how can these challenges be overcome?
8. In today's world, do you see circular manufacturing as a legitimate substitute to traditional manufacturing?
If yes, why? What are the advantages?
If not, why? What are the challenges?
Future?
9. How does the traditional business models differ from the CE business models related to manufacturing?
Operational difference?
Financial difference?
Profitability?
10. CE business models financial goals?
Long term vs. short term
11. Profitability of the CE business models?
Revenue vs. image vs. outside pressure (regulations etc.)
12. Have you noticed difference in applying financing/capital/funds from financial institutions or banks regarding CE business models?
13. Is it possible to run a global manufacturing company solely in circular manufacturing?

