

# **Drivers and Barriers to Circular Economy Strategies in the Telecommunication Industry**

A Study of Telecom Vendors and Operators

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The pipes, the pipes are calling,  
From glen to glen, and down the mountain side.  
The summer's gone, and all the roses falling,  
It's you, it's you must go.

*"Danny boy"*

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Tack så mycket

## **Abstract**

The telecommunication industry contributes to environmental impacts through energy usage and material resource use. The incorporation of Circular Economy strategies has the potential to restructure and re-engineer systems like those in the telecommunication industry to capture more value for the business while decreasing environmental impacts of business. The objective of the research in this paper is to map the drivers and barriers for the telecommunication sector in adopting Circular Economy strategies. A literature review, industry expert interviews and a focus group were used to gather insight on trends in the uptake of Circular Economy strategies by vendors and operators in the telecommunication industry.

The results of the paper point at the concept of Circular Economy being still in its infancy in many telecommunication companies but that there is growing interest due to more widespread recognition of the concept. Drivers of the adoption of Circular Economy strategies are the increasingly harsh competition and disruption in the telecommunication market, value leakage from current business model, growing data consumption and energy use, and the potential for new business opportunities. Barriers to adoption included misaligned policy, issues with product return, risks of business model change, brand risk, company culture, and complexity of change.

**Keywords:** Circular Economy, telecommunication industry, ICT, drivers, barriers

## Executive Summary

The thesis aims to map the drivers and barriers for the adoption of Circular Economy strategies in vendor and operator telecommunication companies. Circular Economy strategies have received attention for the potential they hold to reduce environmental impacts. Through shifting to new business models that change value creation and capture to drawing attention to inefficiency in business activities and design Circular Economy strategies claim to help reduce energy use and resource use.

The possible adoption of Circular Economy strategies in the telecommunication industry is important as a potentially powerful set of tools to reduce its environmental impact of increasing energy usage and use of non-renewable resources. The telecommunications industry is a highly competitive and rapidly innovating industry making it an interesting case study to explore in how Circular Economy strategies are being used.

The research questions and sub-questions used to guide the paper were as following:

*What barriers and drivers are most significant for telecommunication vendors and operators for the adoption of circular economy principles into their business?*

*What potential value do telecommunication vendors and operators anticipate could be captured with CE strategies that is being missed in current linear business models?*

*What risks exist for telecommunication vendors and operators in transitioning to CE strategies?*

The drivers and barriers in adopting Circular Economy strategies in the telecommunication industry were examined through a literature review, expert interviews and a focus group session where data was gathered and then analysed. The primary drivers for the adoption of Circular Economy strategies in telecommunication companies that were: policy, improved customer relations, new business opportunities, stopping value leakage and inefficiency, data and energy consumption trends; societal trends; and top management commitment. The primary barriers of Circular Economy adoption were: regressive policy; financial model change; product cannibalisation; product return issues; brand risk; company culture; and system and operation change.

It was found that while there was hesitance and lag in the telecommunication industry in due to various issues there was a growing interest in the potential of Circular Economy. This principle drive comes from the potential for Circular Economy strategies to aid in improving the current value capture of operations and with new business opportunities. This is especially pertinent for the telecommunication industry seeing as the competition in the industry is so tough and new avenues that hold potential for a competitive edge on competitors or new potential growth opportunities could be a lifeline in the future. It seems clear that Circular Economy is a legitimate route for the telecommunication industry to simultaneously reduce its environmental footprint while also increasing its competitive edge and will grow in ubiquity as industry trailblazers in Circular Economy showcase its benefits.

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## **Abbreviations**

CE – Circular economy
EMF – EllenMacArthur Foundation
EoL – End of life
ICT – Information and communications technology
IoT – Internet of things
KPI – Key performance indicator
OEM – Original equipment manufacturer
OTT – Over-the-top (telecommunication services)
PSS – Product service systems



# 1 Introduction

Information and Communication Technology (ICT) is important to society, business and an integral part of the effective functioning of the global economy. It helps drive economic growth and enable new sectoral and business opportunities (Roller & Waverman, 2001). The OECD defines the role of ICT as “primarily being intended to fulfil or enable the function of information processing and communication by electronic means” (OECD, 2011, p. 20). It is developing rapidly and expanding into more areas and sectors (International Telecommunications Union, 2016; OECD, 2014). Mobile broadband networks covered 84% of the world’s population in 2016, 47.1% of the population made use of them (International Telecommunications Union, 2016), and in sub-Saharan Africa alone between 2010 and 2013 mobile subscriptions grew from 14 million to 117 million (OECD, 2014). ICT can lead to positive and negative implications for society. It can make processes more efficient and reduce resource intensities but simultaneously due to increased expansion it is consuming more natural resources in the production of its hardware, leading to burgeoning levels of toxic e-waste, and demanding ever greater levels of energy to power its systems of communication. Consequently, its environmental impact is expected to increase (Malmodin, Lundén, Moberg, Andersson, & Nilsson, 2014; Van Heddeghem et al., 2014).

The impacts from the ICT industry feed into greater global environmental problems stemming from a linear economic structure that are pushing the Earth beyond its planetary boundaries and destabilising the natural systems that keep the Earth habitable and safe for humans (Steffen et al., 2015). The current global economic model has a linear structure where resources are extracted, used and thrown away to produce products and services. This linear system has produced a level of consumption of natural resources whereby the equivalent of 1.6 planets are needed in order to have sufficient regenerative capacity to maintain it into the future (WWF, 2016). The impact on the Earth’s systems from this linear economic model has been so severe, that some scientists are arguing that the Earth has transitioned to a new geological epoch called the Anthropocene (Carrington, 2016; Steffen, Crutzen, & McNeill, 2007). There needs to be a more radical approach to how the economy and industries like ICT function to reduce impact through resource and energy use on the natural world. One such approach is the Circular Economy (CE) concept. This concept pulls together a large wealth of insights and research from different schools of thought, aiming to solve issues related to materials and energy use in the economy by employing different strategies (EllenMacArthur Foundation, 2015b).

## 1.1 Problem definition

The EllenMacArthur Foundation (EMF), one of the major CE platforms, defines the CE as “an economy that is restorative and regenerative by design and aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles...to ultimately decouple global economic development from finite resource consumption” (Ellen MacArthur Foundation, 2015b, p. 2). CE as a concept and a strategy is becoming more widely researched and explored in academia and in policy circles (Geissdoerfer, Savaget, Bocken, & Hultink, 2017). China (Su, Heshmati, Geng, & Yu, 2013) and the EU (European Commission, 2014) are starting to develop policies to support it. While there still seems to be a lack of mainstreaming of the concept in industry (Bocken, Ritala, & Huotari, 2017), in the US at least, a few prominent corporate champions such as Google, Unilever, Renault and H&M are starting to adopt CE strategies to reduce their environmental footprints and find new opportunities for value creation.

The ICT industry is poised to only grow, along with its environmental footprint, as sectors of the global economy digitise and other emerging sectors mature. Within ICT, the ‘C’ for communication is especially important due to the rise in importance of connectivity and

communication for the globalised economy and contemporary society. This telecommunication area is one of the most rapid areas of development and innovation within ICT and as such its environmental impact is burgeoning. Take the emerging telecommunication sector the internet of things (IoT). It is projected that there will be one billion machine-to-machine connections by 2020 (EY, 2015) demanding high levels of scarce materials and additional energy to power. The use of smartphones has grown exponentially and has led to a surge in data usage for media and video. In 2010, these sources accounted for 10% of mobile traffic. By 2015, this figure had grown to 50% of mobile traffic. These trends have led to a need to expand the quality and capacity of data networks, and as a result, the material and energy impacts of the telecommunication industry (EY, 2015).

The thesis will conduct exploratory research to map perceptions of CE in the telecommunication industry. The aim is to shed light on how telecommunication companies view CE strategy adoption and what motivates and stops these companies working further with the concept. From a practical perspective, the research will contribute to insight on the current situation of CE in telecommunication companies, providing clarity and input on the topic that does not currently exist. From a research perspective, it is worthwhile to do this research because it will add an additional study of CE on a unique sector with features such as rapid innovation cycles and tough market competition. This will add material to contrast and compare with other sectors in the economy working with CE that are more established and mature.

## 1.2 Research question

### **Research question:**

*What barriers and drivers are most significant for telecommunication vendors and operators for the adoption of circular economy principles into their business?*

### **Focus questions:**

*What potential value do telecommunication vendors and operators anticipate could be captured with CE strategies that is being missed in current linear business models?*

*What risks exist for telecommunication vendors and operators in transitioning to CE strategies?*

## 1.3 Limitations and scope

The telecommunication industry is incredibly expansive and complex. It is constantly in flux, shifting and evolving as it develops and innovates (McKinsey, 2015; OECD, 2014). Within the telecommunication industry, the scope of focus for the research is on the two traditionally large and influential players; telecom hardware vendors and telecom operators. While this scope leaves out some of the more recently disruptive and lucrative over-the-top (OTT) telecommunication-service businesses, like WhatsApp and Skype, it encompasses the telecommunication businesses that still manufacture, operate and deal with the end-of-life of telecommunications equipment where a significant level of environmental impact and resource use occurs.

A limitation of the research is that interviewing employees of private competitive businesses about internal strategies or thoughts entailed a certain level of sensitivity and secrecy. As such, the level of depth in some responses is questionable due to their likely unwillingness to share insights that will be scrutinised and shared in a public document. Additionally, as it was difficult to verify responses, it is possible to question the veracity of what was claimed in interviews. It is possible that responses could be business speak and the company ensuring the

communication of ‘safe answers’ that won’t be controversial. Additionally, since in most stakeholder interviews only one employee was interviewed from each company, responses could be coloured by the individual’s experience and not be representative of the company itself. The research period allocated was over the summer months and meant contacting relevant interviewees was challenging as many employees of the stakeholder telecommunication companies were on leave for lengthy vacation periods.

## **1.4 Ethical Considerations**

Consent was sought for before the recording of interviews for transcription purposes. Any recorded content was not shared with other parties and was solely used for transcription and review of responses. All interviewees were kept anonymous. Data collected was treated with sensitivity. There were no financial benefits for the author from businesses dealt with during the writing of the paper. Academic integrity was maintained throughout the writing of the paper to avoid plagiarism.

## **1.5 Audience**

The audience for the paper is telecommunication companies to offer an overview of what is happening in CE. It will offer insights into what businesses in the telecommunication industry are doing and layout a variety of views that should spell out more clearly the promising pathways and steps to be taken along with potential pitfalls and how they can be avoided.

Additionally, the paper should also be of use for the wider academic debate on CE. It will add some granularity on another sector that has quite unique characteristics like rapid innovation and high levels of competition. This similarly should be useful for policy makers looking to get insights on how to work with the concept of CE and the private sector.

## **1.6 Disposition**

Chapter 2 is to provide context on the telecommunication industry and its related environmental and sustainability aspects to put the CE research in better perspective.

Chapter 3 covers the research design and methodology crafted to carry out and analyse the research conducted.

Chapter 4 is a literature review of content related to the research questions on the circular economy and its strategies and benefits, and general drivers and barriers to CE adoption.

Chapter 5 explores the data collected presented through an analytical framework and brings together the literature reviewed to compare and contrast results.

Chapter 6 considers discussing how the analysed data can help answer the research questions presented at the beginning of the paper.

Chapter 7 is for reflections on the research including a summary of advice for telecommunication industry business about the topic of CE, recommendations on further areas of research, and reflections on the research carried out in the paper.

Chapter 8 is the concluding chapter that wraps up the paper.

## 2 Context

This section is to give additional contextual information on the telecommunication industry and its environmental impacts, helping frame why CE strategies could be effective.

### 2.1 The telecommunication industry

The telecommunication industry is a difficult sector to outline or define. This is due to just how rapidly evolving and amorphous it is and how many other sectors the companies within it overlap with regards to the services and products they sell (McKinsey, 2015; OECD, 2014). Investopedia defines the telecommunication industry as “complex networks, telephones, mobile phones and internet-linked PCs” that “allows us to speak, share thoughts and do business with nearly anyone, regardless of where in the world they might be” (Investopedia, 2004).

Some of the largest businesses in the world by revenue are found within the telecommunications vendor and operator industry sector. For example, AT&T, Verizon, China Mobile Communications, Nippon Telegraph & Telephone, Deutsche Telekom, Huawei, Vodafone, Telefonica, America Movil, Cisco Systems, Orange, and China United Network Communications all appear in the top 250 of the Fortune 500 (Fortune, 2017).

While many telecommunication companies are very large and complex with many different product and service offerings (See Table 1) they can be more simply broken down into the main two focus business segments for this thesis: telecommunication hardware vendors (to be referred to as vendors) and telecommunication hardware operators (to be referred to as operators).

**Vendors** manufacture and sell telecom network equipment and services to operators.

**Operators** maintain and run communication networks and contract customers to sell them communication services, see Figure 1.



Figure 1 Simplified telecommunication value chain (Source: author)

Table 1 Non-exhaustive list of products offered by telecommunication businesses (Adapted from: OFCOM, 2009)

Mobile systems	Fixed wired	ICT and internet
2G	Telephony and broadband	Servers and server farms
3G	ADSL/xDSL	Routers
4G/LTE	NGN	Enterprise ICT

### 2.2 Telecom industry sustainability aspects

While extensive data on the environmental impacts of the telecommunication industry is not widely available and what does exist is fragmented (Malmodin et al., 2014), this sub-chapter is an attempt to collate literature to give a clearer picture about the environmental impacts of the

telecommunication industry. Literature on the broader ICT industry is used to compliment when necessary.

