

The barriers of circular public procurement for ICTs

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The barriers of circular public procurement for ICTs

A circular matter of life and waste

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Abstract

The EU procured for roughly 202000 MEUR (14% of the EU GDP) during 2021 in the public sector. The majority of these contracts are traditional, linear business model purchases. The EU has been developing several strategies, guidelines, and policies for sustainable purchasing, with Circular Public Procurement for a Circular Economy (CE) being one of them, but the implementation rate is low. Electronic and Electrical Equipment (EEE) is one of the fastest growing and evolving technological areas with a low retention rate, meaning that the products are often discarded before the life cycle is up, shortening the product lifetime. This has led to a mass generation of e-waste which has several negative environmental aspects.

Therefore, the aim of this study is to investigate the potential barriers for implementing circular public procurement for ICTs (Information and communication technologies) with an objective to extend the product lifetime by the 9 Rs (refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle and recover) of circularity. The results demonstrate the complexity of circular public procurement. Inconsistencies of definition of circularity is a highlighted issue which trickles down to the implementation of circular public procurement. The outcome is either not committing fully to circularity or simply abandoning the idea completely due to inconvenience as there is little or no support, incentives, and stricter regulations from the organisation and government, respectively. The issues for lifetime extension of ICTs are multi-layered with barriers such as lack of standards, incentives, and pricing of repairs and spare parts. Appropriate solutions should be implemented in a top-down approach starting with regulations and ending with circular activities at organisational and individual level.

Keywords: circularity, circular economy, circular public procurement, ICT

Populärvetenskaplig sammanfattning

Offentlig upphandling är en inköpsprocess av nyttjas av offentliga verksamheter såsom myndigheter och kommuner. Årligen spenderar Sverige ca 800 miljarder kronor via offentliga upphandlingar, vilket har en stor inverkan på miljön då dessa kontrakt ofta följer den linjära ekonomiska modellen, slit- och släng samhället. Begreppen cirkularitet och cirkulär ekonomi är relativt nya koncept som har de senaste åren populariserats bland annat inom mode- och möbelindustrin, men har även inom elektroniksektorn och hållbara upphandlingar. Den cirkulära ekonomins novation har lett till tvetydiga definitioner vilket ger utrymme för avvikande tillvägagångsätt som egentligen inte uppfyller den cirkulära ekonomins ändamål, att ”close the loop”.

Vidare har de tekniska avancemangen och snabba utvecklingar inom IT intensifierat slit- och släng mentaliteten vilket har gjort att personlig bärbar IT som omfattar smartphones, tablets och laptops nu anses vara en förbrukningsprodukt. Detta har genererat ofantliga mängder ”e-waste” som vid felaktig hantering både i användarfasen och slutstadiet kan dels reducera produktens livslängd, dels förmågan att förnya och förlänga livscykeln.

Ur denna problematik har tre forskningsfrågor uppkommit, (1) Vad är definitionen av cirkulär ekonomi, och hur påverkar den cirkulära offentliga upphandlingar?; (2) ”Vilka barriärer finns för cirkulära offentliga upphandlingar för personlig bärbar IT?”; och (3) ”Vilka möjligheter finns det att förlänga livslängden på personlig bärbar IT via cirkulär offentlig upphandling?”.

Resultaten visade att problematiken kring en ambivalent definition och konceptualisering av cirkularitet har spridit sig till styrning av offentliga upphandlingar för personlig bärbar IT. Hindren har klassificerats i tre lager; (1) styrande; (2) organisatoriska; (3) individuella. Det finns betydande brister i alla kategorier bland annat finner man bristande legala dokument (lagstiftning och policyers), inga ekonomiska incitament, ingen support inom organisationen och kunskapsbrist som överväldiga hinder för implementering av cirkulära offentliga upphandlingar. Vidare upplevs brist på standardiseringen när det kommer till prissättning av reparationer och återvunnet material samt så finns det ingen standard för kvalitetssäkring av återvunnen eller återbrukad produkt/material heller, vilket försvårar förlängningen av livslängden på personlig bärbar IT. Fortsättningsvis avsaknar många leverantörer och organisationer stöd för processer och infrastruktur som upprätthåller dem ”9 Rs” [Eng] av cirkularitet (refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle och recover [Eng]).

Som lösning föreslås top-down approach där organisationen är i fokus för att identifiera möjligheterna att implementera cirkulära offentliga upphandlingar och driva en cirkularitet-positiv attityd, en stöttande högsta ledning är nödvändig för att få genom cirkulära metoder. Cirkulära åtgärder kan implementeras genom stöd från EU i form av striktare reglering för cirkulära offentliga upphandlingar men även ekonomiska incitament. Stöd från regering kan uppmuntra till att implementera processer för en universell returlogistik som kan behövas regleras på EU nivå såsom WEEE och RoHS. Även utbyggnad av lämplig infrastruktur för returlogistik behöver stötts från regeringen, då detta kan innebära höga investeringskostnader till en början. Många av barriärerna kan redas ut men det krävs insatser från varje led i samhället.

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Abbreviations

GPP - Green public procurement

SPP - Sustainable public procurement

EGD - European Green Deal

EPR - Extended Producer Responsibility

CE - Circular Economy

CEAP - Circular Economy Action Plan

ICT - Information and communication technology

PSS - Product Service System

HaaS - Hardware as a service

PaaS - Product as a Service

EEE - Electrical and Electronic Equipment

EOL - End of Life

NAPP - National Agency of Public Procurement

LFASA - Legal, Financial, and Administrative Services Agency

SALA - Swedish Association of Local Authorities (Sv. ADDA, a central purchasing body)

LCA - Life Cycle Assessment

LCC - Life Cycle Costs

LCM - Life Cycle Management

BAT - Best available technology

BNAT - Best not yet available technology

SC - Supply Chain

1. Introduction

1.1 Problem definition

Public procurement is a purchasing process utilised by various governing bodies. The basic principles of public procurement are based on fairness, non-discrimination, equality, transparency, proportionality, and monetary value (European Commission, n.d.-f, 2016). Therefore, public procurement is strictly regulated through national and EU laws and directives. Currently, public procurement stands for 14% of the total GDP within the EU which amounts to roughly 2 TEUR yearly (European Commission, n.d.-f). In Sweden, the amount is approximately 800 billion SEK, a fifth of the national GDP (Upphandlingsmyndigheten, n.d.-e). This mass acquisition of products and services can take a toll on the environment if the tendering processes disregards it, leading to unsustainable purchasing practices and obstructing the ambitions of the sustainable development goals. Currently, most tenders are cost focused. However, with the aid of policies, market-based and non-market-based instruments the focus can shift from cost-only to incorporate a circular economy (CE). Therefore, given the vast expenditure of public procurement, an opportunity arises to instil circular procurement practices which not only pertain to lowering the climate impact but to reduce the use of virgin materials by boosting reusing, refurbishing, remanufacturing, repurposing, or recovering of products and components. Extending the lifetime of a product further encompasses circularity by including options for repairs and maintenance, supported by upstream activities, ie. design for modularity/disassembly.

Circularity is one of the latest sustainable ambitions of the EU Commission and Sweden. Circular public procurement is an untapped 2 TEUR market (yearly) that has the potential to drive the market towards circularity by putting pressure on various public sectors to change. But it is evident that something is not working since the policies and guidelines recommended by the EU have been public for nearly a decade with little to no change in the market. The newly adopted CEAP (COM (2020) 614 final), is still in the trial-and-error phase and many countries, including Sweden, have yet to incorporate the action plan as a strategy within public procurement. Furthermore, it has been documented that the framework for sustainable and circular public procurement may be insufficient and weak to engage organisations and promote circularity (2. 0-LCA et al., 2021). Other inadequate national and EU

regulations and policies may be obstructing implementation of circular public procurement, which is one of the issues this essay aims to investigate. Furthermore, GPP does not encompass CE. One definition of circular public procurement is closing the loop of material flows and reducing waste by recapturing the value within them (European Commission, 2017). The fact that circularity is considered a part of GPP may add to the confusion regarding what "circularity" really is. Circularity is a new concept popularised only during the 2020s and thus, unfamiliar ground in need of investigation.

Previous research on circular public procurement amplifies the notion that circularity is still in its infancy with lenient governance and incomplete or obscure frameworks and concepts. The issues are further inflated by the confusion regarding GPP and circular public procurement on how they differ and relate to one another. This essay will identify the current status of circular public procurement for ICTs in primarily Sweden, with the current EU regulations. All of these issues are further explored in the literature overview. The results of this essay will tell how far the EU, and Sweden in particular, has come since the first and second adoption of CEAP (COM/2015/614 & COM/2020/98) and if the issues and barriers experienced in prior research have been dealt with, or if they still exist, and thus why? Investigating the potential barriers of implementing circular public procurement in the case of ICTs (information and communication technologies) is one of the focus areas of this essay. Another research objective is to identify obstacles for lifetime extension for ICTs which encompass process and structures throughout the product life cycle. The product group was chosen because it is a fast-developing technology generating enormous amounts of e-waste without proper waste management systems in place (Cucchiella et al., 2015; European Parliament, 2020). It has become a dire situation, demonstrating that the current regulation, ie. WEEE and RoHS, is inadequate, and that the potential solution is implementing circular measures. Cucchiella *et al.*, (2015) state that WEEE, which include ICTs, is responsible for up to 50 Mt of annual waste generated and at least half of it ends up in developing countries illegally. According to the European Parliament (2015) ICTs is the 2nd largest e-waste product group. The beginning of the essay is marked by exploring the impact of having various definitions of circularity and CE on public procurement and other mitigating actions. The outcome of this essay, should aid in strategizing a Swedish action plan for country and product specific circular public procurement solutions, adding a different perspective of the circular issues experienced by Swedish public actors and suppliers.

1.2 Aim

This study aims to identify the potential barriers of implementing circular public procurement and extending the lifetime of ICTs (RQ2 and RQ3). The barriers for

circular public procurement for ICTs target mostly the regulatory and institutional barriers, while the third research question focuses on the barriers of various approaches and measures for extending the lifetime or lifecycles of an ICT through procurement. These two research questions are closely linked as lifetime extension of ICTs is influenced by country and sector specific governance. However, the problematisation extends to the definition of circularity and the impact of it and how it relates to circular public procurement (RQ1). The challenges faced by public procurers' and suppliers' will be analysed in order to identify practical issues of transitioning towards a circular economy and procurement process. Additionally, identifying their requirements for implementing circularity and the feasibility of establishing and enforcing a circular solution for their perceived problems will be investigated. Lastly, circular cases will be reviewed to address failures and success stories of circular public procurement of ICTs based on the implementation possibilities and solutions presented to each public authority. A literature overview will be conducted in order to understand the current state of circular public procurement in the EU, which will act as a foundation for the interview process and the review of circular cases.

In order to fulfil the purpose of this essay the following three research questions have been phrased (figure 1):

RQ1	RQ2	RQ3
How is circularity defined? (and how does it impact circular public procurement?)	What are the potential barriers for implementing circular public procurement for ICTs (i.e. smartphones, tablets, and laptops) within the EU and Sweden?	What barriers exist for lifetime extension of ICTs through circular public procurement? <small>miro</small>

Figure 1. The research questions.
A overview of the chosen research questions.

The goal is to identify obstacles and propose solutions and mitigating actions by analysing the qualitative data gathered to answer the above-mentioned research questions. The outcome will partly reflect the current state to see how far circular public procurement for ICTs has come, and partly give meaningful insight to which obstacles are more urgent to deal with than others. Another purpose of this essay is to classify the barriers by finding patterns within and between them (taxonomy). This understanding will not only aid in defining the urgency and prioritisation of barriers, but also finding the best and comprehensive solution that will deal with several challenges.

By finding the barriers and challenges, appropriate actions can be identified that will aid in overcoming these obstacles and increase the implementation of circular public procurement for ICTs. This will in turn decrease the negative environmental

impact that the unsustainable linear economic business model has, which currently plagues public procurement practices.

The outcome should give valuable insight for public actors and suppliers in Sweden. The results of this essay can be used for educational purposes as information about the status of circular public procurement in Sweden, and what approaches or gaps need to be solved to standardise circular public procurement and increase the implementation rate for the product group ICTs. The ideal outcome of this essay is to be used as a template for a national action plan for circular public procurement for ICTs but can be stretched towards other product groups and sectors with some further research. This essay highlights the needs and experienced challenges of public actors and suppliers that need to be addressed by measures outside of their reach, such as regulatory governance and supporting tools.

1.3 Scope and delimitation

The essay will only focus on laws and regulations within the EU and Sweden. ICTs is the focus product group of the investigation of circular public procurement with a further narrowing towards personal portable devices such as smartphones, tablets, and laptops. Additionally, the scope of the essay is limited to assessing public actors and suppliers as an extension to the 3rd tier would be too great of a scope for this timeline.

The essay will not cover procurement of vital societal functions and critical infrastructure as the use of these functions differ vastly from the functions of ICTs in office settings. Furthermore, the telecommunication network and digitalisation services will not be included in this essay.

1.4 Ethical reflection

There will be handling of integrity sensitive material and information. As the thesis is in collaboration with IVL Swedish Environmental Research Institute, sensitive and confidential information may come across during the writing process. To minimise the risks of this, all sensitive information will be omitted.