Work by (Hilty et al., 2006) lists three types of positive and negative environmental effects associated with ICT which can be applied to the telecommunication industry: They can be structured into first, second and third order effects. They are depicted in Figure 2 and discussed in greater detail in the following sub-sections.

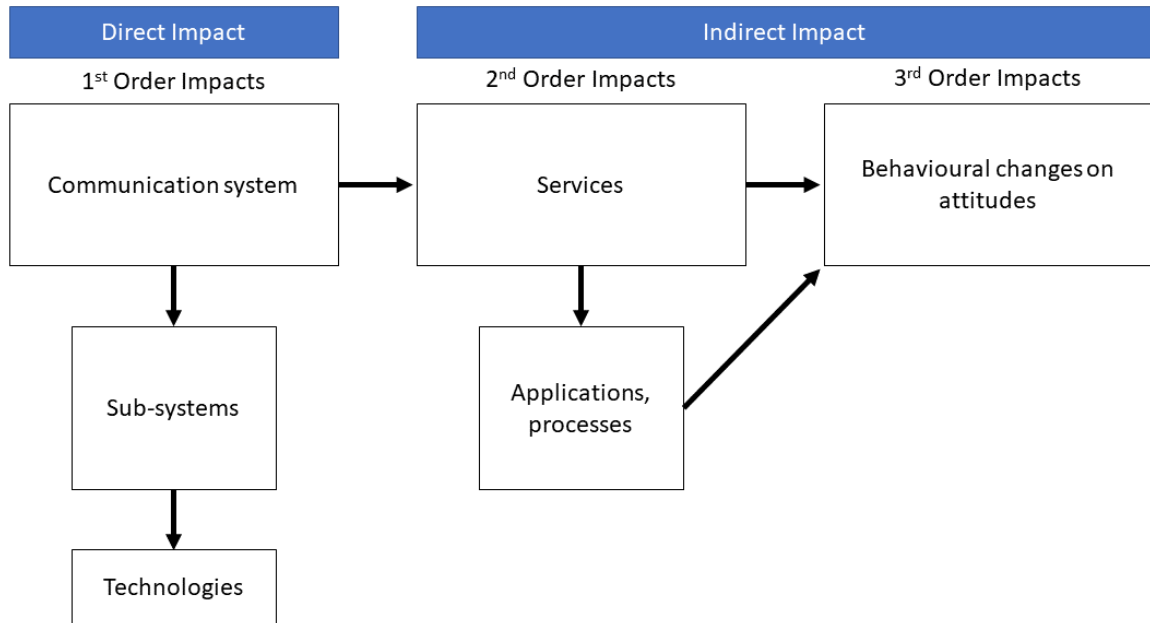


Figure 2 Environmental effect levels of ICT (OFCOM, 2009)

### 2.2.1 First order effects

These effects encompass the physical impacts of the telecommunication industry on the environment through the production, use, recycling, and disposal of hardware. This constitutes the entire communication system that delivers the communication service, the sub-systems like ‘core networks’ and other such mid-level components of the system, and finally individual technologies that make up sub-systems, (see Figure 2).

Studies (Malmmodin et al., 2014; OFCOM, 2009; Scharnhorst, Althaus, Classen, Joliet, & Hilty, 2005) ultimately stress the use-phase impacts of telecommunication networks and the large impacts stemming from end-user products, such as mobile handsets. For example, mobile handsets have a low-use phase impact, but have high life-cycle impacts due to manufacturing, distribution, EoL and short product lifecycles contributing to consumption (OFCOM, 2009). If compared, phone manufacturing in the UK in 2005 had as much embedded CO<sub>2</sub> emissions as all GSM and 3G base stations (a sub-system in the communication network that provides a connection between mobile phones and the wider telephone network) over a yearly period, using 1000GWh and 1300GWh respectively (OFCOM, 2009).

#### Production phase:

For a GSM 900 mobile phone network (rolled out in Europe in 1991 and by 2005 had over 1.5 billion subscribers) the major impacts in the production phase stemmed from the manufacture of the printed wiring board components (Scharnhorst et al., 2005).

### **Use phase:**

In 2009, ICT was estimated to contribute around 2% of total global GHG emissions, or ~800 MtCO<sub>2e</sub>. This is forecast to grow rapidly to 1,400 MtCO<sub>2e</sub>, or 2.8% of global GHG emissions, by 2020 (OFCOM, 2009). Telecommunication systems (mobile, fixed and communications devices), alone are forecast to contribute 230 MtCO<sub>2e</sub> (Fehske, Fettweis, Malmodin, & Biczok, 2011; OFCOM, 2009). While overall energy demand and emissions for the ICT industry are projected to rise, due to the large expansion of demand for ICT performance, research shows that the energy intensity of data transmission in ICT networks halves about every 2 years (Aebischer & Hilty, 2015; Aslan, Mayers, Koomey, & France, 2017). While this points to impressive energy efficiency gains in how telecommunication technology is developing it also highlights a significant risk that, if improvements in efficiency in ICT hardware were to slow down, then the already growing impacts of ICT would speed up by possibly large factors. Drivers listed by OFCOM (2009) that are attributed to the increase in the impact of communication systems: *growth of services; increase in transfer of data per service; increased no. of users per service; increased geographical coverage*. Malmodin et al. (2014) note that there is significant room for improvement in reducing the impact of the use-phase emissions from telecommunication hardware with the rapid incorporation of renewable energy in countries' energy mixes. Sweden is an example of this, having one of the largest rates of per capita consumption and use of ICT products, but due to the high level of renewable energy in its national energy mix, the 'use-phase' impacts of ICT products is diminishing over time.

### **Recycling:**

In the case of the GSM 900 mobile network study, it found that recycling materials from the hardware led to a two-fold reduction of environmental impacts (Scharnhorst et al., 2005). This is primarily through the avoided primary production of input materials, most dominantly precious and rare metals.

### **End-of-life (EoL):**

With the GSM 900 mobile network, the EoL phase heavily affected impacts on ecosystem quality due to effects of long-term emissions of heavy metals that escape into the environment (Scharnhorst et al., 2005).

## **2.2.2 Second- & third-order effects**

The indirect second-order effects refer to how ICT equipment changes processes in other systems that either increases or decreases the process' impact on the environment. The indirect third-order effects refer to ICT service provision over longer periods of time, and how it changes behaviour such as consumption habits or economic structures, that will in turn have environmental impact implications.

### **Positive impacts:**

Hilty, Lohmann, and Huang (2011) list various ways in which ICT products and services can affect the life-cycle of other products: *optimising the design; optimising the production; optimising the use; optimising the EoL treatment; modifying demand by a. substitution (decreasing demand) or b. induction (increasing demand)*.

Beneficial 2<sup>nd</sup> and 3<sup>rd</sup> order impacts can be categorised as follows (OFCOM, 2009):

- Enhancing: making processes more efficient



- Enabling: doing things differently
- Transforming: new business models

For example, telecommunication services can help reduce environmental impacts by enabling teleworking (substitution for commuting to work) and teleconferencing (substitution for business travel) and helping avoid emissions from travel (OFCOM, 2009). It is noted that while savings of travel mileage between 48% and 77% can be achieved with teleworking, there is a rebound effect (see below) for increased personal travel that causes savings to fall to a much lower 11% to 19% savings.

OFCOM (2009) notes that while there are many possible positive enabling effects of ICT, they are hard to quantify compared to the direct negative impacts. The same report notes that many studies on the enabling effects of ICT are optimistic and generous in noting what positive environmental benefits ICT could provide, but lacking in giving weight to regulatory, policy and behavioural changes needed to affect change.

### **Rebound effects:**

While ICT and telecommunications technology have been championed for enabling sustainability in various forms (Hilty et al., 2011), it has been argued that using ICT equipment and applications for efficiency gains will not lead to absolute decoupling of impacts, where environmental impacts shrink while growth rises. Rather, they are expected to lead to a growth in output and rise in overall consumption of resources, prompting impact decoupling, where each unit of growth creates less impact but the overall impact continues to rise. This is called the rebound effect, or Jevons paradox (Hilty et al., 2011). However, it is noted that, if efficiency gains are coupled with sufficiency aims through constraining resource access, such as with energy, then innovation efforts should shift towards lowering overall energy consumption (Hilty et al., 2011).

### **Current minimisation of impacts:**

According to OFCOM (2009), there is effort to improve the impacts of ICT through the EU Energy Using Products (EuP) programme and directives, and efforts by the International Telecommunication Union (ITU) and European Telecommunications Standards Institute (ETSI). More concretely, CONNECT2020, a project by ITU, is geared to achieving e-waste reduction by 50% and GHG emissions per subscription by 30% between 2015 and 2020 within the telecommunication vendor and operator businesses (European Telecommunications Standards Institute, 2017). Additionally, vendors and operators supposedly work in partnership to reduce impacts in order to reduce operational and energy costs, material use and recycling costs and create value through 'green' marketing (OFCOM, 2009). While this industry effort for reducing environmental impacts occurs OFCOM (2009) noted that the telecommunications industry expressed that there is a lack of policy and institutional guidance towards reducing environmental impact in the sector.

### 3 Methodology

The research design was exploratory in nature and interview questions were kept open-ended to capture as wide as possible input on the topic. Seeing how there is little previous research on the topic, the aim of this thesis was to gather inputs that might clarify the current situation with telecommunication companies' attitudes regarding the circular economy and set the foundation for further research on the topic.

The research collection started with secondary data collection in the form of a literature review, and primary data collection in the form of interviews with telecommunication professionals and CE experts, and a focus group with several employees from a telecommunication company. These were figured to be the most appropriate methods to conduct exploratory research by allowing an informal approach to discussion to collect a wide set of data.

#### 3.1 Information collection

##### 3.1.1 Secondary data collection

###### ***Literature review of drivers and barriers regarding CE strategies***

A systemic analysis was performed to collect instances of literature relevant to the scope of the research and analysing the content. Academic articles, books, grey literature, online news articles and additional online content was explored and investigated to collect information on the drivers and barriers to CE. No strict definition of CE was adhered to when in search for input for the literature review to expand the scope of possible useful material. To find content, search terms used in Google, Google Scholar and LUBsearch were: circular economy, circular economy drivers and barriers, telecommunication circular economy, ICT and circular economy.

##### 3.1.2 Primary data collection

Alternatives to the two chosen methods of primary data collection, interviews and a focus group, were considered to gather different types of data. An approach, such as a survey, could add granularity to the topic but was deemed unfeasible because of anticipated low levels of response. Due to time constraints and that research was to be carried out over summer vacation period, when many professionals are on break from work, it was felt that it was wiser to spend time on liaising with a smaller number of companies and increase the likelihood of acceptance.

###### ***Semi-structured interviews with telecommunication vendors and operators***

To collect data on drivers and barriers on transitioning to CE strategies and principles a number (n=7) of semi-structured interviews was conducted with stakeholders from telecommunication vendor and operator companies (See Table 2).

The semi-structured interview approach was chosen as a data collection method due to its flexibility that would allow for interviews to unfold more naturally around the subject of CE and telecommunications. This less rigid method would allow for broader exploration of CE driver and barrier themes. Additionally, to add further depth and triangulation to data collected from the telecommunication companies' representatives, several interviews (n=3) were conducted with experts in ICT sustainability and CE (See Table 2).

To find interviewees, a pool of 25 possible telecommunication vendors and operators were contacted using the snowball sampling method (Bryman & Bell, 2015). Appropriate interviewees were identified and contacted through various avenues: mutual contacts, using Fortune 500 listings to identify the largest and most impactful telecommunication companies, searching the webpages of ICT and telecommunication companies and CE experts, and over

the professional social-network platform LinkedIn. Anonymity of interviewees and their companies was granted to increase the likelihood of acceptance of being an interview candidate. When approaching possible interviewees, effort was made to contact the large and impactful companies whose operations span the entire globe. Telecommunication companies that replied and agreed to interviews were mostly large multinationals. This underlines how important and influential some of the interviewee companies are in developing CE as part of the telecommunications sector. Appropriate interviewees from telecommunication companies for interview purposes were loosely defined as an employee in the company who worked towards and had knowledge of the sustainability or corporate-social-responsibility (CSR) efforts and actions of said company. Additionally, effort was made to communicate with telecommunications companies who had direct experience with CE.

Prior to conducting interviews an interview guide was developed to prioritise areas of interest for discussion. The interview guide was to be just a general guide that was sent out before the interview to participants to give them an idea of the interest in discussion. The guide was kept reasonably broad to help interviewees to tell the story of CE in the company themselves and was only used to help shape and return to important focus areas when it was felt interviews were veering off track. The interview guide was informed by the CE and ICT/telecommunications literature review. Additionally, some inspiration about business stakeholders where CE barriers and drivers could occur was taken from a sustainable business Value Mapping Tool (See Figure 3). Go to Appendix 1 for a list of questions and sub-questions used to guide interviews.

All interviews lasted between 30mins and 1 hour and were conducted either over telephone or Skype. The audio of interviews was recorded when possible. In the case of being denied by the interviewee to record or when the phone connection was of poor quality notes were taken in place of an audio recording. Summaries of the content of interviews was detailed in a document after. All interviewees are kept anonymous and referred to numerically in the paper: Interviewee #1 - #10 (See Table 2 below).