As for the interviews, ensuring that the participants are comfortable and feel safe enough to disclose truthful information during the interview is crucial. Therefore, all the information regarding the participants will be changed so that it is untraceable. However, enough vital information will be given to support and uphold scientific integrity and validation. Additionally, the participants will be fully informed about the purpose of the essay before the interviews. All legal consents, ie. GDPR and

anonymity, will be in place before any interviews can be conducted and documents published. The interviews will only be recorded with the participants approval. The participants will be ensured that the recording will only be used for the transcription of the interview and will be deleted as soon as the essay is completed. Well before the final submission deadline, each participant will receive a copy of the essay for them to ratify.

1.5 Background

1.5.1 Green Public Procurement

Both the EU and Sweden have frameworks that encourage sustainable and green procurement practices, however all types of sustainable public procurement (SPP) practises whether green or circular are voluntary (European Commission, n.d.-c, n.d.-a; Upphandlingsmyndigheten, n.d.-c). Green public procurement (GPP) encompasses environmental criteria into the procurement process by looking at the environmental impact of products and services throughout the entire life cycle, often conducting a LCA (life cycle assessment) (European Commission, 2016). The European Commission (2016) states that the voluntary GPP must, as all public procurement processes follow the rules and regulations of GPA (Government Procurement Agreement), WTO (World Trade Organisation), and the Treaty on the Functioning of the European Union, but that green criteria can be incorporated into these frameworks. The EU GPP has listed some green criteria for some sectors as guidance for procurers. Verified labelling of products is an indication of a product's or service's environmental impact and can be used as a criteria, these labels include but are not limited to the EU Ecolabel and TCO (European Commission, 2016; TCO, n.d.). The European Commission (2016) highlights the importance of knowledge of the procurement processes for GPP to be implemented successfully.

There are various standardised procurement procedures to award contracts; (1) open procedures; (2) restricted procedures; (3) negotiated procedure with prior publication; (4) negotiated procedure without prior publication; (5) competitive dialogue; (6) innovation partnership; and (7) design contest (European Commission, 2022; Upphandlingsmyndigheten, n.d.-g). The differences are listed in table 2.

Table 2. Procurement procedures.

Illustrates the various tendering types and their differences, information is translated from Upphandlingsmyndigheten (Upphandlingsmyndigheten, n.d.-g). Design contest is omitted due to the specific circumstances.

Procurement procedures						
Open	Selective/ restrictive	Competitive negotiated w/ prior publication	Competitive negotiated w/o prior publication	Competitive dialogue	Innovation partnership	Design contest
All tenders are invited	Pre-selected tenders are invited	Tenders are restricted	Tenders are restricted	Tenders are restricted	Tenders are restricted	Tenders are restricted
No possibility to negotiate	Possibility to negotiate	Possibility to negotiate	Possibility to negotiate	Possibility for dialogue	Possibility to negotiate	Possibility for dialogue
Suited for when the procurer is well informed of what to procure for	Suited for when the procurer is well informed of what to procure for but want to restrict the amount of bidders when expected to be high	Only to be used under certain circumstances	Only to be used in extraordinary situations	Only to be used under certain circumstances	When the procurement needs cannot be met with current solutions existing on the market	To be used when the procurer wants a design or project description

The European Commission (2016) elaborates that open procedures render the most choices for green tenders but does not automatically award the most environmentally friendly tender while restricted procedures may miss out on tendering offers that are more environmentally conscious due to the pre-selection of tenders.

LCAs, LCCs, and joint procurement are a few tools and approaches listed in GPP that can encourage procurers financially to procure for more environmentally friendly products and services as these reveal the true cost (LCC/LCAs) of a product throughout the entire life cycle or through splitting the costs of several procurement contracts by encouraging sharing of products and services (European Commission, 2016). During the contracting process the procurer is allowed to make requirements, whether that be environmental performance demands, technical specifications, or specific production methods, etc. However, these requirements can never go against the basic principles of public procurement which are the following: (i) non-discrimination; (ii) equal treatment; (iii) proportionality; (iv) transparency; and (v) mutual recognition. In general terms this regards the accessibility to tender, discrimination and unfair competition due to specifications, therefore the requirements must be relevant to the market and must include equivalents, eg. ecolabelling equivalents. Specific labelling is therefore prohibited. All these rules concerning the contract award criteria are listed in directive 2014/24/EU Art. 67 & 68.

1.5.2 Circular Public Procurement

Circular public procurement is seen as a branch of GPP and CE. Circular public procurement encompasses circular economy aspects such as closing the loops of a linear economy model (European Commission, n.d.-d). It includes all that GPP stands for but extends the boundaries further by incorporating the 9 Rs (refuse, rethink, reduce, repair, repurpose, refurbish, remanufacture, recycle and recover), and thus retaining and recapturing the value of materials. Circularity embraces the entire product or service life cycle, starting at the idea of a product or service and "ending" by the 9 Rs, hence refusing and reducing waste generation (EPRS, n.d.). Whilst SPP and GPP encompass environmentally friendly products, ie. certifications and chemical restrictions (RoHS), circular public procurement and CE incorporate several levels and all aspects from cradle to cradle and arguably beyond as it focuses on lifetime extension, all in line with the zero waste concept (Qazi & Appolloni, 2022).

The European Commission released a Circular Economy Action Plan (CEAP) as a part of the European Green Deal (EGD) package (European Commission, n.d.-c, n.d.-a). The aim of the Green Deal is to move the EU towards climate neutrality by strategizing sustainable plans and policies for various sectors (European Commission, 2021). CEAP (COM (2020) 98 final) consists of product policy frameworks and other regulations that streamline processes within the economy and society. In the section 3.1 of COM (2020) 98 final, a "Circular Electronics Initiative" is described as a regulatory framework with the aim of lifetime extension of a product by various means, ie, take-back schemes, and eco-design.

NAPP (the National Agency for Public Procurement) identifies circular public procurement as integrating sustainable aspects into the procurement process by creating policies and strategies that include guidance and circular criteria (Upphandlingsmyndigheten, n.d.-f). NAPP lists criteria examples, ie. reused components and criteria for an extended lifetime and adds aspects such as doing a needs assessment before the procurement process and promoting functional criteria to encourage innovation. The NAPP encourage pre-procurement activities to succeed with circular public procurement (Upphandlingsmyndigheten, n.d.-b).

During the procurement, NAPP, have listed examples of a few sustainable criteria, ie. procuring for recycled materials, packaging, service and maintenance, and reverse logistics (Upphandlingsmyndigheten, n.d.-b). Monitoring and follow-up are carried out throughout the implementation stage, it also gives room for further dialogue and collaboration. NAPP promotes dialogue for innovation as a tool to accelerate circularity which include approaches such as RFI and dialogue meetings with suppliers, and it is encouraged to keep up these dialogues for innovation throughout all stages (Upphandlingsmyndigheten, n.d.-d). The NAPP encourages management to use the circular procurement model (Figure 11, in Appendix D) to find the most relevant tool to strategise a circular policy for each suited purchasing category (Upphandlingsmyndigheten, n.d.-c).

Product Service System (PSS) is often mentioned in CE context. PSS is an innovative business model in which the supplier has the ownership of the product, not

the end user. PSSs are marketed as a sustainable solution for the digitalisation of societies (Lugnet et al., 2020). Shehab & Roy (2006) explain that this business model focuses on the customers' need, ie. function, rather than owning a product, which in turn can significantly reduce the negative environmental effects of traditional LE models. This is due to the fact that services, ie. repairs for lifetime extension, is the money generating aspect of the business model (Lugnet et al., 2020). As the ownership is still with the manufacturer or supplier, there is an automatic EPR. Because of this, the companies will want to make more durable and higher quality products (Shehab & Roy, 2006). These contracts enable the user to use the product for a given amount of time and at the end of the contract time period the user will return the product to the supplier or renegotiate a renewal of the contract and product.

E-waste is a growing problem globally as the technological advancements are surpassing the rate of solutions for proper waste management. This has led to a generation of e-waste in landfills due to improper disposal and immature waste management, including insufficient capacity, infrastructure, and activities. The EU has tried to combat this problem by implementing the WEEE directive (2012/18/EU). ICTs fall under category 3 in the annex of the EU directive 2012/19/EU. Producer responsibility, and the extended producer responsibility (EPR) has gotten a revival in the past year as the EU has implemented a new 2-year legal guarantee law (2019/771/EU). The EU law (2019/771/EU) ties into the producer responsibility as the seller and/or manufacturer is responsible for repairing, replacing, or refunding the customer if the product is defective.

The WEEE directive aims to minimise the amount of e-waste generated, as well as to control the various streams of e-waste. Even though the EU has provided manufacturers and consumers with plentiful tools the EU has failed to regulate or incentivise take-back schemes for electronics. According to the European Parliament (2020) less than 40% of the generated e-waste is recycled, the number for ICTs is staggeringly low, only 14% is recycled. The RoHS (2011/65/EU) unifies EU:s efforts to make e-waste more environmentally "safe" by restricting the use of certain hazardous substances in EEE. The directive (2011/65/EU) regulate hazardous substances- it also includes safer, in regard to health and environment, substitutions. The Ecodesign for Sustainable and Circular Products is a new regulation proposal that builds on the original Ecodesign Directive that aims to improve the environmental performance of products by reduction the energy- and resource consumption (European Commission, n.d.-b, n.d.-e). According to the European Commission (n.d.-e) the proposed framework consists of a set of ecodesign requirements which include product durability, reusability, upgradability, and reparability, recycling and remanufacturing, and recycled content, among others, which is in line with CE. The standards and the ecodesign directive are heavily energy focused and the measures are promoting energy efficiency (2022/C 182/01). The new workplan promises to include some new ICT products, ie. smartphones and tablets (European Commission, n.d.-e) which denotes that these product groups need to be

evaluated with suggested methods: (a) LCC/LCA; (b) Best Available Technology (BAT); and (c) Best Not Yet Available Technology (BNAT), to find appropriate ecodesign requirements and solutions (C/2022/2026 Final/2.; European Commission, 2013).

1.6 Literature overview

A literature overview of circular public procurement issues was conducted in order to understand the subject better and to formulate relevant questions for the interviews. A summary of the searches made for the overview can be found in Appendix B, table 1. Figure 2 below illustrates how the literature overview has aided in the process of structuring the data for the results of the interviews and cases. A substantial amount of data was generated by the literature overview and subsequently processed to develop the interview questions seen in Appendix A. This following chapter will summarise the general findings of the literature overview. A detailed version can be found in Appendix C.

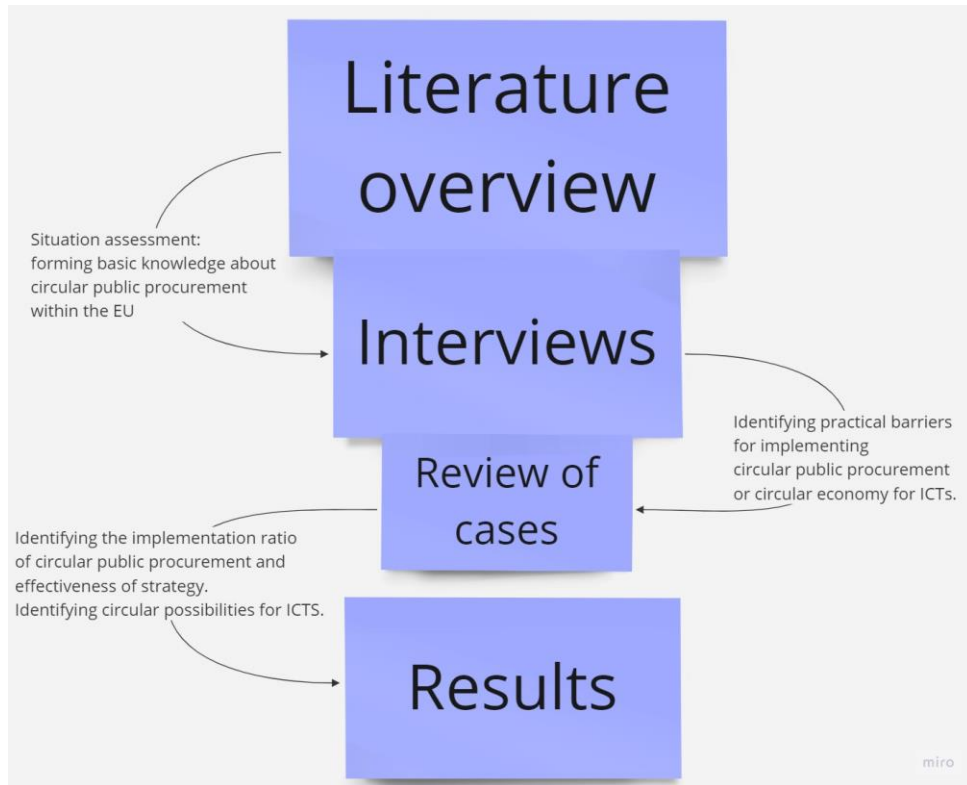


Figure 2. Approach overview.

An illustration of the data collection process, in total 3 steps starting with a literature overview. The arrows mark the interrelation between each step.