*Table 2 Interview participants*

#	Organisation	Profile	Date
1	Telecommunications equipment vendor	LCA expert / CE research / Business development	15/19/21.06.2017
2	Telecommunications equipment vendor	Corporate social responsibility manager	02.08.2017
3	Telecommunications equipment vendor	LCA expert	22.08.2017
4	Telecommunications operator	Director of environmental sustainability	08.08.2017
5	Telecommunications operator	Vice president of sustainability management	09.08.2017
6	Telecommunications operator	Environment, health and safety manager	09.08.2017
7	Telecommunications operator	Senior corporate responsibility manager	13.08.2017
8	University	Professor – IT sustainability expert	24.07.2017
9	CE service provider business	CEO	29.08.2017
10	Management consulting	CE expert	29.08.2017

### ***Focus group with telecommunication company***

After contact with one of the initial interviewees a focus group was organised with additional members (n=8) of the telecommunication company in question.

The structure of the focus group session was as follows:

1. A round of introductions and level of knowledge of CE.
2. Presentation on paper and research.
3. CE introduction.

4. Value mapping tool explanation.
5. Work through steps of the value mapping tool brainstorming about drivers and barriers for CE for the company.

The structure of the focus group started with an introductory presentation on CE theory and strategies. In order to scope the focus of the exercise a CE business model of product-service-systems (PSS) (Mont, 2002) was used. This model was chosen since in the earlier semi-structured interviews with telecommunication stakeholders it was noted as being the most attractive CE business model to transition to. The main section of the focus group was spent on running through the Value Mapping Tool (Bocken, Rana, & Short, 2015). The stakeholder areas of the Value Mapping Tool were narrowed down to prioritise for time limitations. They were *environment; customers; suppliers & partners; and investors & shareholders*. Keeping in mind CE strategies, each stakeholder group was focused on while cycling through the different value steps in the Tool (See Figure 3) and then dialogue was started on identifying *internal* and *external, drivers* and *barriers* that the telecommunications company could possibly have.

The focus group added more depth on the topic of the use of CE in a specific company by allowing numerous multidisciplinary participants to develop the topic of CE drivers and barriers in telecommunications and to probe further into each other's answers (Bryman & Bell, 2015). Some of the reasons for using a focus group to complement the interview findings are that focus groups allow for the challenging of ideas by other participants that can be missed in one-to-one interviews and it allows for a wide variety of roles or expertises to share views and different angles on the topic in question (Bryman & Bell, 2015).

Effort was made to include a varied selection of employees from the company from different departments to maximise the level and variance of expertise for different insights into the complexities of barriers and drivers. When in correspondence with the company representative helping organise the focus group they were asked to communicate with business developers, engineers, designers, sales staff, general managers, environmental and sustainability staff, and research staff. See Table 3 below for a list of focus group participant profiles. Limited access to employees meant that those in attendance at the focus session were employees with prior experience and/or knowledge in CE. Additional employees from other functions with no prior knowledge of CE could have helped inform responses further with different insights. Another limitation was that company time granted for the focus group session meant that only a 1 hour 30-minute window for discussion was possible. The audio of the focus group was recorded and a summary of findings was compiled in a document and circulated back to the focus group participants to check the validity of the researcher's understanding of proceedings.

Table 3 Focus group participants

#	Participant profiles
1	Senior researcher
2	ICT expert
3	Global sustainability operations
4	Services researcher
5	Sales development manager
6	Environmental researcher
7	Industrial designer
8	Senior environmental expert (Skype)

The Value Mapping Tool was chosen as a framework a help with primary data collection. It helped to explore and make visible the different dimensions of stakeholders of the company in

question and additional value that could be captured with CE strategies when applied to a linear business. This relatively new tool is described by its authors as useful for helping ‘sustainable business thinking’. The structure draws attention and awareness to additional values relating to sustainability that are largely overlooked. They argue that it is necessary to understand the viewpoints of a wide variety of stakeholders for a company to build sustainable business propositions that avoid damaging society or the environment. Such an approach facilitates the incorporation the triple bottom line approach to of sustainability; economy, environment and society. Adding these stakeholders’ viewpoints helps to identify where new value can be captured by the company to benefit operations, help customers and create competitive advantage, while minimising negative impacts. To properly identify sustainability innovations in a business, additional areas need to be considered that are commonly left out of the business model planning process, such as product and process design. In this way, inviting experts from various departments in a company to participate in identifying motivations and barriers to incorporating sustainability helps expand the depth and breadth of what can be identified.

The Value Mapping Tool (See Figure 3) value segments can be described; in the following manner.

**Value captured** represents the positive benefits delivered to stakeholders.

**Value missed** represents cases where stakeholders fail to capitalise on existing assets, capabilities and resources, are operating below best practice or fail to receive benefits they seek from the network.

**Value destroyed** is negative outcomes of the business (sometimes referred to as ‘negative externalities’ and concerns the damaging social and environmental impacts of business.

**Value opportunities** are new operations identified that could be started.

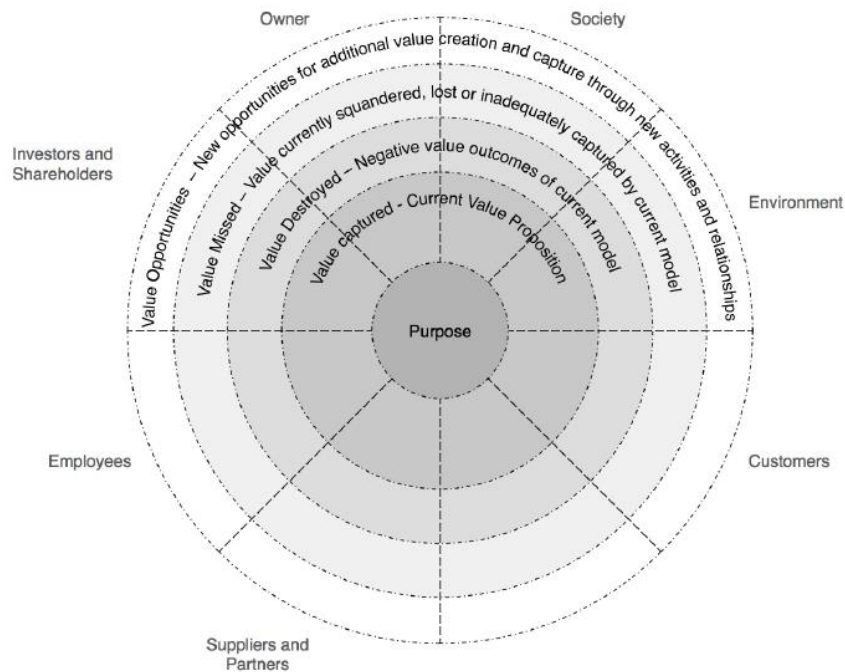


Figure 3 Sustainable Business Value Mapping Tool (Source: Bocken et al., 2015)

Bocken et al (2015) list of various examples of contributions that the Value Mapping Tool can make:

- *identifying positive and negative values in a network of stakeholders*
- *identifying conflicting values between stakeholders*
- *identifying opportunities for sustainable business model redesign to improve impacts on the environment and society*

## 3.2 Data analysis

### 3.2.1 Method of analysis

Content analysis was chosen as a method for the analysis of both the interviews and the focus group. This choice was made due to the fact that it is a flexible method that can be applied to analyse various types of content (Bryman & Bell, 2015). Content analysis is defined by Holsti (1969) as “any technique for making inferences by objectively and systematically identifying specified characteristics of messages” (Holsti, 1969, p. 14). Due to the exploratory nature of the research done was more specifically a *qualitative content analysis* whereby it allowed the researcher to let thematic categories emerge through the recognition of significance relating to the paper’s focus (Bryman & Bell, 2015). Thus, when summarising the material collected during the interviews and focus group the researcher made decisions about what qualified as significant to be included as drivers and barriers and were grouped thematically in the analytical framework.

### 3.2.2 Analytical framework

The framework developed to present the analysis of the primary data collected was a modified PEST (Cadle, Paul, & Turner, 2015). This was done due to the fact the PEST framework could not adequately incorporate the requisite dimensions to structure the analysis of telecommunication companies’ experiences and small alterations were needed to better suit the data. The original PEST framework is oriented towards helping bloc information about external forces that could affect a business and the focus is upon 4 areas that could affect change: Political; Economic; Socio-cultural; Technological. The original PEST was modified by the researcher’s own themes developed as part of the qualitative content analysis to better incorporate internal forces. The modified themes to more fully capture the analysis are: Policy & operating environment; Economic & financial; Socio-cultural; Technology & process related. Furthermore, the modified PEST was divided into two separate compartments that allowed for the distinguishing of drivers and barriers (See Figure 4). Results from the data collection that were considered significant and relevant to the topic of study were then inserted into the modified PEST framework and further categorised into sub-themes within PEST category.

	<b>Drivers</b>	<b>Barriers</b>
<b>Policy &amp; operating environment</b>		
<b>Economic &amp; financial</b>		
<b>Socio-Cultural</b>		
<b>Technology &amp; process related</b>		

Figure 4 Modified PEST analytical framework

## 4 Literature review

This next section is a literature review of the areas relevant to developing the research problem area. It aims to give insight into the Circular Economy and the strategies and benefits it claims. Then there will literature explored on the general drivers and barriers for business to adopt Circular Economy strategies.

### 4.1 Overview of the Circular Economy

#### 4.1.1 The Circular Economy

The concept of the Circular Economy has a range of interpretations but is generally considered quite encompassing of many old and new techniques and strategies to find ways of decoupling waste and environmental impacts from growth. Circular economy requires systemic changes, from micro to macro levels of the economy and society, with innovations in both nontechnical and technical respects. In this way the Circular Economy is an umbrella term or concept for a number of other synergistic and complementing ‘approaches, methods, and tools’ to fit under (Mendoza, Sharmina, Gallego-Schmid, Heyes, & Azapagic, 2017).

One of the most prominent actors in the Circular Economy field, The EllenMacArthur Foundation, defines a Circular Economy as “an industrial economy that is restorative or regenerative by intention and design” (EMF, 2013b). Accenture economists, Lacy and Rutqvist (2015), write that the Circular Economy concept allows the economy to ‘reimage waste’ and capture value currently lost. They outline 4 forms of waste that can be improved to capture additional value:

*Table 4 Four forms of wasted value in a linear economy*

1. <b>Wasted resources</b>	Materials and energy that are gone forever once used
2. <b>Wasted lifestyles of products</b>	Artificially short working lives
3. <b>Wasted capability of products</b>	Not being used effectively all the time
4. <b>Wasted embedded value</b>	Components, materials, and energy that could be recovered and put back to use

Leading management consultancy firm McKinsey argues that the ‘ultimate’ goal of the Circular Economy is to achieve huge material loops at the global level that would redirect large streams of high quality materials back into the system (Nguyen, Stuchtey, & Zils, 2014). This would be a highly efficient system where a minimum level of resources would be lost from the circulation and high-quality resources would be constantly cycled and upgraded into new products and technologies. This would arguably minimise the need to extract raw materials and lessen the level of waste polluting the natural environment.

McKinsey, argues that research points to potential savings on materials exceeding USD 1 trillion a year by 2025 and presents a great opportunity for driving global growth if implemented on a wide scale (Nguyen et al., 2014). The EllenMacArthur Foundation and McKinsey have made further claims of other possible massive economic benefits at an EU level such as resource productivity boosts generating cost savings of €600 billion annually and additional €1.8 trillion in related benefits (EllenMacArthur Foundation, 2015a).

#### 4.1.2 Influences

The Circular Economy concept and principles take a lot of inspiration from the natural world and its systems where waste products are fed back in cycles as ‘food’ for the system. The intent is to take the natural system of cycles that has found a balance of flows that keep the system

functioning in equilibrium and apply it to the resource flows in human systems. Many previous theories and concepts have built upon this idea of taking inspiration from natural systems and they led to the development of the circular economy concept.

**Natural capitalism** is a business model theory influenced by the belief that a major disruption point for the world economy will occur due to resource scarcity and the disruption of natural systems. It advocates for business to realise opportunities through increasing the productivity of natural resources in their processes; finding inspiration from nature for production models and materials; innovating towards service rather than sales models; and reinvesting in the protection and proliferation of the natural resources on which its business relies (Hawken, Lovins, & Lovins, 2001).

**Industrial ecology** reimagines the activity of industry being like how a natural ecosystem recycles its resources where all activity is integrated and cyclical. It centres on businesses budgeting and monitoring the flows and streams of inputs and outputs; materials, pollution and energy. From that point, business should innovate ways to improve the efficiency in industry factories and reduce the level of inputs needed through retaining and recycling materials and also reduce the level of outputs occurring (Graedel, 1996).

**The performance economy** imagines an economy of loops or cycles that provides societal-level benefit of job creation, competitiveness, resource efficiency and reduced waste. It envisions these through four goals; extending the life that products can be used, products that are kept for longer periods, reconditioning of products, and actively preventing waste. Here too is the idea promoted of transitioning to service business models from linear sales models (EllenMacArthur Foundation, n.d.a; Stahel, 2010).