There is a lot of information about the various obstacles faced on both the procuring and supply side. Most articles reviewed formed barrier patterns and created taxonomies, such as assumption challenges on various levels (Dzhengiz et al., 2023), macro-meso-micro barriers (Qazi & Appolloni, 2022), and dimensional barriers (Aloini et al., 2020; Grafström & Aasma, 2021; Sonnichsen & Clement, 2020), which inspired taxonomisation of the barriers to better reflect at which level in the society the challenge is situated. The classification split the barriers into three levels: (1) governance; (2) organisational; and (3) individual. Governance encompass barrier on EU and national scale, ie. regulations, policies, and politics; organisational, which is within the organisation or company; and lastly if the barrier is individual, which encompasses the individual beliefs and attitudes either within the organisation or the general public.

1.6.1 Definition of circularity

There is no clear definition of CE, therefore it may be one of the reasons that makes it difficult for policymakers to set up guidelines as parts of it are up for interpretation, the definition was not popularised until after 2020 which marks a positive shift from only focusing on sustainability to circularity (Dzhengiz et al., 2023; Milios, 2018; Qazi & Appolloni, 2022; Sonnichsen & Clement, 2020). Saidani et al., (2019) continues stating that there is a "lack of consensus (...) among scholars, politicians, and practitioners." regarding CE. Marrucci et al., (2019) confirms this, stating that CE is a vague terminology and that this ambiguity trickles down to all the processes and activities surrounding CE.

The Ellen MacArthur Foundation, a charity committed to CE, defines CE as: "a systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution.", and explains that this encompasses resource efficiency, SC (Supply chain), production, and use, and EOL management (Ellen MacArthur Foundation, n.d.). Milios (2018) gives a perspective into an aspect of the circularity definition issue, referring to the definition coined by Ellen MacArthur Foundation as a starting point and explaining that the definition is too general and vague to be applicable to policy and framework formulations, especially if the person creating the policy has no prior knowledge about this subject.

The EU commission explain their interpretation of CE by stating that "The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended", thus closing the loops (European Commission, 2015). The CEAP (COM (2015) 614 final) conceptualises circularity to facilitate the translation to policies and framework (Milios, 2018). Dzhengiz et al., (2023) explains that there are conceptualisations of CE that are more concrete, ie. strategies for eliminating waste; while some more abstract, ie. the theory behind decoupling economic growth. However, common for many definitions and assumptions about CE is the closing of loops and eliminating EOL (Dzhengiz et al., 2023; Milios, 2018; Qazi & Appolloni, 2022; Saidani et al., 2019). The EU explain their interpretation of CE by stating that "The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended", thus closing the loops (European Commission, 2015).

The Swedish NAPP have their own definition of circularity which goes as follows, "CE is the opposite of a traditional linear economy. In a CE everything that has been produced is used for as long as possible (...) by reusing and recycling till exhaustion" (Upphandlingsmyndigheten, n.d.-f). NAPP (n.d.-c) states highlights 5 actions to achieve CE, these are (1) Reduce consumption; (2) Reuse more; (3) Design for X for products and packaging; (4) recycle more; and lastly (5) recover the energy

from anything that cannot be recycled. NAPP includes social sustainability as a part of CE which differs from the EU definition.

Several researchers list various processes of circularity, including lean manufacturing, eco-design, Industrial symbiosis or ecology LCM (life cycle management), sustainable consumption, waste-to-resources, and many others, all resource strategies that aim to close the loop for a certain aspect (Milios, 2018). Dzhengiz et al., (2023) continues on the same assumption which is the achievement of a never-ending closed loop with the support of the 9 Rs which is an ideological way of interpreting CE, not equal to reality. A summarisation of the various definitions of CE can be found in Appendix E.

1.6.2 Governance

Policies and regulations

The challenges experiences are often country specific, and sometimes sectoral and business based. Generally, EU countries tend to have similar governance issues since most national regulations regarding circularity are derived from EU directives and guidelines. Some legal documents may be either obstructing efficient adaptation of CE or simply inadequate to ensure proper implementation of the CE concept, lacking in regulation of waste management and treatment, including ease of dismantle, recyclability, reusability, etc., which are key aspects of CE (Marrucci et al., 2019). Grafström & Aasma (2021) support this notion of weak and inconsistent policies regarding CE on both national and international level. It is considered a widespread problem and limiting for a transition towards CE. Many policies in the EU are waste-focused but are unsuccessful in recovering most materials and promoting the 9 Rs (Milios, 2018). Dzhengiz et al., (2023) elaborates, eco-designs and eco-standards, and certifications are currently considered enablers and barriers at the same time. Their inherent purpose is on a par with CE and can be used to facilitate and signal sustainable efforts, however, the lack of standardisation is a major barrier.

Svensson-Hoglund et al., (2021) mention limited profitability of repairs due to the costs of spare parts and labour as a barrier. Arguably, policies and regulations are key to overcoming this obstacle and exemplify the EU Ecodesign Directive, which promotes a "right to repair" and incentivises OEMs to provide tools and spare parts (Svensson-Hoglund et al., 2021). Feedback from various EU suppliers corroborates the notion that certain waste management options are preferred, such as improved durability over extended consumer warranty and dismantling (Dalhammar, 2016). Durability labelling is associated with quality and trust and is shown to have a more positive connotation compared to repairability (Milios & Dalhammar, 2023).

Instruments, ie. legislation, policies, and support, and economic drivers are the powerful enablers that facilitate and encourage a transition to CE. Aloini *et al.*, (2020) explain that governmental interventions are pivotal for this transition as they have the

potential to not only affect the economic choices of organisations but also urge various sectors and stakeholders to implement sustainable habits and processes through proper legislation.

Lastly, waste management of EEE is regulated by the WEEE directive (2012/19/EU) which encourages recycling and recovering of precious materials to a certain extent which is in line with GPP/SPP but not circular public procurement. Going back to the 9 Rs, the WEEE directive does not promote reuse, refurbish, full recovery, and reduction, therefore these systems are neglected in favour of recycling (Qazi & Appolloni, 2022). Many authors claim that GPP/SPP can act as a springboard for circular public procurement (Milios, 2018; Sonnichsen & Clement, 2020) but Qazi & Appolloni (2022) give another perspective, that GPP/SPP can shift the focus away from circular public procurement, that the government and organisation unknowingly may dismiss circular public procurement in favour of GPP/SPP.

Other factors

The main difference between SPP/GPP and circular public procurement is how they handle the EOL stage of a product; circular public procurement aims to keep the product or components within the system loop for longer, thus reducing waste and promoting reuse of materials (Qazi & Appolloni, 2022). Sonnichsen & Clement (2020) state that GPP and SPP can aid in the transition towards circular public procurement as these processes move the focus away from the upfront (purchase) price and incorporate risk, timeliness, and true cost (LCA/LCC) into the tendering process. Both national agencies and suppliers believe that LCAs/LCCs and LCMs will play an essential role in circular public procurement in the (Crafoord et al., 2018). Qazi & Appolloni (2022) highlight the problem of not thinking in a cradle-to-cradle perspective when designing a product. Designing for dismantling or modularity will inevitably facilitate LCM and waste management and promote CE.

In order to facilitate for procurers to incorporate sustainability criteria, NAPP and the LFASA (Legal, Financial and Administrative Services Agency) have set up frameworks and guidelines that support CE. As these frameworks and guidelines are regulated by state agencies in cooperation with suppliers, actors, and the market, it can be used as a starting point for circular public procurement. Full text can be found in Appendix C.

1.6.3 Organisational

Knowledge and awareness

According to Crafoord *et al.*, (2018), some common challenges include performance issues, low knowledge about circularity and lack of support for purchasing remanufactured units, supply issues, and product heterogeneity. To support circularity, international collaboration between suppliers, manufacturers, and waste collectors are

imperative for an efficient take-back scheme globally (Milios, 2018). Sonnichsen & Clement (2020) noticed a greater ratio of circular public procurement if senior management were supportive of it, setting up goals, strategies, and allocating resources for circular public procurement. The emphasis of successful circular public procurement lies in a supportive and knowledgeable organisation that regularly educates and updates procurers of current information on circular practices such as the use of environmental criteria and specifications (Sonnichsen & Clement, 2020). Qazi & Appolloni (2022) acknowledge that there is a conflict of interest between price, quality, and circularity, in which circularity is often down prioritised if it is not a part of the organisation policy. Therefore, it is essential to have support from management and a management team that prioritises circularity.

Criteria and requirements

Sonnichsen & Clement (2020) propose to use "fewer, but more stringent, criteria" to increase the positive impact and outcome of circular public procurement. But environmental criteria and award criteria, even though the use is encouraged in both GPP and circular public procurement, it cannot be too specific to hinder fair competition. The demand for remanufactured computers is limited; it is mostly procured for the administration and the educational sector as the processor demands are not as high (Crafoord et al., 2018). However, procuring for remanufactured computers is often limited by the procurers' demand for brand new units (Crafoord et al., 2018; Qazi & Appolloni, 2022). Therefore, remanufacturers are unable to participate in the procurement process (Crafoord et al., 2018).

Procuring for returns tends to occur but a specified EOL management is rare, and therefore not fully circular (Qazi & Appolloni, 2022). Most tend to settle for ecolabels which in itself is sustainable to a certain extent as ecolabels tend to mind sustainability by various aspects, but do not encompass the responsibility for EOL management.

Other factors

Grafström & Aasma (2021) found that organisational barriers occur either in the early stages of production or at the EOL stage, such as issues with integrated components (soldered elements) and lack of waste capacity, infrastructure, monitoring, and capability. Several authors noted apprehensiveness towards transparency throughout the SC which inevitably makes many aspects difficult, such as monitoring and LCA/LCC (Grafström & Aasma, 2021; Saidani et al., 2019; Sonnichsen & Clement, 2020).

Sonnichsen & Clement (2020) and Saidani *et al.*, (2019) recommend that the senior management should encourage circular processes by creating internal policies that include CE factors and indicators. Entering a collaboration and dialogue with the suppliers and the market will not only confirm if the suppliers are in compliance with the purchasing criteria but also support information sharing and leave room for

innovation to expand the circular public procurement capacity (Milios, 2018; Sonnichsen & Clement, 2020). For a more comprehensive text see Appendix C

1.6.4 Individual

Organisational and societal culture

Qazi & Appolloni (2022) state that most procurers tend to lean towards purchasing new products made from virgin materials and that the secondary market is a good idea but not a viable one. This ties into what Sonnichsen & Clement (2020) noted which is that one of the more halting barriers of implementing circular public procurement at management level is the misconception that sustainable products cost more; and due to the budgeting constraints of public actors many tend to be discouraged to implement circular public procurement if no support is shown higher up. Consequently, most procurers opt for the linear price model where the purchase price is the decisive factor. Sonnichsen & Clement (2020) explain that knowledge is a far better driver for implementing circular public procurement than for instance any monetary benefit.

There is a general consensus that the price of virgin materials is not true to actual cost, which is why the initial cost for recycled materials may seem high (Qazi & Appolloni, 2022). The price of the material is dependent on several factors, ie. extraction method, supply and demand, and labour costs among other factors (Richter et al., 2022). Labour costs in EU tend to be higher than labour costs in Asia. However, Richter *et al.*, (2022) highlight a trend that can be seen on the market, which is the increasing price tag of new materials, which will open-up the idea of creating a spare part market. Milios & Dalhammar (2023) explain that increased product durability can regulate the spare parts market, and Richter *et al.*, (2022) advocate for harvesting spare parts strategically in collaboration with OEMs that will result in economic gain. For full text see Appendix C.

2. Methodology

Several qualitative research methods have been chosen as most suitable to generate the results with various perspectives and interpretations (Tight, 2017). This combined qualitative research design aims to present a comprehensive yet generalised understanding of the barriers and opportunities for implementing circularity for ICTs in Sweden and the EU. This essay has made use of data and method triangulation, ie. using data from different sources (interviews and cases), to establish trustworthiness (Nightingale, 2020; Williamson, 2018). The interviews are expected to corroborate the data collected from the literature overview in addition to giving sector and product-based insights to establish the practical issues. The review of cases will further establish the capabilities and possibilities in the EU. The processed data from the interviews and case reviews will be linked to find a reasoning behind why these implementations and capabilities are not utilised.

2.1 Interviews

A total of 11 interviews (13 interviewees) have been conducted in order to understand the practical issues for implementing circularity within procurement practices and the challenges suppliers face when transitioning towards a circular economy. Out of the 11 interviews, six of them were with various public actors (numbered) and five with suppliers (lettered), all situated in Sweden. The public actors and the suppliers were chosen on one criteria, which was that all had to have some type of environmental policy or environmental culture, however circularity was not mandatory. The environmental criteria could have been something as simple as having environmental targets or being environmentally or sustainably certified, eg. ISO14001. The interviews were all held in Swedish for ease of language. Each interview was later verbatim transcribed in Swedish, thereafter translated into English. During the translation the statements were summarised as results in a non-verbatim manner with no direct quotes, but more so to find patterns and connections. An extract was sent to each participant for approval.

The interviews explored the current approaches made by procurers and suppliers towards circularity and their definition of it. Lastly, a needs analysis has been

conducted by assessing the various requirements procurers and suppliers may need in order to enable and accelerate the transition towards a CE, and to evaluate what they consider is holding them back. The interviews have also aided in the analysis of the state of the interrelationship between procurers and suppliers, to see if some challenges may lie there as well.