**Cradle-to-cradle design** is a concept that divides material inputs into industrial processes - technical and biological. This division allows for circularity with the technical materials kept in a recycling loop to be reused in later manufacturing and biological materials being absorbed back into the natural biological system to be recycled – there is no cross-contamination of materials that renders them useless (See Figure 5) In this way, waste can be effectively eliminated as it is cycled endlessly in the industrial system. This should affect the design of products to make recapture of materials easier. Furthermore, the concept promotes the idea that products should be designed like trees – they have a positive impact on their surrounding not just zero impact or a negative impact (EllenMacArthur Foundation, n.d.b; McDonough & Braungart, 2009).

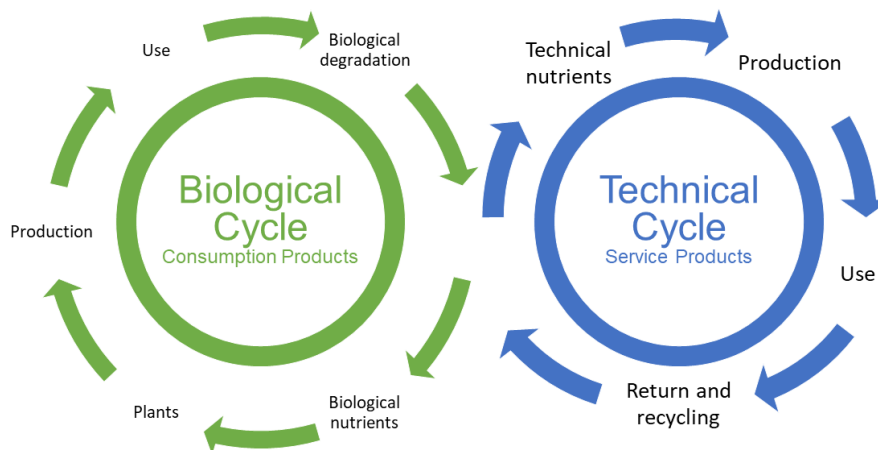


Figure 5 Cradle-to-cradle biological and technical cycles (Adapted from (McDonough & Braungart, 2009)



### Circular Economy principles & strategies

The EllenMacArthur Foundation argues the concept of the Circular Economy has 3 fundamental principles (EllenMacArthur Foundation, 2012) which they visualise in ‘the butterfly diagram’ (See Figure 6):

1. **Preserving and enhancing natural capital** by controlling finite stocks and balancing renewables resource flows
2. **Optimising resource yields** by circulating products, components, and materials at the highest utility and value always within technical and biological cycles
3. **Fostering system effectiveness** by revealing and designing out negative externalities.

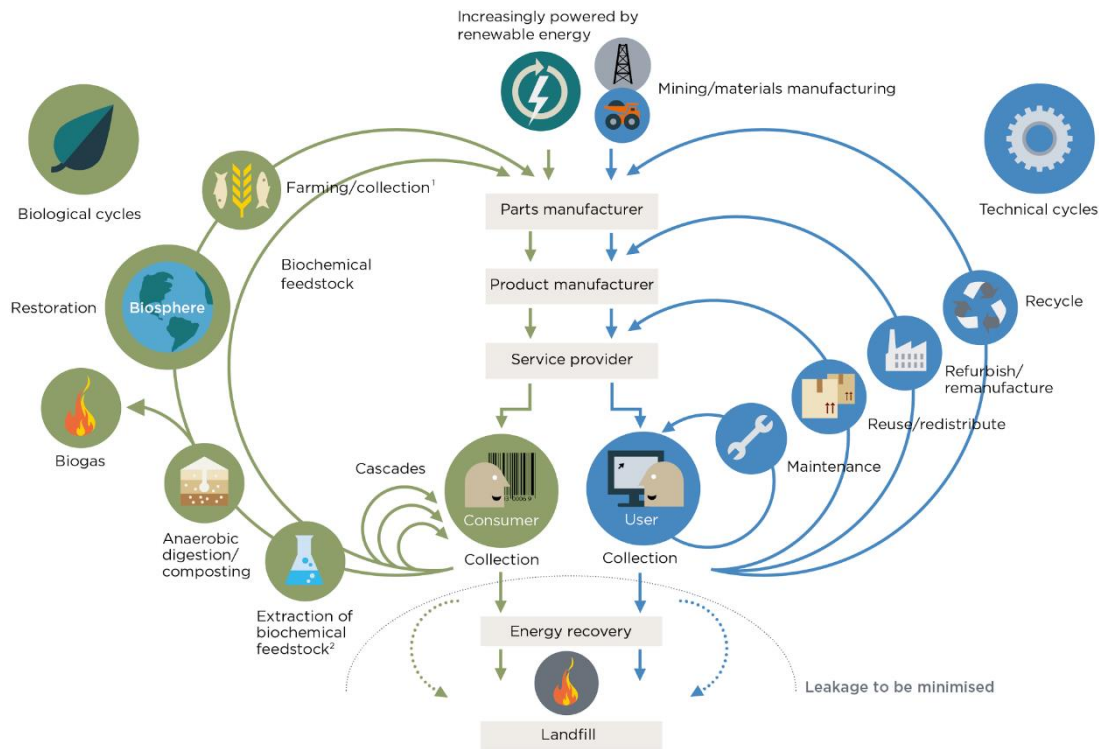


Figure 6 The butterfly diagram (Source: EllenMacArthur Foundation)

This diagram of circular systems builds upon the cradle-to-cradle concept (See Figure 5) to outline and detail a conceptual ideal of what a fully circular economic system would look like, helping to preserve and enhance natural capital, optimise resource yields, and fostering system effectiveness.

Work by Bocken, de Pauw, Bakker, & van der Grinten (2016) explores another way of visualising how the Circular Economy can aid the reduction of environmental impacts. If looking at the ‘flow’ of material through a system or economy, then to reduce it there are four approaches that can be taken: closing, slowing, extending and shrinking resource loops.

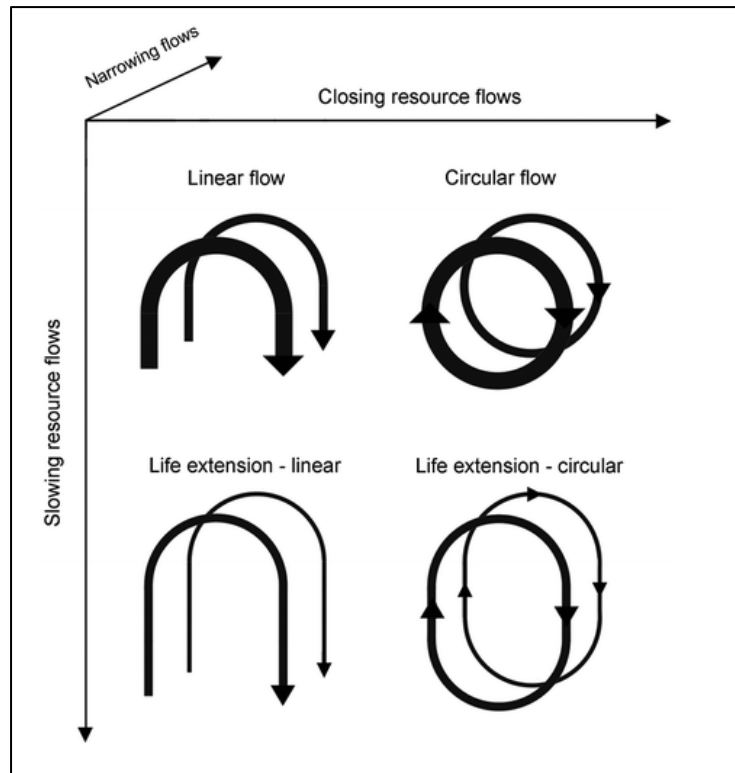


Figure 7 Closing, slowing, extending and shrinking resource loops (Source: (Bocken et al., 2016))

McKinsey lists 6 Circular Economy strategies that they argue could improve performance and reduce costs for 28 industries (EllenMacArthur Foundation, 2015a).

1. **Regenerate:** shifting to renewable energy and materials.
2. **Share:** promote sharing of products or prolonging product life spans through maintenance and design.
3. **Optimise:** improving product efficiency and removing waste from supply chains.
4. **Loop:** keeping components and materials in ‘closed loops’ through remanufacturing and recycling.
5. **Virtualise:** delivering goods and services virtually.
6. **Exchange:** Replacing old materials with advanced and renewable ones or applying new technologies such as 3D printing.

### 4.1.3 Circular Business Models

The above 6 CE strategies in turn influence circular business models. Circular business models are business models that apply and enable these CE strategies in a competitive economic setting. This is one of the most critical areas innovation in the shift to a Circular Economy. Circular business models are fundamental to creating more circularity within an economy by changing the basic aims and structures of how materials are used, waste is created and value is captured. Additionally, the models collected in literature so far show the promise of allowing the capture of additional financial value and offsetting of environmental impacts simultaneously (Bocken, Short, Rana, & Evans, 2014). Two of the most applicable CE business models are elaborated on below.

**The leasing** circular business model creates a shift from a consumer ‘owning’ and product to ‘leasing’ a product. This facilitates the creation of a loop back to the company where a business can now recover products (See Figure 6) so they can reuse products, parts and materials rather

than losing them and having to purchase new materials and manufacture new products (Nguyen et al., 2014). According to research by The EllenMacArthur Foundation, leasing business models could benefit both the customer and the manufacturer. They give an example of how high-end washing machines being leased cost less for the consumer per wash due to the costs being spread over more users per machine and less for the manufacturer having to produce less machines among more people (Nguyen et al., 2014)

**The remanufacturing** circular business model moves to take back used products and bring them back to the quality of a new part allowing savings on costs and materials. French car manufacturer Renault remanufactures parts for its cars allowing to capture higher operating margins and large environmental impact reductions over the production of new parts. They claim 80% energy savings, 90% less water and 70% less oil and detergent waste (Nguyen et al., 2014). This new business model has pushed Renault to alter the way it designs products now that new criteria for remanufacturing has been added. Effort is now made to make parts easier to disassemble and fix creating more efficiency and savings in the model.

Table 5 Business model innovations to slow and close resource loops (Adapted from (Bocken et al., 2016))

<b>Business model strategies</b>	<b>Definition</b>
#1 <i>Access and performance model</i>	Providing the capability or services to satisfy user needs without needing to own physical products
#2 <i>Extending product value</i>	Exploiting residual value of products – from manufacture, to consumers, and then back to manufacturing – or collection of products between distinct business entities
#3 <i>Classic long-life model</i>	Business models focused on delivering long-product life, supported by design for durability and repair for instance
#4 <i>Encourage sufficiency</i>	Solutions that actively seek to reduce end-user consumption through principles such as durability, upgradability, service, warranties and reparability and a non-consumerist approach to marketing and sales (e.g. no sales commissions)
#5 <i>Extending resource value</i>	Exploiting the residual value of resources: collection and sourcing of otherwise “wasted” materials or resources to turn these into new forms of value
#6 <i>Industrial symbiosis</i>	A process- orientated solution, concerned with using residual outputs from one process as feedstock for another process, which benefits from geographical proximity of businesses

## 4.2 General drivers in adopting Circular Economy strategies

The Circular Economy has been said to offer massive benefits globally and nationally in aggregate (EllenMacArthur Foundation, 2015a). To realise these benefits there is reliance on the transformation of activities in the private sector. In looking to understand what drivers and barriers might exist for the telecommunications industry in transitioning to CE strategies here is a literature review of what drivers and barriers have been identified for the private sector. Many of the drivers and barriers identified are generic in nature but should give an indicator of areas that could potentially be pertinent to the situation of telecommunication companies.

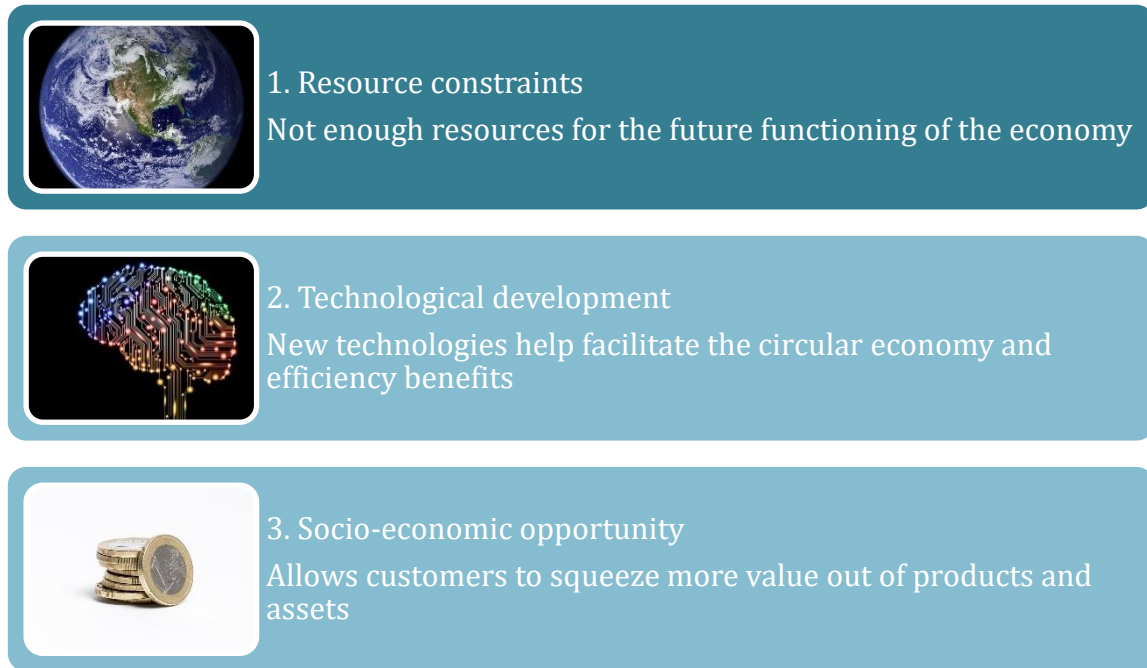


Figure 8 Primary drivers for business transition to Circular Economy strategies (Lacy & Rutqvist, 2015)

(Lacy & Rutqvist, 2015) list what they argue are the 3 main drivers for companies to implement Circular Economy strategies (See Figure 8) but The EllenMacArthur Foundation provides a much more granular set of drivers that are collected and elaborated on below.