The interviews were conducted through a video communication programme such as zoom or teams between 06/03/2023 - 29/03/2023. The interviews ranged in time from 36 - 78 minutes long. Some interviews were shorter due to the fact that some participants had already answered the interview questions (see Appendix A) beforehand in text and thus needed only to elaborate if there were any uncertainties or if I needed more thorough answers. All of the participants received the interview questions in advance, of which two gave written explanations to each question beyond the interviews. The interview questions were the same within each group; group (i) public actors and group (ii) suppliers but differed between each group (i and ii). The interviews were semi structured in order to encourage the subjects to include their own personal experiences and perspectives regarding the possibilities and barriers faced within public procurement (Bildtgaard & Tielman, 2017). Furthermore, this type of in-depth interviews have a more constructionist approach which allows for viewing the material and information on several levels creating a diverse interpretation and reflection of the current situation (Johnson & Rowlands, 2012; Warren, 2001). The subject of the interview has solely focused on the circularity of ICTs. At the end of the interviews there was a possibility for the participants to express their thoughts on the subject freely, in case some vital information had been missed or overlooked during the interviews.

2.2 Review of case studies

To identify and assess potential success stories and failures of circular public procurement, case studies within the EU and Sweden have been reviewed. The case studies have been used as a base for comparing various implementation processes and their target area(s); reduce by design, repair, refurbish, etc. (any of the 9 Rs of circularity). Some case studies have been researched using the EU commission's search engine as a base foundation. To potentially fill in any information gaps about the chosen EU cases further searches were made using google. These information gaps include aspects such as the implementation process or results. The set of Flanders cases were provided by the external supervisor as the supervisor had come in contact with 'Circular Flanders' previously as a best practice model. All the Circular Flanders cases had to be translated into English with the aid of two translation programmes (Google translate and TranslatePress) to boost accurate understanding of the cases. The cases had to include either a circular measure for ICTs, ie. The 9 Rs of circularity,

or a circular policy/circular governance for implementing or promoting the implementation of circular public procurement. The case studies have been researched using the EU commission's search engine. The aim was to find studies of actors and suppliers trying to transition towards a circular economy in various EU countries.

Case studies tend to have the disadvantage of being very specific to a certain set of circumstances and situations (Gomm et al., 2009). However, the cases studied are meant to illustrate the capabilities and success rate of CE put into practice, and if it can be implemented elsewhere equally successful or not (Gomm et al., 2009; Hamel et al., 1993). The cases are further meant to recognise various experiences of CE and to observe the adaptation of legislation and other legal documents, with the concluded challenges listed in previous research method (Tight, 2017).

3. Results

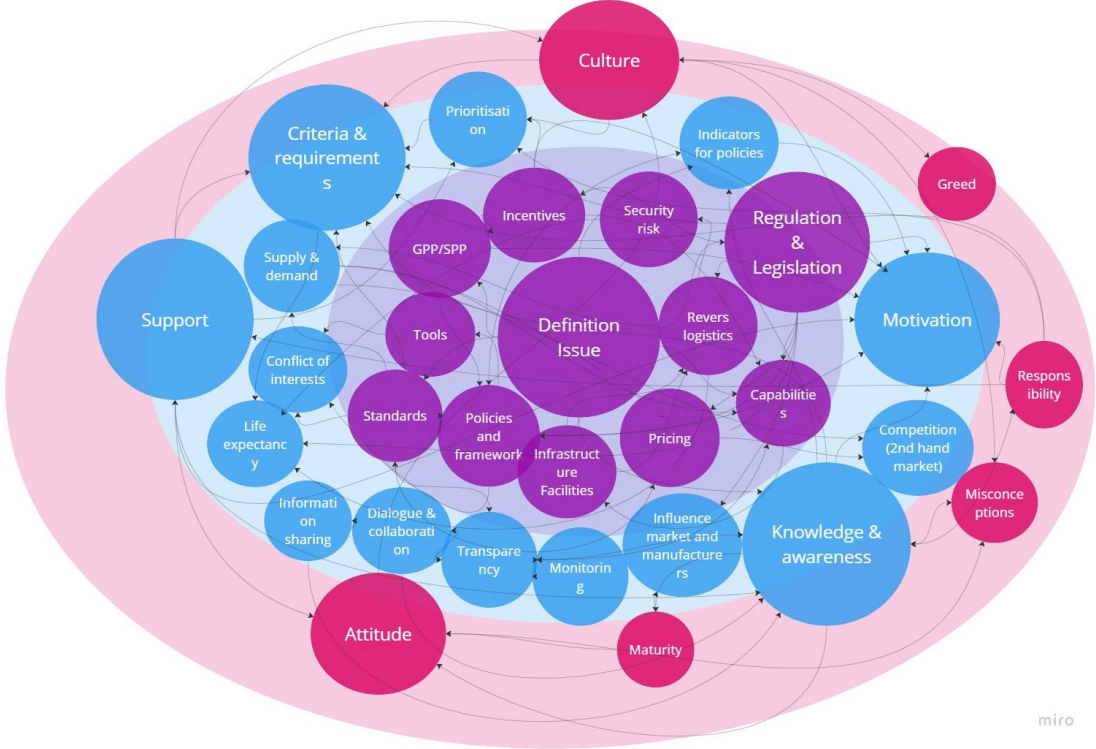


Figure 3 Barriers. Collection of all the issues mentioned the interviews and how they are connected to each other. Each issue is explained further in the results sections. The lilac bubbles represent governance issues, the blue bubbles represent organisational issues, and the pink bubbles represent individual issues. The size corresponds the degree of perceived difficulty based on the collected information from the literature overview and the interviews. The aim of this figure is to show the complexity of problems regarding circularity.

3.1 Interviews

3.1.1 Definition issue

There was a noticeable issue with the definition of circularity and CE as there is no formally accepted definition. When the participants were asked to define their version of circularity and CE there was a wide range of interpretation. The answers were collected in figure 4. Many identified the focal point of circularity as reverse logistics. The other factors mentioned may directly or indirectly relate to reverse logistics or efficient resource management. All participants state that CE comprises a multitude of factors and aspects, some go further crediting external elements such as the individual behaviour and mindset as a sub-layer of circularity (Participant 1-1 & 1-2; E, 2023), while others include that circularity starts before any procurement takes place (Participant 5-1 & 5-2; 6, 2023). The participants are aware of this definition conundrum. The hypothesis of what is sustainable, and circular is divided, even producers are unaware of what is considered circular, with questions arising whether it is the product, ie. the use of environmentally safe chemicals, or the processes, ie. lifetime extending processes that make something sustainable (Participant 6, 2023).

CE definition according to participants

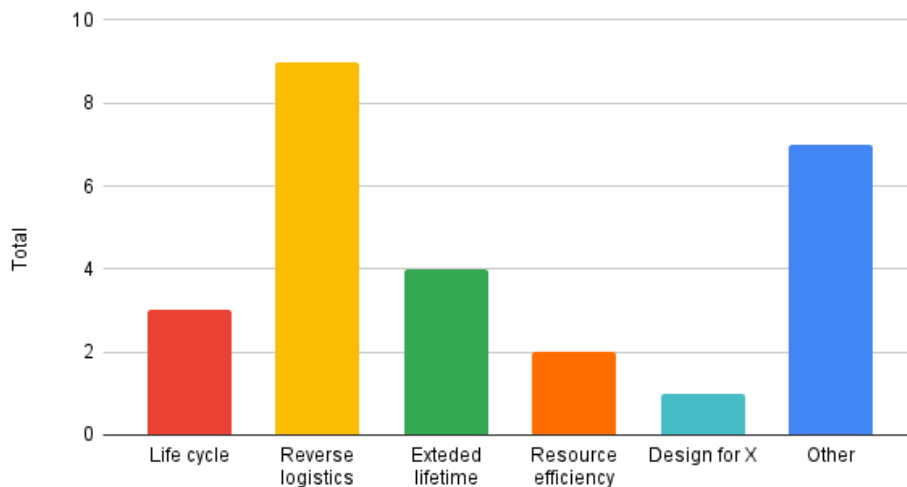


Figure 4 CE definition.

Overview of what CE is according to the participants. Life cycle stands for having a cradle-to-cradle mindset for any product or service. Reverse logistics is the return process of a product to either the manufacturer, retailer, or a third party company. Extended lifetime can include a wide range of procedures, including a reverse logistics process (repair or resell) and design for X. The variable X can be exchanged for any sustainable or circular aspect, in this particular case it is referred to disassembly (modularity). The category others include various surrounding aspects such as choice of transportation through the life cycle and TCO (total cost of ownership).

The varying interpretations align with the various definitions mentioned in Appendix E. Many of the public actors mentioned that they have at least one person that is educated in sustainability and that this person can be utilised during the procurement process. Oftentimes the same person will be the one that educates the organisation about sustainability and circularity. Since the definition is somewhat ambiguous the focus during procurement will be heavily influenced by the persons own perception and views. Judging by what the participants have expressed regarding circularity it is most likely that they use the definition created by NAPP (see Appendix E).

3.1.2 Governance

Regulations and policies

A barrier observed barrier is the setting of circular criteria; the current regulations paired with an uneven playing field amongst the suppliers can force the procurers to settle for lower criteria to avoid a procurement review, as overly specific criteria and too high requirements is considered an obstruction of free competition, one of the five pillars of procurement (participants 1-1 & 2, 2023). Organisations need people with great competencies that know what to look for and which questions to ask in order to formulate effective requirements and criteria as proper competence, knowledge, and effective criteria/requirements are key for a successful and circular procurement (Participant 2). The competition must be upheld at all times, and according to the Swedish Competition Authority (Konkurrensverket, n.d.). procurers can set criteria and requirements freely but need to be relevant and reflective of the current market conditions. Other participants elaborates that the law may not necessarily be restrictive but agree that you need to have proper competence and experience to utilise the regulations effectively (Participant 3; 6; C; D, 2023). The information is available but hard to find, the laws and regulations do not facilitate the process (Participant 6, 2023).

Some participants state political intervention as the main barrier and potential enabler for circularity (Participant 3; 4; 5-1 & 5-2, 2023). Currently, there are no strict policies for circularity, even the statutory regulations are recommendations and voluntary. Participant 6 and E (2023) add that there is usually no one taking responsibility for implementing and maintaining circular measures. The national regulations are similar in that they are recommendations, with no clear strategies, repercussions, or praise (Participant 1-2; 6; 5-1 & 5-2, 2023). Because of this lenient policy-mix much of the implementation is either not measured and monitored or simply non-existent (see figure 5). Other regulations needed for circularity include standardisation of the reverse logistics processes, price-point of repairs, second hand market products, and price and quality of recycled materials and supporting instruments for the implementation of these processes, but also regulations for the

security aspects of second-hand products such as a standardised information erasing process (Participant 1-1 & 1-2; 5-1 & 5-2; A; B; C, 2023).

Standardisation of quality assessment of recycled materials and products and a standardised price setting for repairs and replacements and other circular activities are currently non-existent (Participant B, 2023). Because of this, price-setting is individual and subjective, in Sweden the costs of labour and service tend to be quite expensive, this can increase the prices of refurbished products and repairs making it economically unsustainable (Participant A; B; C, 2023). This issue ties into the motivation of the price-point dilemma of repairs or use of recycled materials. There is no visible information for motivating a higher price-point of repairs, use of recycled materials, or second-hand products (Participant 6, 2023). This in turn is linked to the lack of transparency along the SC, making it difficult to accurately assess the environmental impact of a product and set appropriate pricing. Additionally, the second-hand market of ICTs can be seen as a competitor against the global producers, as they are not the ones making a profit from their products being repaired and refurbished (Participant E, 2023).

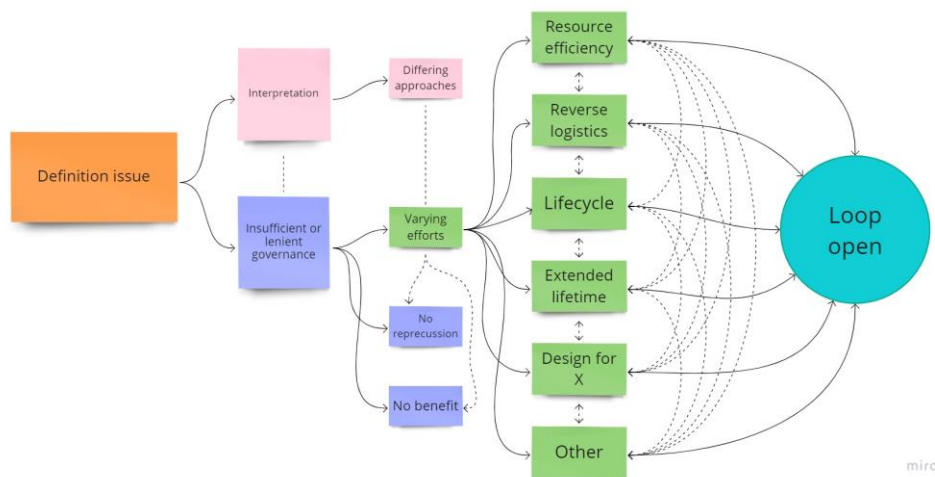


Figure 5 Consequences.