#### 4.2.1 Economic losses and structural waste

With industry being highly wasteful in its value creation - only 5% of original raw material value is captured in the EU through energy recovery and recycling (EllenMacArthur Foundation, 2015b) - it means that there are significant levels of value leaking out from business. This value is either being lost or captured by other parties. Additionally, the existence of structural waste and product inefficiency causes similar leakages of value that could be converted in to profits. For example, EU cars are found to be parked 92% of time, while 31% of food wasted, and offices are used only 35-50% of the time (EllenMacArthur Foundation, 2015b).

#### 4.2.2 Material and resource risks

Resource supply risk and resource price risk are tied together. Fluctuations in these resource risks can slow economic growth due to increased uncertainty, and discourage business investment while increasing the cost of hedging against resource-related risks (EllenMacArthur Foundation, 2015b). They stem from a reliance on imports of raw materials. The EU has huge reliance on resource imports where it imports 6 times as much material as it exports (EllenMacArthur Foundation, 2015b). As supply chains grow more complex and globalise this increases supply chain risk regarding security and safety. Since supply of certain resources is contained to a small number geographic regions globally it increases risk of access to those materials. This can happen through natural disasters like the 2011 Great East Japan earthquake. This disrupted the supply chains of major global companies, especially car manufacturers and caused a 20% jump in price for random access memory (RAM) components due to disruption of silicon production, 60% of which is produced in Japan (Park, Hong, & Roh, 2013).

Additionally, there can be political concerns related to issues like China's monopoly on rare earth metals, which are of importance for high-tech products. In 2008-2013, China limited production and exports, and raised taxes on rare earth metals (Campbell, 2014). Another

example is when Japan accused China in 2010 of restricting exports due to the political conflict between their nations. This has caused stockpiling of the resources and speculation on their uncertain supply leading to rapid price increases in short time-frames (Campbell, 2014). Currently, Tungsten, 80% of which is produced in China, has seen a price increase of 50% in two months. This is a metal that is considered by the EU as a 'critical commodity' and in the U.K it sits at the top of a list of supply-risk materials needed to maintain the economy. The price rise is thought to be in response to a mix of tightening environmental standards in Chinese mines and production quotas (Biesheuval, 2017). There is research that the market is also undervaluing the scarcity of raw materials which could lead to very rapid prices shifts should it correct its prices (Henckens, van Ierland, Driessen, & Worrell, 2016). The trending shift to renewable technologies to keep to a 2C warming limit or lower as agreed upon in the Paris Climate Agreement 2015 could put pressure on scarce resources. Technologies such as battery storage, electric vehicles, solar installations, wind turbines have resulted in a massive growth in demand for certain metals, some of which are rare and critical metals. As metal demand goes up it could lead to increasing prices or new policy for recycling and circularity in order to improve the efficiency of the system and stop losses of limited materials (The World Bank, 2017).

Projecting supply and demand trends for resources into the future is highly difficult because of the complexity of what is going on globally between so many variables (World Economic Forum, 2014) but certain drivers and trends could be important to pay attention to such as growing IT, Asian and African consumers, and new technologies (McKinsey Global Institute, 2017).

### **4.2.3 Regulatory trends**

There is an increasing introduction of environmental-related regulation globally. In 2016, the Grantham Research Institute measured climate laws increasing to 854 up from 54 in 1997 and 426 in 2009 (Grantham Research Institute, 2016). Carbon pricing exists in some form in ~40 countries and 20+ cities, states and regions, and China plans on introducing it in 2017. This would mean ~50% GHGs produced would be in jurisdictions with carbon pricing (The World Bank & Ecofys, 2016). The European Union (EU) has 20 countries that have landfill taxes (European Environment Agency, 2012). More specific to CE, the European Commission (EC) view CE as a framework to achieve growth in recycling, saving valuable materials, lowering waste levels and environmental impacts, and reducing GHGs while creating jobs and aiding economic growth. The Circular Economy compliments the European 2020 green growth strategy of 'smart, sustainable, and inclusive growth' (European Commission, 2010). With an EU CE package introduced in November 2015, along with other regulations and directives that impact producers of e-waste like WEEE, RoHS, and ErP, there is significant policy development that could act as impetus for engaging with CE strategies (European Telecommunications Standards Institute, 2017).

### **4.2.4 Business trends**

More support and momentum is gaining traction in society and business for a transition to an economic model that does less damage to the environment. For example, there is the 'B lab' working on 'road to a new economy'; 'The B team' business elite working on 'ending business as usual'; and EMF's CE100 platform that brings together some of the most influential global businesses to 'accelerate a transition to a circular economy' (EllenMacArthur Foundation, 2015b).

#### **4.2.5 Technological advances**

New technologies in IT, ICT and industry can enable and facilitate circular economy business approaches and models that were not feasible before; collaboration and knowledge sharing; tracking of materials; forward and reverse logistics; increased renewable energy usage (EllenMacArthur Foundation, 2015b). One of the best examples of these technological steps forward is the IoT development taking place. The expanding use of IoT is allow for many new possibilities in how products and materials are tracked and monitored (EllenMacArthur Foundation, 2016).

#### **4.2.6 Acceptance of new business models**

A wider acceptance of service or leasing business models from traditional ownership business models means lower barriers to transitioning to new models. Due to new technologies allowing rental, performance-based and sharing models to proliferate and grow massively like Airbnb and Uber it has caused a greater awareness in new business model potential (EllenMacArthur Foundation, 2015b).

#### **4.2.7 Improved customer interaction and loyalty**

There are new forms of engaging and keeping relations with customers such as in the leasing circular business model where the number of ‘touch points’ with the customer increases and lengthens the period of the relationship. This extended interaction allows for the collection of more data and input to understand usage pattern insights giving feedback to improve products, improve service and increase customer satisfaction and retention (EllenMacArthur Foundation, 2015b). Take the example of Renault, in their remanufacturing model they help stay in closer contact with customers through the take-back procedure and in doing that can offer benefits to customers while creating closer ties (Nguyen et al., 2014).

#### **4.2.8 Urbanisation and population growth**

50% of the global population are now living in urban centres and this will continue to increase (United Nations, 2014). By 2050, the world economy is projected grow to four times its current size and the global population to burgeon to around 10 billion. These new populations with higher average incomes will demand more products and energy. Linking back into the previous theme of resource risks, this will put a strain on global resources (Wijkman & Skanberg, 2016). Also, due to these trends there will be opportunities as costs in reverse-logistics, collection and treatment of EoL products being cheaper due to population density, simplified logistics and scale for service providers (EllenMacArthur Foundation, 2015b).

#### **4.2.9 Innovation potential**

With the Circular Economy principles and rules new companies are forced to innovate in ways that might have been invisible earlier due to having different aims and values (Nguyen et al., 2014). There will be heightened focus and attention on improving materials, energy efficiency and new types of technological development to help aid and exploit Circular Economy strategies further leading to new profit opportunities (EllenMacArthur Foundation, 2015b). An example of the products that can come from adding in new CE principles is Nike’s Flyknit technology where they tried to innovate with resource productivity and customer value in mind. This led to a product with 80% less waste from more conventional Nike shoes and lighter, better fitting shoes (Lacy & Rutqvist, 2015).

## 4.3 Barriers in adopting Circular Economy strategies

### 4.3.1 Policy

Policy pushing for the measurement of recycling volume or weight can push business to meet legislation with constructing poor quality systems for meeting targets. Lack of quality policy stops the creation of systems that product quality material streams or help keep material in higher loops (techUK, 2015).

### 4.3.2 Geographic dispersion

The extensive and complex supply and manufacturing logistics already built into linear business models to minimise costs causes an issue with path dependency and how large and difficult a job it is to transition to something new (Nguyen et al., 2014).

### 4.3.3 Market prices of materials

Low market prices incentivise the purchasing of virgin materials and fuelling linear models (techUK, 2015).

### 4.3.4 Complex materials

New product formulations to get specific characteristics from material-mixes make it much more difficult to identify, organise and deal with new complex materials in a circular way (Nguyen et al., 2014).

### 4.3.5 Rapid innovation

Standardisation and working with constraints that CE might place on producers can hamper the process of rapidly innovating technology industries (techUK, 2015).

### 4.3.6 New business models

Transitioning to a new business model is a major move that could make or break a company. There is understandably fear with a transition and it cannot be done with just a 'leap of faith' (techUK, 2015).

### 4.3.7 Culture of status quo & behaviour change

The internal transition away from company habits and culture to new habits and strategies is very difficult. Additionally, there are incentives built up in the system that keep a culture supporting an old system like the desire to own rather than rent a product (Nguyen et al., 2014; techUK, 2015)

## 4.4 Drivers and barriers in circular business models

Research was conducted by (Mont, 2002) with a more specific focus of mapping drivers and barriers in product service system (PSS) circular business models. PSS models refer to the shift from selling a product linearly to providing a service or leasing the product. Even though the focus is on a specific business model there are plenty of overlaps with the more generic drivers listed above.

Table 6 Internal and external drivers and barriers for Swedish companies towards PSS business models (Source: (Mont, 2002))

<b>Drivers</b>	<b>Barriers</b>
<i>External</i>	<i>External</i>
Legislation	Lack of market demand
Competition	Lack of customer acceptance
New business opportunities	Acceptance of refurbished products and company image by association
Customer demand	Access to sensitive information of customers to provide solutions
Closer customer ties	Lack of care from customers not owning products
	Conflicts of interest in value chains
	High price of labour
<i>Internal</i>	<i>Internal</i>
Opportunity for savings and revenues	Reluctance to internalise use-related costs
Reduction of costs	Over-diversification of offers
Clearer cost structures	Uncertainty regarding the return of products
Top management commitment	Lack of change in the design of products
Reduction of risks and liabilities	Conflict of interest between different departments
Development of lower impact and higher quality products that are affordable	Internal competition



## 5 Results and analysis

This section will present the results of the data collected and its analysis. The empirical data, collected from ten semi-structured interviews and the focus group in the form of textual summaries, was analysed using a qualitative content analysis approach. Results of the qualitative content analysis were ordered into the modified PEST framework, described in Figure 4, accordingly and various thematic groupings emerged (See Table 7).

The thematic groupings in the modified PEST are then contrasted with the drivers and barriers that emerged from the literature review to see if the research results matched with literature findings or if new areas emerged.

Table 7 Modified PEST analysis findings

	<b>Drivers</b>	<b>Barriers</b>
<b>Policy &amp; operating environment</b>	Nudging policy	Regressive policy
<b>Economic &amp; financial</b>	Improved customer relations	Financial model change
	New business opportunities	Product cannibalisation
	Stopping value leakage and inefficiency	Product return issues
	Material risk reduction	
	Data consumption and energy costs	
<b>Socio-Cultural</b>	Societal trends	Brand risk
	Top management commitment	Company culture
<b>Technology &amp; process related</b>	n/a	System and operation change

### 5.1 Drivers

#### 5.1.1 Policy & operating environment

##### ***Nudging policy***

Similar to the findings in the literature review on regulatory trends (See 4.2.3) being a driver towards CE (EllenMacArthur Foundation, 2015b; Mont, 2002), one company (#5) expressed that policy was incentivising the telecommunications market to explore CE. They argued that policy helped nudge companies in the right direction and create industry communication on the matter especially in the case of dealing with waste. They felt that customers care so little about these issues that no one party will take it upon themselves to deal with so external intervention to create incentives is needed. (#8) agreed that in the shorter term the motivation seems to be from regulations for waste disposal. But this was only surface level changes, they were not optimistic about policy really incentivising a move to CE in the short to medium term.

#### 5.1.2 Economic & financial

##### ***Improved customer relations***

Company (#2) felt that a leasing model would keep customers closer to them and more loyal. This is confirming what the EMF mentioned as additional 'touch points' with CE business

models (See 4.2.7) (EllenMacArthur Foundation, 2015b) and what Mont (2002) observed in relation to external drivers towards PSS CE business models for Swedish companies. In the focus group, there were fears expressed about competitors starting to offer new leasing or refurbishing contracts that are more attractive to customers that would cost the company dearly in the market. They realise that there is a lot of business and benefits for customers in these new models. (#7) experimented with opening repair centres for mobile handsets and found it was financially profitable and upped the retention of customers. This led them to expand the repair programme to more cities.

### **New business opportunities**

Company (#6) stated that the near sole interest for the company in working with CE was new business opportunities. This was also found to be a driver in the literature review under *Innovation Potential* for new opportunities (See 4.2.9) and in Mont's (2002) findings. There is belief that there is large promise of new business and services through telecommunications and ICT technologies to help with CE enabling effects in other sectors of society. (#6) said the company is confident that CE enabling opportunities will be a very large area of growth in the future. This is pushing the company to want to transform away from the traditional operator business model.