Illustrates the interrelatedness of the various definitions of CE in green and how the definition issue trickles down to lenient governance for circularity as there are no benefits or repercussions. The figure further illustrates the aspect of subjective interpretation which leads to differing approaches depending on the individual which results in varying efforts and various targeted solutions (seen in green).

Design for modularity is a construct ensuring free-standing components within a product, the opposite of integration. Design for dismantling is another product guideline which facilitates the waste management at the EOL of a product, usually this entails modularity, as seen in Fairphone. Therefore, a modular design can encourage lifetime extension, avoiding premature scrapping due to a few broken parts, as broken parts can easily be removed and replaced (Participant B, 2023). You can procure for non-soldered parts (Participant 2, 2023), but the majority of ICTs on the market have

integrated parts even if there is pressure to move away from this (Participant 6; B, 2023). The majority of suppliers state that they are unable to motivate manufacturers towards a change, such as modularity or software aspects. Participant D (2023) continues that a smaller player like Sweden has very little chances of affecting global producers as they are catering to a global market, thus are not going to take any measure that is demanded by a single supplier or public actor in Sweden. This indicates that the size of the public actor may also act as a barrier for circularity as smaller organisations do not have the same prerequisite in terms of capacity, resources, and capability to drive and change the market towards circularity (Participant 2, 2023).

Many utilise ready-made framework contracts through the Swedish Association of Local Authorities and Regions (Eng. SALA; Sv. ADDA) or LFASA, which specify conditions and requirements within a contract, including specific suppliers. Although useful and timesaving, these frameworks may not necessarily have been created with CE in mind.

3.1.3 Organisational

Purchasing methods

The most common form of procurement is a traditional purchasing contract through open tendering (see figure 6).

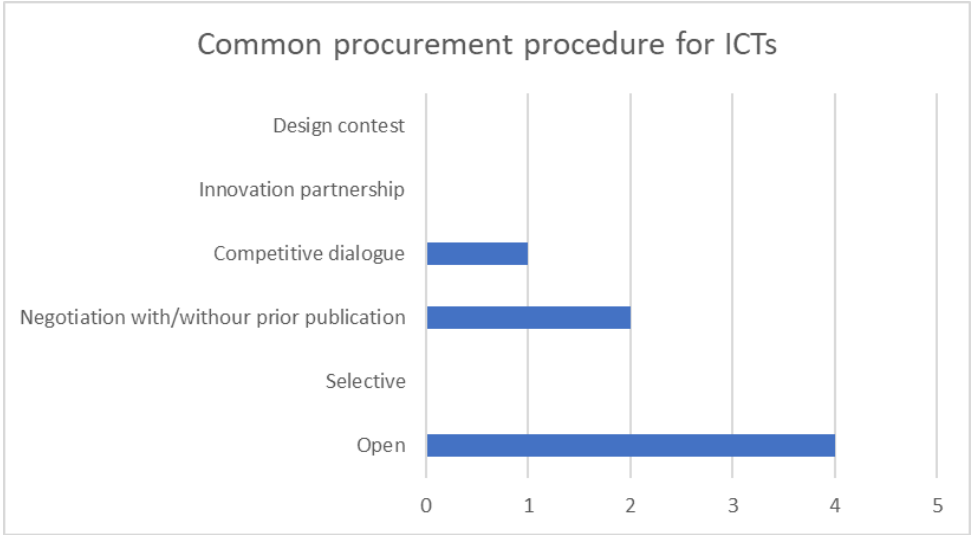


Figure 6 Tendering type.

The collected data from the interviews regarding the procurement procedure for ICTs. The results are in alignment with the statistical data from both EU and Sweden, stating that open procurement procedure is most commonly used (European Commission, n.d.-g;

Upphandlingsmyndigheten, 2022). There are a total of 7 answers from 6 public actors, the reason being that some had a 50/50 split between two procedure types.

Many public organisations prefer these types of contracts as the price of one unit becomes cheaper the more you buy (Participant 2; D; E, 2023). Open tendering type is more price-focused compared to other procedures and it does not allow for dialogue and innovation which are key components of PSS. Few public organisations have started to implement a form of PSS called client-as-a-service (similar to PaaS). The biggest barrier for adopting a PSS contract form is the price, infrastructure, and restructuring of processes. The way that most establishments are currently structured do not have the capability or capacity to transition towards a leasing business model. Traditional purchasing contracts have been the norm for decades and the system has been built and optimised around it, therefore it may take extensive work to change the contract form to leasing and other PSS (Participant 1-1, 2023). However, many public organisations tend to have a central unit for purchases, which in turn will "lease/rent" out the product throughout the various units within the organisation (Participant 1-1 & 1-2; 2; 3, 2023). LFASA had a framework for leasing IT products that was less successful, and it took long before any changes were made, which probably resulted in customers turning towards other options, such as traditional bulk purchases (Participant C, 2023).

Aside from procurement type there are also various procurement procedures that dictate which suppliers can bid. The most common procedure among the interviewed public actors is open tender, which is to be expected as it is the most used tendering type in the EU (European Commission, 2022). During an open tendering, any bidder within the EU is allowed to enter the procurement given that the company can deliver. The issue with an open procedure is that the criteria cannot be too specific as it will be excluding many actors which can result in a review which is both time and resource consuming.

Criteria and requirements

All the procuring participants use some type of environmental certification when procuring for ICTs, ie. "Blue Angel" and request certifications for the supplier as well, such as ISO 14001, Participant D (2023) explains that certification has become a "must" requirement, everyone procures for ecolabels, conflict minerals ((EU)2017/821), and hazardous substances (RoHS). Therefore, procuring for these labels and certifications as a criteria has become the "bare-minimum". Very few procurers set software criteria during procurement and tend to focus on the hardware, transportation, packaging, and the return process when procuring sustainably. These criteria are in line with what is recommended for SPP on the NAPP website. Procurers may be playing it safe because if the pre-procurement process, including setting of quality factors, criteria, and requirements are formulated badly it will leave room for tender offers that are either unserious or not meeting the standard that the

procurement actually seeks; therefore, the quality of the procurement govern how circular the outcome will be (Participant C; D, 2023). Many of the participants mentioned that reverse logistics is a central part of circularity and all of the suppliers interviewed offer a return service, but it heavily relies on the public actor to return the purchased goods. Generally, there is a lower ratio of returned units for traditional purchasing compared to leasing or any sort of renting agreement (Participant A, 2023). The majority of suppliers state that a return process is often procured for, and at times when it is not the suppliers will inform the procurer of this service. All of the suppliers' reverse logistics processes primarily promote reuse or refurbishment for a second-hand private market; it is seldom reintroduced to the organisation. This ties into the apprehensiveness towards purchasing and using second-hand IT products in the public sector, which is further explained in the individual section. This lack of demand and generally higher rate of material recovery and recyclability (as stated in WEEE) over reuse/refurbishment results in a diverse and low supply, which makes the second-hand market unattractive for the public sector.

Suppliers mentioned that the biggest barrier they see is the lack of stricter requirements and criteria. However, there is an increased use of environmental evaluation criteria in form of "added value" to lower the price of the procurement, environmentally speaking an added value criteria can regard the return process and how well it is developed (Participant A; C; D, 2023). Nowadays, there tends to be some type of requirement for return processes, but it can be inadequate of what is needed for circularity, which is why it is favourable to have dialogues with suppliers about it (Participant A; B; E, 2023). There are far less, if any, requirements for the materials and components of the product (Participant B, 2023). Participant C (2023) mentions that poor planning can make for hasty decisions and underdeveloped procurement requirements and criteria, leading to poor procurement contracts.

An issue concerning criteria and requirements on products is the lack of, and apprehensiveness towards transparency further up the SC (Participant 4; C, 2023). Transparency affects many aspects throughout the product's life cycle, it can impede the waste management process and the reporting and monitoring during production and subsequently the CIA/EIA. Some participants mention the frustration regarding emission measurements and proof of sustainability as either being difficult and costly to verify or being too abstract to grasp (Participant 6; D, 2023).

Other factors

The life expectancy of ICTs within a public organisation varies; laptops are generally kept longer, around 4-5 years, while smartphones range from 1-5 years. Many public organisations lack life cycle management for smartphones and tablets as these product groups are "new" in their assortment, therefore proper evaluation has yet to take place (Participant 3; 5-1, 2023). Many state that the reason a certain life expectancy has been set due to the security reasons mentioned previously. Some mention that this age-limit is due to the financial disadvantage of repairs after a certain age; it simply is not

economically defensible (Participant 4, 2023). However, some participants allow for some freedom if the product is still functional to keep it for a year longer (Participant 3; 6, 2023)

There has been noted a wide range of issues when it comes to the use of second-hand products, especially for public actors and agencies. For public actors, the main experienced barrier regarding second hand products and lifetime extension of products is the enhanced security risk, as older models will either stop receiving security updates or not support them (Participant 1-1 & 1-2; 2; 3; 5-1 & 5-2; 6, 2023). Most organisations are built in a way that may not support the use of second-hand products, there are many uncertainties such as warranty, support, and such (Participant 6-1, 2023). Some suppliers mentioned this as an issue as well, but for them it is the uncertainty of supply and the heterogeneity of products (Participant C, 2023). The product heterogeneity is an issue for procurers as it will take longer for the IT department to update the various models. A rough estimate is that it takes 600 hours to update a computer with the newest windows update, how to update a computer varies from model to model, even within a brand, therefore it will take longer the higher the diversity of models (Participant 1-2). Many procurers state that it is better to procure for the same model, which eliminates suppliers that offer second hand products as they cannot ensure the supply (Participant B; C; E, 2023). Some suppliers use second hand products for a swap pool, for whenever a public organisation needs another phone (Participant C, 2023). This could be when a new person is hired, or when an employee has damaged their existing product to the point of needing a repair. However, Participant E (2023) explains that there needs to be a revolutionary change of how the IT departments are operated as most are not able to handle and offer repairs and services both internally and externally.

3.1.4 Individual

The attitude

Several participants mentioned the culture and mindset of people as a barrier. People are constantly wanting the newest product on the market (Participant 1-2; E, 2023). It is not trendy to have something old or from the second-hand market, it is still considered unrefresh (Participant B & C). This attitude may be limited towards ICT's as Participant E (2023) mentions that the second-hand market for clothes is blooming right now but that it in the beginning was also looked down upon. Half of the participants mention that once there is a new release of a product that many rush to get their hands on it, even if they still have a functioning product There is no clear answer as to why people do this, but some participants speculate that it could be due to the notion that there are new features that are appealing, especially for people who are tech-enthusiasts, or that it is a symbol of status in society. However, as this is not the focus of the essay, thus behavioural aspects have not been studied.

Participants 5-1 & 5-2 (2023) highlight the attitude of people higher up, such as the politicians on both regional and national level. They continue stating that there is no one that takes responsibility for circular actions. It is not advocated nor is the responsibility delegated to someone, which is needed in order to get this started. Participant E (2023) concur with the same sentiment that there is no one person or unit dedicated to circularity whose job it is to drive, measure, and monitor circular implementations. There needs to be a societal mindset shift in order to make circularity popular at all societal levels.

Maturity

The majority of participants mentioned maturity regarding the market and individual either directly or indirectly. If the market or society is not ready for a paradigm shift and transition towards circularity then it is nearly impossible to work towards it (Participant 1-1, 2023). It is further mentioned that there is no demand for products that are coming from the 9 Rs, the focus is rather on the return schemes for products to be resold on the private market. Market immaturity is further notable by the unwillingness of manufacturers to contribute with spare parts and collaborate with service centres. Service centres are instead seen as competitors making profit by repairing and extending the lifetime of a product. Whether the maturity barrier is infrastructural or personal it is still a prevailing issue.

1.3.5 Summary of interview results

Definition issue	Governance	Organisational	Individual
<ul style="list-style-type: none"> • No uniform definition of circularity • Vagueness of sustainability • Debatable during procurement of circular or sustainable products • Difficult to conceptualise and create policies, frameworks, and guidelines 	<ul style="list-style-type: none"> • Lenient regulations and policies regarding circularity = take the easy and convenient route • Some participants consider LOU restrictive, especially if there is a knowledge gap • Lack of standards: pricing of recycled products and material, pricing of repairs and spare parts • Lack of standardised assessment of quality and condition of products, components, and materials that have undergone any of the 9 Rs 	<ul style="list-style-type: none"> • Lack of knowledge and awareness of circularity <ul style="list-style-type: none"> • Using the wrong tendering type • Using no circular or improper criteria • Doing the bare-minimum (inconvenience) • Bulk purchases once contract is up • Misconceptions <ul style="list-style-type: none"> • Apprehensiveness towards PSS • 9 Rs-products, components, and materials are worse quality • Lack of support from management • Lack of proper infrastructure and processes for reverse logistics and other circular activities • No cradle-to-cradle mindset 	<ul style="list-style-type: none"> • Misconceptions <ul style="list-style-type: none"> • "Green" is more expensive • Circular products, components, and materials are not durable. • Attitudes <ul style="list-style-type: none"> • Second-hand is 'unfresh' • Management does not care for circularity • No one wants the responsibility • Greed, wanting to have the newest product on the market

miro

Figure 7. Summary of interview results
A summarisation of the main findings of the interview results.