### **Stopping value leakage and inefficiency**

Company (#1) mentioned finding 3<sup>rd</sup> party online sellers of their refurbished equipment and note that little action was currently done to ensure it is being taken back and made useful. Currently they are only recycling a small percentage of products that are taken back, under 10%, and there is no secondary reselling. This current situation allows customers and other stakeholders to grab residual value of end-of-life products. This was also found to be a driver in the literature review, *Economic Losses and Structural Waste* (See 4.2.1). Additionally, there was awareness in the company that old parts could be used as spares and reduce costs of new products but currently not doing so due to various barriers. Interviewee (#4) stated that the company is conducting lifecycle analyses on products to identify how to keep products functioning as long as possible and capturing the embedded value still left in them. They are aware of the additional value of keeping their hardware in higher loops and try to redeploy products and components in their own networks or resell internationally, only recycling them when no other avenue is profitable. (#4) felt confident that it was a cost positive model for the company. (#2) spoke of how CE awareness of inefficiency led them work on something small like minimising the packaging of products. This was one of the first financial payoffs for them and was very easy to affect. (#4) also brought up interest in future work on packaging minimisation to create financial savings.

Similarly, company (#2) views CE as holding major potential for new business opportunities. While not so oriented as an enabler of CE like (#6) they are interested developing a new CE service, or leasing of equipment, business model. They view this as a longer-term strategy but believe the payoff will be huge financially and are willing to invest in it. Others, like (#1), spoke more generally of pressure to change business model due to lowering profit margins because of market saturation, lack of growth options and competition in the telecommunication market. The old business model is under stress and making a transition to a model of service provider is more attractive where higher margins and growth is believed to exist. While this is spoken of as a more general move towards a services company and not specifically towards CE it does indicate that there is a potential entry point for CE business model renewal or innovation. Perhaps some interviewees like (#3) have yet to experience the market pinch or are focused on different tactics for weathering the market storms and this explains some of their doubt in CE.

Interviewee (#2) had an interesting insight into why the company is so supportive of pursuing a leasing model. They said that a leasing or subscription model was valued higher on the stock market than a linear model only selling products.

### **Material risk reduction**

Only one company (#5) mentioned that material risk was something the company was monitoring as an area of importance but that there were also varied opinions on this within the company. They said that it could be used to get ahead of competition and will be an area to benefit from for when material scarcity becomes a bigger deal. In the focus group session, one of the first points made was how the cost price of resources for the company is going up and should be considered more. It was noted that this point was made by a participant with a background expertise in sustainability and as such could be more revealing as a personal opinion than something representative of the company.

This small response to material risk reduction as a driver surprising as there is an abundance of literature and attention referring to material scarcity, due to environmental, policy, geopolitical risks and issues, from academia, government institutions and professional service companies (See 4.2.2). Most telecommunication companies interviewed (#2, #3, #4, #6, #7) did not see material scarcity or price risks as important. (#2) talked at more length on the subject and felt that the risk was overblown and expressed confidence that scarce materials would come out of the woodwork if prices rose. As for price risks, they felt safe since their products commanded such high value and they tended to use few rare-earth metals that material price hikes would have little bearing on final product prices. (#3) similarly felt that material risk is a low for them currently but could imagine in the longer term its importance rising. In saying that, they also feel confident that the company can adapt and switch quickly when a new trend occurs that causes more priority in material risks. (#7) said that being an operator and the numerous levels and tiers of abstraction from where materials are sourced when they just buy and operate products meant that material risk felt vague.

(#8) expressed that material risk reduction really should be a driver for telecommunication companies since current practices are so wasteful where electronic components use half of the elements on the period table and yet recycling rates of some of these scarce materials is very low, under 1%. (#8) argued that the reason companies were not taking on material risks as important is because they lack longer-term strategising and have short-term horizons. To bring material risks into the risk areas of telecommunication companies policy needs to be brought into place to give more economic incentive to innovate recapturing of materials. Additionally, like the resource efficiency strategy of 'narrowing' that Bocken et al. (2016) describes, see Figure 7, (#8) worries about the trend of integration negatively affecting CE since it is in the opposite direction to making product more circular by making materials harder to collect.

### **Data consumption and energy costs**

With data consumption exploding, (#6) said its primary focus is on working on the design of products and its networks to reduce energy use and associated costs. (#3) raised this point as a critique of CE saying it does not make environmental or financial sense for telecommunication companies to extend the life of older network hardware. They should be switching to newer more energy efficient models which the linear model offers. In the focus group, it was mentioned that a driver in energy efficiency in product design of network hardware was competitors working on efficiency that gave them a differentiator benefit for customers. This focus on efficiency seems to be at odds with other companies (#1 and #5) who talked about the benefits and interest in more reused hardware and extended life. While data consumption

and energy costs was not directly referred to in the literature review similar themes such as *Economic Losses and Structural Waste* (See 4.2.1) and reduction of costs as an internal driver by Mont (2002).

### **5.1.3 Socio-Cultural**

#### ***Societal trends***

(#2) mentioned that they feel more attention is being drawn to e-waste by powerful and influential actors. It is an additional benefit to them to claim positive status points and position themselves as helping improve the issue. On the other hand, (#7) experienced more of a negative outcome when they started working more generally on sustainability and experienced higher levels of scrutiny than before from NGOs. This is reflected in the literature under *Business Trends* (See 4.2.4).

#### ***Top management commitment***

One of the companies (#2) which seemed to demonstrate a large level of knowledge and depth on CE had a very committed CEO who decided that CE would play an integral role in the company. This drive of interest and confidence from the uppermost managerial levels has allowed the idea to permeate and legitimise within the whole company. There is a large belief that will be big payoff when they crack the code. An internal corporate champion comes across as a very powerful driver to affect change and overcome many of the barriers. This was not found to be driver in the general literature review on CE drivers and barriers possibly since top management commitment as a driver is quite generic. However, it did show up as a finding in Mont's (2002) work.

### **5.1.4 Technology & process related**

During the interviews and focus group nothing surfaced that fit into this section in contrast to technological advances (See 4.2.5) being listed as a driver in the literature review. This is a little perplexing since the potential of IoT and other technologies that are within the expertise sphere of telecommunication companies are so great (EllenMacArthur Foundation, 2016). But this could be down to these technologies been seen more a new business opportunities like (#6) mentioned in section 5.1.2.

## **5.2 Barriers**

### **5.2.1 Policy & operating environment**

#### ***Regressive policy***

Compared to policy being a driver, more companies (#2, #3, #4) were sceptical of the role that policy could play in supporting and developing CE strategies in the telecommunication industry. This was also captured in the literature review under *Policy* (See 4.3.1). (#4) said part of the company's motivation, even though they were not particularly worried about legislation, was the desire to avoid overregulation. They wanted to be proactive to reduce the possibility of government intervention and felt it would be cheaper for their business in the longer term rather than dragging their feet and dealing with red tape when it eventually materialises if nothing is done. One company (#2) referred explicitly to the Basel Convention on the shipping of transboundary waste and how it creates additional red tape for telecommunication companies. They said the convention added costs for ambitious CE companies making it much more difficult to deal with e-waste in a circular fashion in a cost-effective manner. Ultimately, they felt it pushed any companies involved with e-waste to scrap plans for CE and go for a more

simple and straightforward method with lower loops like scrapping and shredding materials. Additionally, they argued that policy like the Basel Convention did not stop companies that want to flout the law and instead it only held back and punished more ambitious companies. To incentivise more CE behaviour, they argued original equipment manufacturers (OEMs), such as telecommunication vendors, should be treated different and allowed more freedom to deal with their products how they see fit. They mentioned the idea of the creation of bonded warehouses and islands of certification that would be special zones outside of the regulation which would make it easier for the transboundary shipping of waste. They argued that this would not be used for trash but as new input and sent to areas where cheaper labour could improve margins and allow cost-effective CE innovation to occur. The margins on finding higher loops are small and regulation makes them shrink further pushing companies to just shred products and sell materials on to the commodity market.

Interviewee (#3) expressed dismay with the time it would likely take to develop CE policy and the risk that the policy could be regressive and suppress innovation. What they expressed as desirable from policymakers are simple, clear steps. They have found what currently exists, like the eco-design policy in the EU, vague and difficult to deal with. It should be made clear what to do through standards because they feel that currently policy is unclear and fuzzy. They gave the example of a clear aim being cost-effectiveness for companies like remanufacturing being low cost at 1/10<sup>th</sup> price of producing new product. Like this there will be more incentives and clearer pathways for companies. (#1) mentioned that there are policy barriers in some of their markets that could impede new circular business models such as the leasing of products. These were stipulations that operators needed to own hardware in certain countries and in turn would make takeback of products more difficult. While this could be an issue, it should not be a major one. There is a need to working closer with customers to find mutual benefits to win them over to trying new business models. This communication should allow routes around this problem will be found.

## **5.2.2 Economic & financial**

### ***Financial model change***

(#1) highlighted the fear internally of business models shifts to a leasing model due to changing the cash flow. There is a big shock moving from one large initial cash inflow to a model where there is a steady income through the service lifetime of the product. Spreading out the cost of the product and losing those large chunks of investment is very risky. This is captured in the literature review about the risks in *New Business Models* (See 4.3.6)

Additionally, (#1) expressed a worry about loss of 'net sales' in a switch to a new business model but also how a leasing model could lead to overall cashflow increase. Net sales of products might be a good key performance indicator (KPI) in a linear system but it can lead to skewed strategies for increasing cashflow, according to (#9). If the performance focus is wrong, then additional value could be missed out. New measurements needed are needed to communicate how to create more efficiency. Like (#4) said that this can happen quite fast once the new concept or aim 'clicks' with a business unit.

### ***Product cannibalisation***

There was fear expressed by (#1) that a switch to a more circular business model would cause cannibalisation of the primary product lines causing the company to lose revenue. In the focus group cannibalisation also surfaced as a worry but was countered with the view that it would only affect new customer segments that would never buy new products. These would be customers that only buy second hand like those buying refurbished equipment from 3<sup>rd</sup> parties

online. But this seems to be a problematic view as operators (#4, #5) seem interested in the extension of products lifetimes and reduced cost products rather than continued purchasing from primary product lines which would entail cannibalisation.

### **Product return issues**

A major barrier (#2) talked about was the difficulty of getting a product back once that became a priority for the company. Without changing business model and contract with the customer it became problematic to mandate product return due to anti-trust law. This means change had to happen with partners, but that was not so easy since they had to be educated and convinced of CE benefits for them and open to the changes they would have to undergo. This was captured in the internal barriers found by Mont (2002) in the literature review.

Secondary market brokers of network products who had built a business around capturing the residual value in telecommunication hardware by remanufacturing it were also impediments to increasing take-back levels of products. While these brokers were a barrier to the product return plans of (#2) it has been argued by (#9 and #10) that involving these 3<sup>rd</sup> parties could be a very good way of sharing the residual value with less risk and changes from OEMs. This 3<sup>rd</sup> parties could be a way of dipping OEMs' toes into the new model to get an idea of how it functions and the value. Then if the model proves successful the OEMs could buy them up and further integrate it into their operations. (#10), which has experience as a 3<sup>rd</sup> party remanufacturer, said that the barriers stopping companies remanufacturing was that they were deterred by the added complexity of setting up a take-back and remanufacturing operation, they would not have a decent enough size of products in each national market to make the operation worthwhile, and they would not be interested in taking competitors' products to remanufacture. With a 3<sup>rd</sup> party some of these barriers can be overcome as they get a higher number of products since they do not have issue with sourcing from multiple producers, they specialise in the logistics and remanufacturing taking that burden off OEMs, they pay a higher margin on used products compared to what OEMs can get from selling on to recyclers. This is like what was mentioned by expert (#10) about how the expertise, logistics and access to labour is not cost-effective when it is just one OEM. Additionally, expert (#9) agreed with this point, arguing that 3<sup>rd</sup> parties could find these 'points of friction' and provide and capture value within them where other companies cannot. (#10 and #9) had ideas of how this might be overcome by using a non-industry challenging platform that sits in the middle of the OEMs and thus can deal with higher loads of products from multiple manufacturers making the operation more worthwhile. Partnerships with OEMs can function too so some of the original lost value can be captured. This would have to be above what could be obtained from shredding and selling the materials.

In the focus group, there was attention raised to additional accountability for client's data security where they would have offer some sort of guarantee of security if they were taking products back. This seems like it could an easy barrier to overcome and could even be provided as a service somehow since the market has noted that there is a desire for increased security of networks (Surdak, n.d.). There was also the fear of putting attention and money into innovating in design and not having the ability or system in place to get products back and benefit from the additional value put into the design. There was fear that OEMs would be creating benefit for some other party making it easier for other parties to capture the value of the materials or ease of remanufacturing. It was also mentioned that due to the long life of a product, ~7 years, design was not seen as such a priority. (#2) talked about how redesign of products to be more circular, like making them easier to disassemble was a longer-term issue. Firstly, product engineers had other priorities since this was not of interest for customers. Engineers had to spend their time wisely to innovate in other important areas.

### 5.2.3 Socio-Cultural

#### **Brand risk**

Like the driver that was picked up in the literature review by Mont's (2002) work, (#3) expressed worries about the reliability of reused products and how this could harm the image of the company. On the other hand, (#2) felt motivated that more control over their own products to keep the quality of their products up and protect their brand rather than letting them be remanufactured or refurbished and sold on the market by a 3<sup>rd</sup> party. They felt the association of their name would also give confidence to customers that even though this was a remanufactured product they would have a quality reliable product.