3.2 Review of cases

3.2.1 Circularity: independent mobile repair shops (DK)

A case from Denmark regarding smartphone repair shops identified several drivers and barriers when it comes to repairs of smartphones. In the Nordics the labour costs are usually high which can be an economic impediment for repairs as new products tend to cost less. However, Riisgaard *et al.*, (2016) state that the prices of smartphones have increased steadily and are relatively costlier compared to other electronic units, which can make repairs more viable, depending on the type of repair needed. The authors highlight that with repairs you are able to get your phone back in the same functional condition as previously, meaning that the owner will not need to reconfigure and reinstall everything on the phone which can be time consuming.

Knowledge in repair shops needs to be high as the smartphone industry is fast evolving, forcing the tech specialists to refresh their know-how. The various brands and models on the market are not created equally, and thus need various tools for repairing.

The greatest barrier is the limited amount of spare parts available and the difficulties of receiving them (Riisgaard *et al.*, 2016). On top of that, most brands only accept repairs from OEMs, however universal spare parts have been used in repairs but have experienced quality issues to some extent.

One of the main barriers to using used spare parts for repairs is the uncertainty of durability, quality, and how repairs with reused components will affect the phone function and quality. There are some legal challenges as well with using second-hand material for repairs as legally the repaired component will have to have a guarantee, not the phone as a whole, only the repaired part. Using reused materials and components for this, in uncertain condition, quality, and thus durability can negatively affect the repair shops, as some defects may take longer to present themselves.

3.3.3 Circular public procurement and reuse of ICTs (BE) and Fairphone (NL)

Flanders in Belgium have started to interpret and adapt circularity into their own policies. They have become a circular hub for stakeholders and invested in circulatory procurement practices regarding ICTs (Circular Flanders, n.d.-b). The projects between buyers and suppliers are a part of Circular Flanders and consist of standardised purchasing contracts for public procurement of ICTs. The standardised contract, which was created in 2019, comprises the same clauses as a regular public procurement document but with criteria and objectives that promotes circular production of ICTs by designing the product chain to be more sustainable (Charlotte

Dewilde, 2019). The circularity aspect here focuses on the manufacturing part of the product life cycle. Circular Flanders (n.d.-b) explain that in order to achieve circularity there needs to be both supply and demand, meaning that the procuring unit needs to request for circular production and activities, hence having circular processes does not automatically ensure CE.

With this Green Deal on Circular Procurement (GDPC), two successful circular public procurement have been completed between 2017 - 2019 (Circular Flanders, n.d.-c) . The key aspects of the implementation of circular public procurement were information sharing and education by forming a network, as circular public procurement is a new area. Dialogue with manufacturers and suppliers is also essential for successful implementation. This network, consisting of buyers and facilitators, was able to identify the barriers and needs for a successful circular public procurement, and this resulted in three actions; (1) an online learning platform; (2) GDPC impact tool; and (3) publications of fact sheets, reports, and checklists. The platform acts as a library where information is shared while the aim of the impact tool is to support procurers formulating objectives, strategies, and targets (Circular Flanders, n.d.-c). According to Circular Flanders (n.d.-c) circularity can be achieved through circular public procurement by 7 steps; (i) needs assessment; (ii) circular targets; (iii) market dialogue; (iv) specification, criteria, and requirements; (v) monitoring during contract; (vi) EOL management; and (vii) contract evaluation. All of the steps are important to ensure a successful circular public procurement, it is stressed that price should not be the sole focus in the award criteria and that through technical specifications and selection criteria PP can become circular. The authors further highlight the importance of tendering type, which should correspond to the circular target set (Circular Flanders, n.d.-d)

Circular Flanders (n.d.-a) showcases one company (BE networks) that purchase used ICTs from suppliers, for instance, after the procurement contract is up, the company will purchase the returned ICTs and process it (recovering materials) and reusing them, thus extending the lifetime of both product and components, additionally, the company extends the warranty period taking the responsibility. A third project with "Out of Use", e-waste collectors, take back any EEE and either reuse or recycle it properly. Their statistics show that they obtain roughly 89% secondary raw materials from this recycling process. Lastly, SNEW BVBA is a company that specialises in reverse logistics and support organisations that want to implement return flows. These various companies illustrate that there are circular solutions and activities on the market.

Fairphones are marketed as sustainable, both socially and environmentally, and have a modular construct, meaning that most components can be disassembled with ease. There are currently three generations of Fairphones available. Reuter et al., (2018) tested the recyclability and recycling efficiency of Fairphone 2 by testing three different recovery methods; (1) smelting; (2) disassemble and selective smelting; and (3) shredding, with shredding generating the highest material recovery by weight, while

route 2 had the highest variety of materials recovered by weight. However, the second route generated the least amount of kgCO₂eq, and the authors concluded that it is the overall best route for material recovery and recycling, and ecological footprint (Reuter et al., 2018). However, proper infrastructure needs to be developed in order for modularity to have the maximum circular and sustainable effect. The processes and activities for modularity may still be in its infancy in some countries and organisations. Reuter *et al.*, (2018) explain that depending on the infrastructure and processes the recovery rate may be as low as 0%. Furthermore, monetary gain from using modular products have not been established yet.

Another aspect to ICTs is the software and security updates. These are often highly regarded by procuring actors, especially in the public sector. The Fairphone 2 model have had a updateability lifespan of 7 years since its launch which is longer than most manufacturers (Porter, 2023). In an article it is stated that, while the Fairphone will still be usable it will become slower and less supporting in daily tasks, make the product suboptimal and risky for businesses (Amadeo, 2021). Both Amadeo (2021) and Porter (2023) suggest that software updates are regulated by software manufacturers, the largest being Google, Android Inc, and Apple Inc.

3.3.4 Circular public procurement policy (DK/FR/GER)

The ICLEI has in collaboration with SPP Regions produced a collations of best practice reports regarding circular procurement (Jones et al., 2017). Three adaptations from three EU countries (Denmark, Germany, and France) are highlighted. The municipality of Samsø in Denmark has developed and implemented a policy that aims to accelerate circularity on both the procuring and bidding side. The policy regards the use of leasing, with criteria that are divided into fixed (must) and optional (recommended). The framework is created so that it is applicable to all types of purchases, but this particular business case is utilised for heating pumps. Jones *et al.*, (2017) explain that the municipality has transitioned to a centralised procurement with circular criteria that promote service agreements, recycled materials, and resource efficiency, which all are examples of the fixed criteria. With a leasing agreement the money is generated through services such as installation and maintenance. The leasing agreement ensures that there is a return process and that all products that are delivered must be returned and dealt with according to their condition. Jones *et al.*, (2017) explain that leasing agreements like these where procurement has been either centralised or in collaboration with several public actors and suppliers has the potential to save energy and resources but has yet to be evaluated. One of main findings are collaborations where several organisations strive for the same goal will have a positive feedback on circular public procurement practices.

As for Germany, the city of Berlin decided to implement a circular policy waste management strategy to increase the recovery rate (Climate-KIC, 2018). The Berlin

House of Representatives passed an act that requires all procurement to include ecological criteria, such as LCC. Nilsson Lewis *et al.*, (2022) adds that LCC has now become an award criteria for some sectors in Germany procurement. This has, according to Climate-KIC (2018), led to cost savings of roughly €38 million yearly and resulted in an emission reduction of approximately 50% for the concerning categories which include office equipment and recycling of commercial waste. It is worth noting that in Germany each state and region have their own procurement policy and is usually not regulated federally, and in most states environmental criteria is still voluntary.

A roadmap of circularity was created for Paris, France. In this circularity roadmap a strategy for responsible public procurement has been developed. The aim of this scheme, just like Samsø, is to increase sustainable and circular purchases by creating a new resource-efficiency criteria; an environmental footprint criteria has been used in more than 60% of the responsible procurement contracts (Climate-KIC, 2018), however on a total scale only 17% of the procurement include one environmental criteria (Nilsson Lewis *et al.*, 2022). France has passed a law that obliges procurement to have a minimum of one environmental award criteria which shifts the focus from the price aspect of procurement. This law will take effect in 2026, and the environmental criteria can be formulated freely. Nilsson Lewis *et al.*, (2022) explains that lack of capacity is an issue for both German and French procurement.

France has adopted an "anti-waste" law in which they created a repairability index that aims to grade a products on how repairable a product is. The index calculations include aspects such as availability of spare parts and modularity or ease of disassembly (Ellen MacArthur Foundation, 2021). This index is used for ICTs and is a core part of the new circular policy adaptation. The estimated outcome for the repairability is to increase reparations with 20% compared to the reference of 40%. The policy also includes EPR schemes to ensure proper handling throughout the product life cycle. The policy was created in collaboration with stakeholders from the beginning and supported by politicians. The impact and outcome of the policy will be evaluated and compared to mid-term targets (5 years at a time).

4. Discussion

4.1 Main findings

Many challenges have been identified at all levels throughout society. The main barriers and connections between each challenge can be seen in figure 8. The discussion will be divided into sections regarding the research questions with another section for additional reflection.

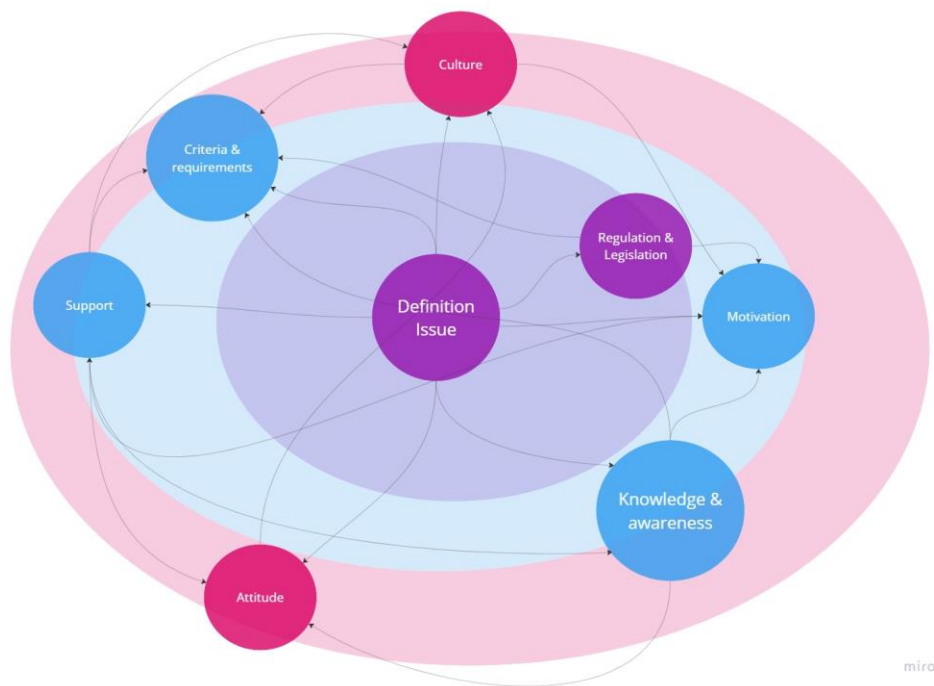


Figure 8 Main barriers.

These are the main issues of circular public procurement (a concise version of figure 3), illustrating the biggest hurdles to overcome for a transition to CE and a successful implementation of circular public procurement for all levels (governance, organisational, and individual). The Lilac bubbles refer to

governance barriers, the blue ones to organisational barriers, while the pink bubbles corresponds to individual barriers.

4.1.1 What is circularity?

The definition issue is global and comprehensive; if there is no uniformity then each nation, organisation, business, and individual can make up their own interpretation of what circularity is and depending on the implication adopt an "appropriate" measure. As illustrated in figure 5 & 9 this will limit the capacity of a mitigating action which corresponds to one portion of the diverse aggregation known as CE. The mitigating action is not incorrect if it fulfils its purpose but it is not fully closing the loop and retaining resources as it is only focused on one or a few aspects of CE. In order to achieve circularity, all aspects need to be regarded. However, an organisation will still be able to implement processes for circular public procurement without a uniform definition, the action however, will not fully close the gap intended. The issue here pertains more towards regulations, policy and framework formulations. It is difficult to create a policy or strategy for circularity if CE is not conceptualised properly (Crafoord et al., 2018). As apparent by the definitions according to the participants, it becomes abstract and overwhelming, which increases the chances of inconsistencies, misdirections, and failure or complete rejection of circular public procurement.

Due to the unfamiliarity and definition issue many procurers may turn to framework-creating agencies for guidance. However, these agencies need to appease a greater crowd, sometimes creating conditions that are either difficult to interpret or very strict (unbendable) leaving little room for your own aspirations. Sustainable frameworks by ADDA or LFASA tend to be for higher acquisition values, excluding smaller actors. Nonetheless, these differing approaches and various definitions lead to actions that are only encompassing a portion of CE.

As circularity needs to encompass all levels throughout society, a single uniform definition will be hard to define and consequently conceptualise and make it tangible. The vagueness and various definitions have led to differing approaches and efforts by throughout these three identified levels (governance, organisational, and individual). Therefore, a proposition is to create specific definitions of circularity sector-wise, even product group specific if needed as product groups within each sector can sometimes vary vastly in terms of components, production, materials, extraction, usage, etc. There can be a general uniform definition of circularity if desired, which should be somewhat abstract whose purpose is to capture the essence of circularity. However, if there are sector and product group specific definitions of circularity then a single and uniform general definition is not needed in order for circular practices to ensue.

4.1.2 Barriers of circular public procurement for ICTs

All of the participants use regulated sustainable criteria, ie. transports, conflict minerals and hazardous substances, packaging, energy- and ecodesign labelling, and other environmental certifications. These factors are formulated clearly and concrete, they are strictly regulated by the EU. Everyone needs to regard it, therefore it has become the bare-minimum of procurement. Green policies and regulations, ie. WEEE and RoHS, push organisations towards environmental awareness but they are not promoting the 9 Rs of Circularity, and focus more on recyclability. This translates into poor circular waste management infrastructure and activities, but also the de facto non-existent standardisation of waste-grading and reconditioning. There are no legally binding documents supporting circular waste management. Because of soft circular regulations most organisations will choose the most convenient and familiar path. It is easy to pick the low hanging fruit, all things circular are still voluntary and the regulations are lenient, thus inconvenient. There is no motivation for organisations to use circular public procurement, especially since much of it relies on personal efforts, ie. finding the information and using appropriate tools to set criteria optimal for circularity, it is time- and resource consuming. Senior management will have to show support and prioritise circularity to overcome the inconvenience. Economic incentives such as subsidies and taxation will also have a positive effect on the likelihood of implementing circular processes. These two solutions (support from authorities and incentives) have been mentioned in the circular policy cases from France, Germany, and Denmark. The coming policy regulations in France and Germany (from 2026) regarding the use of 'must' environmental criteria shows how slowly the process of implementing legally binding circular regulations into public procurement. This is further acknowledged by the fact that the GPP concept has been around longer than the proposed CEAPs yet there is still a low implementation rate of optimal environmental criteria. The Samsø case supports the assumption that in order for circular criteria in form of circular approaches and measures to be enforced, it needs to be regulated higher up, ie. regionally, nationally, or at EU level. The case highlights the use of criteria and circular business models, ie. PSS. According to the literature and interviews there is a general apprehensiveness towards PSS due to the vast structural changes that needs to take place within an organisation for it to become a viable option. PSS is still an emerging innovative business model that needs to be further explored and adjusted to make it an appealing circular solution, but as the case suggests, it can be utilised with support from authorities, even with some uncertainties surrounding it.

The results highlight a knowledge and awareness gap, that will decrease with an engaging management. Several articles and participants hail management as the top facilitator of circular public procurement (Milios, 2018; Qazi & Appolloni, 2022; Sonnichsen & Clement, 2020), which is understandable since most organisations have a top-down approach, meaning that the management has the decisive power and can drive the direction and attitude of the company. The results further indicate that a commitment like this should extend beyond the organisation, many participants

stated that they need governing bodies unafraid of taking responsibility, pushing for a circular agenda. A participant states that they need stronger commitment and communication from politicians and regulators and that this commitment should persist regardless of which party is in charge. Unfortunately, some regulations and policies take time to create and implement, especially in the world of procurement since contracts extend upwards 3-4 years, thus evaluation is trailing behind. By that time, a new government may be in place which has a different agenda. Therefore, in order to increase the chances of continuity of circular aspirations it needs to be regarded at EU-level through legislation. Circularity cannot fully be achieved nationally as public procurement invites actors internationally and in order to create global and universal flows, international collaboration is needed, thus corresponding regulation at EU-level.

There is a second option, and that is to streamline the procurement process. There is a possibility to change the contract term if there is a breach of contract, usually this pertains to either costs or deliverable units (Upphandlingsmyndigheten, n.d.-a). If contractual breaches would encompass circular targets then that would permit contract termination if the procured circular target cannot be met. This could be a temporary ruling as circular public procurement is still a relatively unknown area. Business specific and general case studies regarding circular public procurement for ICTs need to be studied further to determine if this is a viable idea.

LCA/LCCs are proposed tools to utilise during procurement but are time consuming to complete and sometime complex due to transparency and traceability issues. These tools will however, show the true cost of each product and in conjunction with environmental evaluation criteria can promote sustainable products. Arguably, LCA/LCCs are not inherently circular. Instead, using a repairability index as suggested in one of the cases (FR) is more circular as it showcase the ease of which the product can be repaired, dissmantled, and recycled. Therefore, it would be wiser to use LCA/LCCs for price evaluation and repairability indexes as a circular evaluation criteria. Other standardised indexes may be valuable tools for circular public procurement. Repairability index is one aspect of circularity, but other indexes such as, quality assessment for scraps and standardised components will encompass more circular aspects, but for the cases studied, there are no such solutions currently.

A barrier posed by producers is the software updates that have a defined lifespan within a given product. Many participants placed the security aspect high on their priority list during procurement, which is depended on the possibility of upgradability and software maintenance. None of the participants use software requirements and criteria during procurement as software is not yet regulated as opposed to hardware. Software is still solely controlled by the producers, thus even with sophisticated circular measures, processes, and capabilities, it will fall short on the software and subsequently security aspect. The inability to procure for software requirements can be traced back to the inability to influence large manufacturers that already rule a great portion of the market. Thus, a collective effort by the EU to influence the producers

in a circular direction is needed as the hands of public actors and suppliers are tied in this scenario. The producers in the Fairphone case showcase that software updateability is solely up to the software producers as they guarantee a longer updateability compared to many other manufacturers on the market.

4.1.3 The barriers of lifetime extension of ICTs

The attitude and culture of a society can be influenced by the government on national and EU-level. Currently, the attitude towards recyclability is high across the board but the use of refurbished, recondition, etc. ICTs is low, particularly in the public sector. Public actors are apprehensive towards using secondhand ICTs due to various barriers such as security risks (software related), warranty issues, quality and condition assessment, and heterogeneity, among many more. Some of the participants have tried reusing repaired or refurbished products and some have tried purchasing products from the secondhand market. However, the participants stated that the negative aspects and the workload became overwhelming for this to be a viable solution for them. Due to this, many public actors prefer to focus on procuring for reverse logistic processes, ensuring that their "waste" can reenter the economy once again but not back to their organisation. This is where the management can perform a needs analysis of the organisation. The evaluation should include aspects, ie. establishing if there is a need for a new bulk purchase after the contract period is up or if it is feasible to purchase secondhand ICTs for certain departments which do not need high performance products. What can prevent this is the upgradability and updateability of the product which can pose some security risks. Unfortunately, this is managed by the manufacturer, and small actors like Sweden will have a hard time convincing them to change.

The cases reviewed show that there are businesses in the EU that aspire to be circular, eg. Fairphone, Circular Flanders cases, and independent repair shops. However, if the organisation (eg. supplier) or nation/region does not have the proper infrastructure or capacity to process circular products such as modular goods then it is useless to procure for measures such as Design for Modularity or Dismantling. An expansion of appropriate infrastructure, staff with proper knowledge of repairs, refurbishment, etc., appropriate waste management processes and facilities that facilitate circular processes are inevitably needed to maximise the potential of circular products. This will lead to greater initial costs for the organisation or region/nation but investment may return eventually as less money is used on acquiring virgin resources, not to mention the positive environmental feedback. Figure 9 illustrates the activities needed to be able to maintain circularity. Furthermore, other aspects, ie. standards need to be developed to ensure fair pricing and quality assessment. The standardisation needed are for recycled materials/components (quality and condition), pricing for repairs and recycled materials. Currently, the pricing of recycled units,

components and materials are considered high compared to their virgin counterparts. As few suppliers and the mobile repair shop case highlights the labour costs are generally high which makes repairs an unattractive solution. Economic incentives can effectively deal with this barrier, and setting true costs for virgin products and materials will further ease this challenge.

Producers can make repair shops inefficient by not minding the design or providing spare parts. Not only does a longer lifetime equal financial loss for manufacturers but the fact that independent repair shops, like the Denmark case, will simultaneously generate money and gain financially, do not sit well with producers. Shops like these risk being seen as competitors, especially if they use universal spare parts and not from OEMs. Therefore, even if there are activities for circular measures, producers can make it an unappealing solution. Many of the participants experienced push backs from producers regarding the circular processes of reverse logistics. Unfortunately, small actors do not stand a chance against large producers can have a high influence on the current market. Collaborations between producers and suppliers, such as the Fairphone case, can balance out some of the perceived inequalities. The Fairphone case highlights financial gain even with a lifetime extension of the product by providing original spare parts. Because of this, there is no need for repair shops to turn to and use third party components, thus the producers will still make money, indirectly, on repairs. Further money can be made when recovering the materials at the EOL stage. How the financials are distributed between the producer, supplier, and actors is business case specific. Some participating public actors mention that they do not receive a cashback when the procured product gets a new life outside of the organisation, while others do. Therefore, this aspect is purely up for debate during procurement and can become central for producers to be on board with lifetime extensions.


Levels	Barrier	Outcome	Solution	Activity
Governance	No uniform definition Lenient directives and legislation No standardisation No incentives	Doing the right thing half-hearted Doing the right thing, but not all the way Doing the bare minimum BAU	Stricter directives and regulations Policy and guidance Standardisation of: <ul style="list-style-type: none"> quality and condition assessment Pricing on repairs and recycled materials Taxation and subsidies Promote the 9 Rs	Expand infrastructure for reverse logistics Expand capabilities for the 9 Rs (organisational) Waste collection and management Reverse logistics AI assessment Design for Modularity or Disassembly
Organisational	Lack of knowledge and awareness Lack of support from management Bare minimum criteria and requirements Lack of/lenient policies Lack of transparency Business model optimal for LE Life expectancy - bulk purchases	Misconceptions No prioritisation Bare minimum = standard No guidance No collaboration and innovation Renewal before EOL	Education can increase support (competence) Regulations (national/EU): Instil change Information sharing Dynamic contracts Innovative business models, ie, PSS Return process is a must	Workshops (mandatory) Enforce circular policies with indicators Set up sustainable targets, short- and long-term. Clear guidance on circular processes Collaborate with suppliers and SC Innovation partnerships Purchase after organisational needs
Individual	Organisational culture Lack of knowledge Misconceptions Societal rejection/apprehensiveness Greed Lack of responsibility	No implementation Disregard for circularity No demand Renewal before EOL No power, no consequences	Education Accessible information Supply Motivate by: <ul style="list-style-type: none"> True cost of new prod Price deduction of repairs Bust myths of 2nd hand ICTs Delegate responsibility	Start early, school curriculum to spread awareness Mainstream exposure of CE Promote CE on all levels throughout society Appoint responsibility throughout all levels: <ul style="list-style-type: none"> Gov: Politician Org: EPR Ind: Head of Circularity 

Figure 9 Barrier-Outcome, Solution-Activity.

An overview of the barriers and their outcome but also the possibilities and solutions which should be implemented and their activity and processes.

The apprehensiveness towards using products, components, and materials from the 9 Rs due to perceived security risk and durability issues can be addressed by introducing EPR schemes or standards for quality and condition. Milios & Dalhammar (2023) and Richter *et al.*, (2022) explore the attitudes and feasibility of introducing durability labelling which generated positive feedback participants, which can be a complementary solution to the current ecolabels and EPR schemes as it would encourage manufacturers to produce durable products, components, and materials. Furthermore, a solution for warranty of serviced products and components should be agreed on either nationally or at EU-level to delegate and ensure responsibility. The danish case highlighted the issue of warranty and validity for serviced products and components. To make the 9 Rs a viable option and to maximise the effectiveness of eco/durability labelling and warranties, standardisation of quality and condition assessment, the scope of warranties, price of components and materials, and service costs must exist in conjunction with transparency. Otherwise, this will become a unregulated market with a wide range of issues, ie. counterfeit spare parts and materials, quality issues, to illegitimate businesses, which will reflect poorly on circular

aspects and enforcing the negative attitudes towards CE and circular public procurement even further.

Still, the society may not be ready for a circular market judging by the attitudes displayed towards re-used or refurbished ICTs, and the same goes for the organisation. Many organisations are not either equipped with the correct tools for circular actions such as repairs and maintenance or are not willing to purchase remanufactured ICTs due to the above-mentioned issues such as quality and security. At least half of the public actors state that the way the organisation is structured is obstructing the purchasing of refurbished or re-used products. This can be due to inadequate infrastructure and resources such as mentioned lack of IT support and services, repairs, and warranty issues.

All of the suppliers mention that there is limited demand for refurbished products, which can be a sign of individual attitude, but another take on it is the limited supply which is tightly linked with attitude. There are no regulations for promoting refurbishment and remanufacturing at the EOL as seen in directive such as WEEE which mainly focus on proper recyclability of precious elements within EEE.

4.2 Other barriers

Circularity may result in economic losses, however, a system for circular processes can be developed that enable monetary gain for manufacturers even when CE is promoted. This can be in the form of PSS where a subscription is paid for PaaS/HaaS, the ownership will still be with the manufacturer or supplier. PSS promote unit registry and return schemes, and subsequently transparency. However, the organisational structure of most suppliers does not support PSS and most public actors may not have the proper staff and infrastructure to permit it.