#### **Company culture**

What was made apparent during the interviews and focus group was that company culture played a significant role in how committed to CE a company was. In the literature review this was captured also as *Culture of Status Quo and Behaviour Change* (See 4.3.7). (#6) felt a major barrier was the business' attitude of 'doing things the same way' which made it hard to experiment with new activities such as CE. They argued that there was a need for more courage to see if there are business opportunities. Others expressed huge doubt over the concept (#3) and argued that competition were blowing the benefits out of proportion. (#3) explicitly mentions that they have a very conservative culture. They are just cautiously monitoring CE but they want to stick with linear model because it is what currently works and is profitable. This conservative corporate culture aspect could be a reason behind the high doubts expressed but also likely is the fact that they are in a comfortable position in the market and feel little incentive to risk transitioning away from their business model. On the other hand, they did show some attention to CE when trailblazing and inspirational companies like Apple explore the concept publicly, with statements about want to cycle all materials in their products and stop purchasing virgin materials. Doubt was still expressed due to how both companies differed but might tell how industry leaders can change the reputation of a concept and bring it to mainstream legitimacy. In the complete reverse of the experience in company (#2) with their corporate champion of CE, the focus group expressed how higher management is stopping CE from being worked with. The culture is to only sell new things and there is a problem with arrogance stemming from a fear of change, fear of competitors and fear of failing. They argued that there was not a communication problem and message about the possible benefits of CE is fine – they have 2 years of research done on this topic and have presented many positive arguments backed up with data internally - but it is falling on deaf ears in upper management levels. They want to do a small-scale project to show that it could be successful and scale it up.

(#5) talked about how marketing and education internally are necessary to win over support for CE. Good arguments were needed to convince people and a portfolio of arguments split between business benefits, material scarcity and doing the right thing for the environment. (#7) raised the insight that new ideas about sustainability clash with departmental goals which brings back the problem with KPIs giving bad aims for teams. When there are positive outcomes, like with the repair shop activities from (#7), it helps change sceptical minds. The idea to start with some of the guaranteed low-hanging fruit and make sure it is communicated well to the business minds is a good start. The message is more likely to go up through the management hierarchy to spread awareness that sustainability and circular economy can have desired effects for profitability such as the case with redesign of packaging (#2 and #4).

(#4) also talked about how now CE practices are run by the business units. The sustainability department just backs them up with support, helping coordinate and maximising impact. This new reorientation and 'owning' of the CE strategies by regular departments led them run it

effectively. (#4) found the only difficulty was in getting departments to grasp the 'new' ideas and benchmarks. After that benefits were understood quite quickly and once they were observed then business units took it more seriously and managed the new processes effectively.

This gives optimism in that there could be low tipping points and clear strategies developed for winning over companies to really engage in CE strategies seriously. By starting off slow and steady with clear steps, like using 'road mapping' tools, and not jumping in the deep end significant change could happen relatively quickly (Bocken, Short, Rana, & Evans, 2013). Another strategy, according to the focus group, was targeting allies in younger co-workers who grasp the concept of CE faster. In the focus group, they expressed confidence in the tools that they have internally and feel like CE once taken seriously is something that could be innovated and rolled-out quite quickly. This reinforces insights by (#9) that argued that many companies see certain barriers to CE and feel that they do not have the right tools internally to solve them, but in fact CE is just a problem like any other business problem that requires all the same tools and talents that can be found internally. Expert (#8) argued that the subject of CE being very academic is a big barrier to it not permeating more widely into business. The message is hard to understand for companies and the private sector.

## **5.2.4 Technology & process related**

### ***System and operation change***

(#2), mentioned how the integration of circular loops is quite complex and requires major systems engineering. It means the reimagining of the structures, functions and roles, internal communication and re-education of employees. They also expressed anxiety over how overhead costs tied to trading-in products could balloon and reduce the value they could capture. To combat this, they are working with service providers to reduce complexity of the process and introducing digital applications and platforms to make the process more seamless. With advances in technology they stated that tracking and monitoring of products would also make the process easier. Here there is a synergy with IoT developments in the telecommunications sectors as what needs to be developed internally could lead to new CE enabling opportunities externally. This is partially covered in the literature review under geographic dispersion (See 4.3.2) but it does not fully capture the total systems complexity element that was being described through interviews. Additionally, the driver found in literature for technology advances (See 4.2.5) provides a counterpoint to this barrier since it expresses how this barrier should be shrinking over time as technology helps decrease the challenge. (#9) talked about how there are so many ways of measuring in the linear business system through algorithms and stats. This is not the case for CE and must be innovated which is a barrier but also potentially an opportunity to be part of the vanguard to develop new tools and methods.

(#4) also talked about how cracking these logistical complexities could pay off. They gave the example of warehousing expense and how awareness of more effective management of products and tracking along with reusing can save money on purchasing plus decrease space needed to store parts. In their experience, the new logistics such as finding and tracking where they can redeploy effectively in the network is tough. The initial change is especially complex requiring changes in processes and internal thinking. (#6) mentioned how due to mergers and acquisitions globally, which is common in the operator sphere currently (EY, 2015), there are very different stages of maturity regarding environmental development in different countries and this takes time to try to harmonise. (#7) also mentioned organisational complexity as a barrier to overcome as new parts of the company must be in contact and involved with one another if CE strategies are to work. They stressed a lot more coordination between departments is important and a need for clarity on who is taking the lead on the activity. During



interviews, it was observed that there was ‘silo thinking’ issues causing bad communication between departments and slowing down CE development and communication. In the focus group, they stressed the importance of creating seamless integration between company systems in sales and supply chain to have effective impacts. This would be essential for integrating many CE strategies for systemisation of feedback parameters to influence the design of products, manage large change management between sales, supply and IT to track and manage products efficiently in a leasing model. They confirmed that inefficient tracking of products leads to leakages, slows down business, and material degradation. This leads to a situation where 90%+ of products are unaccounted for at EoL.

## 6 Discussion

This section will aim to answer the RQs and sub-RQs from Section 1.2. The order of discussion will be as following:

*6.1 & 6.2 What potential value do telecommunication vendors and operators anticipate could be captured with CE strategies that is being missed in current linear business models?*

*6.3 What risks exist for telecommunication vendors and operators in transitioning to CE strategies?*

*6.4 What barriers and drivers are most significant for telecommunication vendors and operators for the adoption of circular economy principles into their business?*

### 6.1 Drivers to CE for telecommunication vendors and operators

#### 6.1.1 Material risk not a factor

At odds with literature and expert opinion that argue megatrends, such as growing populations, growing affluence and growing industry sectors, will demand many scarce materials and thus affect access and price to those materials, telecommunication companies seemed largely unphased. In the case of operators, this lack of awareness of material risk could be due to the distance they are from the supply chain of materials that their products are fabricated from. Vendors, on the other hand, who are dealing more directly with material suppliers, seem confident that material risk will not pose a threat. They believe more materials will emerge as prices rise or in the case that it does become a problem they can pivot around the problem.

While currently material risk for the telecommunication industry is a low priority, that could change with a shock to prices or access. The negative the environmental effects of material use and its finite nature in the linear business as usual trajectory is projected to have large consequences. With the UN estimating huge future increase of resources globally if there is no intervention (Schaffartzik et al., 2014; UNEP, 2011) then there is likely to be change, in the form of policy interventions or market readjustment, at some point in order to reduce externalities or reflect awareness of scarcity. Even so, it would be wise for companies to be aware of trends and scenarios where this risk could change helping prepare for such a situation of material risk. It is likely that external motivation will be necessary for telecommunication companies to take more notice of this area.

#### 6.1.2 Telecommunication market competition and disruption

This driver is quite generic but demonstrates that when the competition is tough companies are open to find other avenues to stay afloat and give them a more optimistic future. There is an abundance of forces that are currently making life for telecommunication companies very difficult like industry disruptors, lowered margins, issues rolling out networks and a loss of customers (Morris, 2017a, 2017b; Surdak et al., n.d.; Technology Business Research, 2017). El-Darwiche et al. (2017) thinks that telecom operators need to shift to new business models to stay competitive in the market and that tightened spending will harm vendors. From the research, it seems that CE strategies are indeed one way that telecommunication companies are exploring potential to make themselves more competitive. There is believed to be potential in the CE strategies for finding ways to reduce inefficiencies and waste and capture more value, to retain customers who are leaving, increase margins by making operations more efficient and reducing value lost, and looking for new operations to exit market areas of high competition.

### **6.1.3 Inspiration and leadership**

From interview findings, it seems clear that increased interest in CE strategies is coming from more general awareness and exposure in society and business circles about its potential. While the more cautious and conservative of the companies might not be convinced of the potential in CE there is signs of thawing of that view to a certain extent when highly esteemed companies, such as Apple, start advertising their efforts to move towards circularity. This influence is likely due to the fact Apple is a company that works with in the sphere of ICT and are known for making reasoned and intelligent business moves. The power of an industry giant projecting interest in CE can lead others to warm to the idea and commit more energy to exploring its possibilities. Additionally, other telecommunication companies found inspiration from start-up companies who are working with the idea. There is potential in start-ups, due to lower complexity, more flexibility and experimentation, as well as low employee hierarchies, to play with some of the CE strategies. This is a good avenue for more mature companies to learn from and get insight into tangible benefits that CE can offer.

Others telecommunication companies that have more confidence about the potential of CE can face different barriers that stem from an embedded corporate culture that restricts greater experimentation and implementation of CE. In this case, it is important to find internal champions that can steer help steer and motivate the company towards the new commitments. There needs to be effort to craft strong multilevel arguments for the case of CE and targeting colleagues that are more open to new ideas. Once there are some mid- and upper-level contacts committed it should be enough to start further concrete steps. In some cases, this runs a lot more smoothly when the uppermost management levels become convinced that CE is a worthwhile endeavour, as in the case of one of the interviewee companies. This facilitates a longer-term vision and clarity bringing wider involvement and more rapid breakthroughs. A great example of this is Unilever CEO Paul Polman who has been a trailblazer for shifting a major company towards CE strategies. A reluctant culture for experimentation and avoidance of risk could blinker a company to potential opportunities, especially in the face of various market risks. Path dependency, institutionalisation and fear of making mistakes should be fought against and internal research pointing to promising business opportunities should be received and not squandered.

## **6.2 Barriers to CE for telecommunication vendors and operators**

### **6.2.1 Policy as a barrier**

The CE concept is only receiving more widespread recognition in recent years. It requires the rethinking of systems at many different levels, from the individual consumer to the globalised world. Perhaps current legislation is not adequate, as various respondents mentioned. It is logical that when large complex companies need to change their systems that they will find external systems unfit for the integration of the new business system. For CE to flourish some current policy might be antiquated. While such policy might create certain positive impacts it might also be doing damage by stopping a better option taking its place. From interviews, it seems that for CE to prosper there needs to be an evolution for how companies can experiment with how to deal with taking care of their products and keep them in higher loops. With low margins, red tape for shipping waste around and the costs of labour for keeping products in higher loops can disincentivise a shift to CE strategies.

While there was acknowledgement that policy could be useful in nudging telecommunication companies towards CE. This might only be effective at a superficial level, with more ambitious and complex business changes requiring different policies. The right balance needs to be hit where policy motivates and does not hold back innovative companies. The worry would be that

slow policy development could diminish the enthusiasm of CE supportive companies and miss riding a wave that could push support for the concept. Furthermore, other companies want clear and objective policies that act as a clear guide to what they need to implement. While fuzzy and vague can work for certain companies that want to innovate their own strategies and need the flexibility to experiment others find that the opaque nature of certain CE-related policy just confuses them and adds overhead costs. It would be wise for policy-makers to integrate more awareness of promising concepts like CE and look at how other policy might clash with it, like the Basel convention. Working closer with ambitious CE companies and NGOs to inform policy direction could make it easier to set standards and create clearer steps for the telecommunication industry and increase uptake and support.

### **6.2.2 System change and complexity**

For CE strategies to be embedded in telecommunication there will need to be steps taken to reconfigure the industrial system that has been built up which will necessarily lead to large levels of new complexity for the company. This complexity includes tracking and monitoring of products and materials, new roles, education and awareness training, and working with the value-chain. That requires huge investment and thinking at the beginning of a transition to CE. For more major and transformative shifts, like in the company's business model, KPIs will need to be reimagined and goals to be changed. For most employees, something transformational will mean their jobs will be impacted in some shape or form. This could make it harder for employees accustomed to their old roles to switch and mean possibly a period of adoption where there would be growing pains for the business. Partial or sequential steps to work out the kinks of new complex operations or models would be a way of gaining experience to make rollout to other sections more seamless. There was an optimistic response from one of the interviews that the experience so far was that while difficult at the start it quickly gets easier once the business team grasps the potential and new valuation methods.

Complexity problems in telecommunication businesses are persistent in current business models anyway. Business efficiency and organisational agility are listed as high level challenges by leading telecommunication operators (EY, 2015). With these as priority areas, needing attention and investment to solve, it makes sense to roll these challenges into one and it easier to incorporate some CE strategy. Investing in and building the competencies needed to deal with organisational complexity in an efficient manner would likely lead to further positive knock-on effects. These would include developing the skills and expertise in how to exploit new business opportunities for offering services or developing new products that would require clients to work with CE complexity change, like in monitoring and tracking products.

## **6.3 Potential value capture with CE strategies for telecommunication vendors and operators**

Harsh competition is a big driver for telecommunication companies to find an edge on improving their current business models with alterations and searching for new business opportunities to diversify operations.

### **6.3.1 Improving value capture in current operations**

Respondent telecommunication companies felt improving the value capture of current operations could be achieved through changing from a linear business model to a leasing or service model to keep products within the company, rather than losing them to other companies to sell on the market refurbished. This new model could allow for savings through keeping products at higher loops and squeezing additional value from each product while offering benefits like retaining customers. Additionally, it was found that extra value created would come in the form of higher stock market valuation for a company using a leasing or service model.

This could be market awareness of the various superior benefits that a service model can provide over a sales model. While there were worries expressed about the need to work with customers to reduce reluctance to adopt a new model it has been dealt with in companies like Caterpillar before. To reduce customer risk, Caterpillar would offer warranties of the same length as in the sales model. This would give a large level of confidence to a customer that might be sceptical of a new business model that they would be taking on little risk (Lacy & Rutqvist, 2015).

In a leasing model that extends the life of telecommunication products there could be drawbacks in an industry that innovates rapidly. There were some responses that seemed to contradict one another over the choice between valuing the energy efficiency of networks or longer life network equipment. While both aims have arguments for benefits in terms of financial and environmental savings it would need to be considered further to provide a clearer picture of why this gap exists in responses. It would be interesting to look deeper into the product technologies that tend to provide the largest efficiency savings in telecommunication equipment and see if perhaps there is some middle ground to be found. This would imagine the upgrading of certain components as they innovate, helping the energy efficiency of a product, and leaving other components that do not upgrade as fast. In this case of remanufacturing there would be material savings through keeping products in higher loops while aiding the energy efficiency of a product.

### **6.3.2 Value capture in new business opportunities**

Outside of improving the value capture of current telecommunication operations there is awareness of the new opportunities that lie in CE through enabling others to capture more value or increase efficiency. It seems like a wise choice to follow since telecommunication companies have lots of the tools and expertise to build and monitor products and services that communicate and improve efficiency and could innovate upon that knowledge. This point reflects what others such as McKinsey, Accenture and EMF have pointed out about wider trends towards using new technology and services for efficiencies (EllenMacArthur Foundation, 2016; Lacy & Rutqvist, 2015; McKinsey Global Institute, 2017). While there is awareness of the new opportunity potential for telecommunication industry working on offering CE services, telecommunication companies need to get their house in order by finding more internal commitment and support to properly exploit these emerging business areas.

## **6.4 Potential risks with CE strategies for telecommunication vendors and operators**

### **6.4.1 Business model change risks**

As for potential risks moving to CE strategies for telecommunication companies, these came principally in regards the move from a linear business model to a circular business model. There was worry about the risks of new financial flows and how traditional product lines could be harmed by cannibalisation. This will need to be explored, modelled and measured more by companies to more adequately weight up the benefits and how it would affect the company, require changes to the structure. But in times where there is a lot of disruption and competition it would seem wise to explore promising avenues such as these to find ways to minimise costs, keep customers, and develop new competencies and business opportunities.

While there could be initial adjusting issues to a change in cashflow a leasing model could also be viewed as more attractive to customers since they don't need to fork out huge amounts of cash when making purchases, making it less of a grand investment. This could make new equipment rollouts, like 5G, more attractive to operators who are experiencing shrinking

margins and worrying about how to finance expensive rollouts while customers demand higher quality networks (EY, 2015; Nolle, 2017; Wigginton, 2017).

It seems possible that cannibalisation could happen in the shorter term, especially with the interest expressed by operators in longer life network equipment. But with a total shift to a leasing model this would be less of an issue as KPI should no longer be the numbers of new products sold. Leasing models that can keep products in higher loops and extend product lifetimes could potentially lead to higher cash flow while reducing new products sold. Even in a transition to a new model cannibalisation worries might be overblown. Caterpillar, the equipment manufacturing company that employs remanufacturing, found that it did not experience much cannibalisation when it switched models. This was because it was found that it allowed new types of customers to purchase equipment that normally would not have bought new. Interestingly, even if there was some cannibalisation, the product margins on these products were higher than new ones (Lacy & Rutqvist, 2015).

### **6.4.2 Brand risk**

Another potential risk for companies in switching to a CE business model that kept equipment in higher loops was the fear that the reputation or brand of a company would be associated with lower quality and lose value. This seems to be a misaligned view. This could be partially due to the fact a linear model is still functioning so well up until recently and there has been little need to explore anything outside of that model. But it would seem to be an outdated view as there has been interest expressed by operators who just have an interest in the equipment working and being cheaper. Some companies are grasping that faster than others and see that in acting on controlling the refurbishment and remanufacturing of their products going on the market they can be more confident in its quality and in turn protect their brand from 3<sup>rd</sup> party manufacturers that might sell sub-quality products that are still associated with the OEM.

## **7 Advice, further research, and reflections**

### **7.1 Advice for telecommunication vendors and operators**

Advice for telecommunication companies on a path to CE will be given below. This will be different for companies since they are all at different stages of development of the CE concept and face varying problems.

- Join a CE platform, like EMF's CE100, and meet with other telecommunication and IT companies to learn from their experience of overcoming barriers and capturing maximum value. In addition, it will help by providing a space to find motivated customers and suppliers to engage together.
- Start small projects in appropriate markets to test the CE ideas, get data, work out software and logistics, new roles and KPIs. Relatively low commitment and investment will keep risk low and potential to accumulate knowledge and convincing data if successful to roll-out on larger scales.
- Engage internally in multidisciplinary CE value mapping exercises with tools such as the Value Mapping Tool by Bocken et al. (2015) to develop greater insights on potential opportunities and barriers from various departments and roles.
- Work on breaking out of internal information silos and improve internal communication between departments. This is especially important for departments that would need to be heavily incorporated into CE strategies if adopted like supply chain, IT, sales, and product design.
- Talk within the value chain about win-win scenarios to be gained from CE strategies to work with partners and pool resources to solve problems such as product return issues.
- Work with NGOs and platforms aligned with e-waste and CE to start improving communication and awareness of the difficulties that maligned policy poses to telecommunication companies to start creating momentum. This will provide additional input and avenues to help solve policy problems.
- Look at activities that are key to finding efficiencies and solving new complexities that CE strategies will produce. For example, Google uses machine learning to find the best efficiencies for its data centres in choosing when to remanufacture, what components are needed and already accessible in inventories, and when to recycle (Rana & Brandt, 2016).
- Build up new skills in areas associated with CE, like material science, reverse logistics and treatment methods, and start finding them inside the company and incorporate these people in dialogue.

### **7.2 Further areas of research**

In carrying out the thesis further areas of research emerged as potential areas deserving of more attention:

Exploring and clarifying how policy, like the Basel convention, might be constructed in a way that impedes transition for companies towards CE adoption and ways in which alterations could be made or policy updated to better incorporate new evolving CE strategies.

Identifying how and why a CE leasing or service model is valued more on the stock market. Does this affect the attractiveness of adoption and risks that are entailed, and are telecommunication companies generally aware of this?

More granular and quantitative research on financial and environmental impacts of CE strategies that are currently taken by telecommunication companies would be of interest to see in greater detail the effects and how approaches and strategies differ among companies.

A deeper consideration and clarification of if new networks and resulting energy savings or keeping old networks is more profitable and enticing for telecommunication companies.

### **7.3 Reflections on the research and methodology**

Reflecting on the research and methodology there are various insights that became apparent through the process of carrying out the writing of the paper.

There should have made more effort made to divide up and distinguish the differences between vendors and operators and mapping what differs in their drivers and barriers toward CE strategies. Also, there should have made more effort to delve into the differences between internal and external drivers and barriers. In addition to this, more effort to distinguish between circular strategies and circular business models when interviewing telecommunication companies could have led to deeper insights. These three points together if implemented could have significantly increased the clarity and focus points of the research carried out and analysis made.

With more time, a greater depth of literature review would have improved the formation of questions for interviews and analysis of findings which in turn would have added more insights to results. In addition to this, further depth and new questions answered through doing a second round of interviews with telecommunication companies. More time for the focus group would have been beneficial as 1.5 hours limited how far the topic could be engaged with. Additionally, in the focus group session all attendees had experience in CE. The attendance of more varied employee backgrounds to the focus group would have improved findings by acquiring more critical results that reflect additional functions in telecommunication companies. Finally, more focused attention in interviews into how telecommunication companies defined or interpreted the concept of CE to encompass would have added clarity as differing comprehension of the concept would have implications for interpreting results and analysis.



## **8 Conclusion**

The aim to map the drivers and barriers for the adoption of Circular Economy was due to the potential that Circular Economy strategies hold to reduce environmental impacts from energy use and resource use. These could be achieved by shifting to new models of value creation in businesses that use less materials and draw attention to value leakage and inefficiency in activities and product design. In the highly competitive, rapidly innovating and growing telecommunication industry it makes for an interesting study to explore how Circular Economy strategies are being used.

A research question and two sub-questions were to guide the identification of drivers and barriers for the adoption of Circular Economy strategies in telecommunication companies. A literature review was performed to inform the research and data was collected from seven interviews with the telecommunication industry, three Circular Economy experts, and one focus group session with 8 participants. Data was analysed through a qualitative content analysis in a modified PEST framework. Through these steps the main drivers found in the telecommunication industry were policy, improved customer relations, new business opportunities, stopping value leakage and inefficiency, data and energy consumption trend; societal trends; and top management commitment. The primary barriers of Circular Economy adoption were: regressive policy; financial model change; product cannibalisation; product return issues; brand risk; company culture; and system and operation change.

From the research findings, it seems there is a reasonably broad spectrum within vendors and operators in the telecommunications market regarding Circular Economy strategies. There are some whose hearts are behind it, and others who have large doubts about the efficacy of strategies both financially and environmentally. But most fall somewhere in between and closer to the interested side. The mix of companies interviewed meant there were very large vendors and operators, along with some smaller voices, shaping how Circular Economy was perceived and experienced in the industry. Overall, one of the biggest take away is that it seems that most companies probably have the required tools internally to overcome most of the identified barriers and risks and as such the most important initial steps to take the concept further would be a shift in company culture mindset. Steps to improve the cultural mindset to further commit to Circular Economy strategies could happen through gathering more support internally for the opportunities the Circular Economy holds and experimentation on a small scale to provide proof of potential. This could happen naturally in time with more attention on the Circular Economy and the influence of big influential industry players showcasing how it has benefitted them through platforms like the CE100. The development of more intelligent and clear policy formed through working with trailblazing companies on the Circular Economy should also help to expediate the adoption of Circular Economy strategies in the telecommunication industry.

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# Appendix 1

## Interview Guide

### Circular Economy Transition - Telecommunications

**Current level:** What is the company doing currently with CE?

*Sub-questions:*

Where did the company learn about CE initially? What parts of the company are dedicated to it?

Has the company found it a good or successful exercise? Are there different opinions on the inside, some supportive and others sceptical?

**Motivations:** What were the motivations or incentives behind pursuing CE?

*Sub-questions:*

Was the company initially supportive of it? What made it supportive or not supportive? Were there any big triggers for support?

How did the company measure or analyse whether CE was a worthwhile endeavour?

Are investors and shareholders an influence? Were they supportive or apprehensive of transition to CE? How were they convinced?

Was it done for competitive advantage? Is not using CE seen as being a potential area of disruption to the company from competitors?

What raw materials are most important to the company? Is the price fluctuation and availability of these materials an influence for CE?

Were there other stakeholders/reasons that had an impact on motivation to work with CE?

**Changes:** What changes were required by the company to incorporate CE?

*Sub-questions:*

Were there changes to the business model? The design of the product? How the company conducts decisions? Stakeholders worked with? More functions of the company involved in the process? Etc.

Has the company explored new circular business models?

Does the size of the company or the type or the product etc. make it easier or harder to adopt CE principles?

**Barriers:** What barriers were found that made transitioning to CE difficult?

*Sub-questions:*

Were there internal barriers?

Were there external barriers? Is there legislation that affects current business models and makes CE more attractive?

What was the hardest part of transitioning? What would be done differently if done again? What was most useful to transitioning (contacts, influences, tools, etc.)?

**Outcomes:** What outcomes, positive and negative, were experienced with the transition to CE?

*Sub-questions:*

What were the positive outcomes? Were there beneficial outcomes that were not anticipated? Where did they create value and for whom?

Were there any negative outcomes? Any that weren't anticipated? Did some stakeholders lose out? Could these problems have been avoided?

Are there conflicts and trade-offs? Creation of positives and negatives for some stakeholders? How were these problems solved? How were risk takers compensated in the transition? Did the company collaborate with stakeholders when transitioning?

Has CE helped frame new areas of innovation for the company? Does it have knock on effects of showing new environmental sustainability uses or new areas for expansion of services and products?

Is it desirable to collaborate with other companies/competitors or better to keep CE internal?

**Future:** Is there interest or future plans to go further with CE?

*Sub-questions:*

Has working with CE helped identify new opportunities and risks for short, medium and long term? Are they different than current risks/motivations? How hard/easy is it to project into the future?

Are there future plans to go further with CE?

Why is CE not being adopted and explored more widely in businesses similar to this company?

**Final:**

Are there any external contacts that I could be connected with? Other sustainability experts in ICT/IT companies working on CE?