Materials usually have definite recyclability as it deteriorates with each recycle. However, this does not automatically mean that the material properties are worse than virgin materials. The properties of the material all depend on their chemical makeup and extraction and production process. This is why you can have a difference in quality and durability between two of the same material. Standardisation of quality and condition assessment is therefore key to appropriately designate the recycled material.

Solutions and activities such as dialogue with the market and suppliers, and information sharing between units will increase the knowledge valuable for upcoming procurement. This is complicated by using open tendering (widely used, see figure 6 in Results) as it does not allow for dialogues. All of the various procedures have their pros and cons regarding implementation of circular criteria which is why it is highly essential for the procurer to be knowledgeable in the area to choose the correct one for each product to be procured to ensure that the outcome has the best environmental solution. Open tendering is the most used procurement method, it is also the most

well-known and established, thus the most convenient. Open tendering, while being the most accessible for bidders, it is the most restrictive in regard to setting criteria and requirements, being cost-focused, formal, and restrictive for innovation and collaboration between procurer and supplier. But the upside of open tendering is that actors that are serious about circularity can enter bidding even if it is not procured by the organisation specifically and can showcase their elaborative circular processes which may lower the price due to the benefits of "added value" if evaluation criteria for circularity is used. However, circular tenders can be excluded due to other criteria such as procuring for new production only.

4.3 Overcoming obstacles

There are numerous projects around the EU that aim to achieve or develop the CE concept. Out of the three cases, two are concerning circular processes of ICTs, all of which have had their fair share of ups and downs. As for the circular public procurement implementation, all is still voluntary EU wide, only some municipalities have started to adopt circular policies and circular public procurement. The municipalities that have utilised stricter environmental and circular criteria has resulted in reduced emissions and more efficient processes, ie. waste management and take-back schemes. The many cases of Circular Flanders have proven that circular public procurement is possible but the low ratio of implementation (only 2 between 2017-2019) illustrates that it is still an emerging area. All of the Flanders cases have support both from the government and between public actors, suppliers, and producers which facilitate the implementation. The various cases studies of ICTs (Circular Flanders, n.d.-a; Fischer et al., 2022) show that there are companies that are dedicated to circularity but as Circular Flanders (n.d.-b) mentioned, the procuring unit needs to make these demands and requirements for CE and circular public procurement to reach their full potential.

The Danish repair shop case, just like the ICT cases, is another circular activity that exists but in order to utilise it there needs to be a demand. However, repair shops rely on reverse logistic processes and standards to function effectively as a circular aspect, which is why governmental interventions are needed to remove these experienced barriers, ie. quality and condition assessment and pricing. The circular public procurement case from Samsø exemplifies the crucial need for governmental and organisational support. It illustrates the possibility to implement circular public procurement, even with the current regulations and other obstacles if you have support and motivation. Knowledge makes the transition easier and the procuring process smoother, particularly in regard to setting criteria and requirements.

4.4 Limitations

The result of this essay is built on the interviews with public actors and suppliers. It is further complemented by a review of three case-areas regarding either CE of ICTs or circular public procurement. An assumption was made that there would be somewhat more result-oriented case studies regarding circular public procurement in the EU but unfortunately many case studies on the European Commission's webpage are concerning GPP, and the ones that regard circularity have yet to be implemented, such as the case with France and Germany aspiring to use stricter regulations. The results for most implementations of circular public procurement are scarce or yet to be evaluated as it is somewhat a new and novel approach. The Circular Flanders cases had to be translated into English using the help of various translation programmes posing a risk of information loss or incorrect translations.

The interviews reflect the Swedish market and approach to circular public procurement. However, the aim is to generalise and find trends that are applicable to all EU member states. There might be some aspects that are only representative for Sweden or specific business cases, ie. size. With personal interviews there is always a possibility for misinterpretation, especially translations. Other risks include dishonesty or being inclined to answer a certain way depending on several factors, ie. sensitive subjects, particularly if it concerns organisational activities and structure. This has been partially mitigated by anonymity.

4.5 Future research

It would be valuable to compare the results of this essay, which focuses on the challenges of implementing circular public procurement for ICTs, with the results of other countries outside of the EU, such as China and the US as other countries may have different approaches and solutions to the barriers that are prevalent here. Since countries outside of the EU will have regulation and legislation dissimilar to the EU therefore impacting CE differently, barriers that the EU experience may be non-existent in non-EU countries. Hence, EU legislators may be able to find solutions for our regulatory challenges. Looking for answers towards other non-EU countries may also present policies and frameworks that are more successful in achieving CE than the ones that the EU have recommended.

It would further be relevant to research solutions for these experienced barriers, ie. regulatory barriers, in other sectors that have come further in circularity. For instance, it is more accepted to purchase second-hand clothing, and the EU has approved a new law, "EU strategy for Sustainable and Circular Textiles" which aims to boost the recycling rate of textiles by implementing a separate waste stream and

introducing EPR for this sector (COM (2022) 141 Final). The communication strategy aims to support circularity by introducing mandatory eco-design requirements and green criteria. The EU will revise the current waste directive to incorporate an EPR scheme and to monetise waste collection and management. The law will take force by 1 January 2025. Stricter directives like these will incite transformation of a market towards more sustainable habits. Thus, it would be relevant to compare the circular public procurement implementation rate for various sectors, and how directives like this will affect procurement of textiles.

Exploring more cases from various sectors with calculated and proven results, both negative and positive will increase the knowledge of estimated outcome and impact of a circular measure, especially in cases of public procurement. Unfortunately, many of the cases studied did not have any results as of yet since the concept of circularity is still new. Further research focusing on studying various circular cases can give valuable insight for creating and adopting cross-sectoral circular regulations and policies.

5. Conclusion

This essay has identified several challenges for implementing circular public procurement for ICTs in the EU at three levels; (1) governance; (2) organisational; and (3) individual. One of the main challenges is the lack of uniform definition of circularity. It is challenging to achieve CE and create and conceptualise regulations and policies for circular public procurement if the definition is up for interpretation to everyone which leaves room for differing approaches with various outcomes based on individual knowledge and beliefs. A single general definition of circularity cannot encompass all levels and sectors efficiently, it is too broad of a concept to apply to vastly differing sectors and measures, leading to failure to adapt and comply, and thus not needed. Therefore, this essay suggests creating sector or product group specific definitions of circularity which will make strategizing circular public procurement, circular actions and adaptations easier and smoother for all. It will be easier to conceptualise circularity and transition all of its aspects from theory to practice. Stricter regulation in conjunction with economic incentives will encourage actors to implement circular public procurement as people and businesses in general tend to choose the most convenient path that is familiar.

A committed and aware senior management will facilitate the implementation of circular public procurement as an engaging management will prioritise circularity and spread awareness throughout the organisation, ensuring circular processes at all levels, even without proper regulations. Management can incite pre-procurement activities that are central for a successful procurement process. Putting in effort during the pre-procurement stage by assessing the market, having dialogues, etc. can aid in determining the best circular approach for a particular procurement. Knowledge and awareness are also central for implementing appropriate circular criteria.

It is acknowledged that circular public procurement is still in its infancy, thus there is a knowledge gap that needs to be addressed by stricter policies and frameworks, and supporting governing bodies such as NAPP, LFASA, and ADDA, to increase implementation rate. Appropriate knowledge is vital throughout all levels; the government needs knowledge to formulate proper regulations while the organisation needs it to formulate proper procurement decisions (need assessment, targets, market dialogue, and setting of criteria). There are several factors on various levels that influence the successfulness of circular public procurement implementation, including proper infrastructure for reverse logistics activities and processes such as DfM/D. Individual awareness is decisive for creating a supporting circular culture and

to combat any misconceptions. A summarisation of the conclusions to each research question can be found in Figure 10 below. Further summary of potential mitigating actions and solutions can be seen in figure 9.

RQ1	RQ2	RQ3
<p>How is circularity defined? (and how does it impact circular public procurement?)</p>	<p>What are the potential barriers for implementing circular public procurement for ICTs (i.e. smartphones, tablets, and laptops) within the EU and Sweden?</p>	<p>What barriers exist for lifetime extension of ICTs through circular public procurement?</p>
Conclusion		
<p>Vague definition gives room for interpretation which will lead to: A. Non-uniform measures B. Difficulties to conceptualise CE C. Creating inconsistent policies and regulations D. Rejection of circularity</p>	<p>Lenient and soft regulations impact the efforts of implementing circular public procurement or circular measures = choosing the most convenient route LOU can be restrictive, especially if staff is uncertain which can discourage circular efforts Many rely on WEEE & RoHS but these directive do not promote circularity</p> <p>Lack of knowledge and awareness results in: A. Implementing inappropriate or no circular criteria B. Doing the bare minimum C. Choosing inappropriate tendering type. D. Choosing the easy and convenient route which promotes the linear business model.</p> <p>Lack of support from management makes circular public procurement cumbersome, if not impossible</p>	<p>Many nations, regions, and organisations lack infrastructure and processes that enable circular activities, ie. DfM/D, reverse logistics, repairs, etc. which makes procuring for lifetime extension futile as these products and processes cannot maximise their potential.</p> <p>Circular products and processes are considered unattractive because: A. Lack of standards for pricing of repairs and recycled products, components, and materials B. Lack of standards for quality and condition assessment of recycled products, components, and materials. C. Lack of EPR and take-back schemes. D. Misconceptions and attitudes towards second-hand and second-life products, components, and materials. Most of these issues can be resolved (see figure 9)</p> <p style="text-align: right;">miro</p>

Figure 10. Summary of conclusions.

A visual summary of the concluded results and reflections. Figure 9 complements this figure with potential solutions to each barrier.

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Bibliography

2. 0-LCA, Directorate-General for Environment (European Commission), Heid und Partner Rechtsanwälte GmbH, Pré, RISE, Umweltbundesamt, Hofbauer, B., Tisch, A., & Schreiber, H. (2021). *Study on the implementation of life cycle assessment and environmental footprint methods in the context of public procurement: Final report*. Publications Office of the European Union. <https://data.europa.eu/doi/10.2779/74025>
- 2022/C 182/01, no. 2022/C 182/01 (2022). <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022XC0504%2801%29&qid=1651649049970>
- Aloini, D., Dulmin, R., Mininno, V., Stefanini, A., & Zerbino, P. (2020). Driving the Transition to a Circular Economic Model: A Systematic Review on Drivers and Critical Success Factors in Circular Economy. *Sustainability*, 12(24), Article 24. <https://doi.org/10.3390/su122410672>
- Amadeo, R. (2021, March 25). *Fairphone suggests Qualcomm is the biggest barrier to long-term Android support*. Ars Technica. <https://arstechnica.com/gadgets/2021/03/the-fairphone-2-hits-five-years-of-updates-with-some-help-from-lineageos/>
- Bildtgard, T., & Tielman, S. (2017). *Hur man gör litteraturoversikter*. <https://doi.org/10.13140/RG.2.2.12982.09285>
- C/2022/2026 final/2, no. C/2022/2026 final/2 (2022). [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=PI_COM:C\(2022\)2026&qid=1649313226650](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=PI_COM:C(2022)2026&qid=1649313226650)
- Charlotte Dewilde. (2019). *Clausules standaardbestek voor de circulaire aankoop van ICT-apparatuur | Bond Beter Leefmilieu*. <https://www.bondbeterleefmilieu.be/artikel/clausules-standaardbestek-voor-de-circulaire-aankoop-van-ict-apparatuur>
- Circular Flanders. (n.d.-a). *FACTSHEETS. 40 Leveranciers stellen hun circulair aanbod voor*. Retrieved 10 May 2023, from <https://docplayer.nl/104937851-Factsheets-40-leveranciers-stellen-hun-circulair-aanbod-voor-p-62-p-73-p-21-p-53-p-40-p-2-ict-bouw-kantoormeubilair.html>
- Circular Flanders. (n.d.-b). *Public procurement for circular ICT equipment*. Aankopen Vlaanderen Circulair. Retrieved 23 January 2023, from <https://aankopen.vlaanderen-circulair.be/en/cases/detail/public-procurement-for-circular-ict-equipment>
- Circular Flanders. (n.d.-c). *Retrospect—Vlaanderen Circulair*. Retrieved 10 May 2023, from <https://vlaanderen-circulair.be/en/retrospect>
- Circular Flanders. (n.d.-d). *The 7 steps of the circular purchasing process—Aankopen Vlaanderen Circulair*. Retrieved 10 May 2023, from <https://aankopen.vlaanderen-circulair.be/en/getting-started/the-7-steps-of-the-circular-purchasing-process>
- Climate-KIC. (2018). *Municipality-led-circular-economy-case-studies-compressed-ilovepdf-compressed.pdf*. <https://www.climate-kic.org/wp-content/uploads/sites/15/2018/12/Municipality-led-circular-economy-case-studies-compressed-ilovepdf-compressed.pdf>

- Crafoord, K., Dalhammar, C., & Milios, L. (2018). The use of public procurement to incentivize longer lifetime and remanufacturing of computers. *Procedia CIRP*, 73, 137–141. <https://doi.org/10.1016/j.procir.2018.03.316>
- Cucchiella, F., D’Adamo, I., Koh, S. C. L., & Rosa, P. (2015). Recycling of WEEEs: An economic assessment of present and future e-waste streams. *RENEWABLE & SUSTAINABLE ENERGY REVIEWS*, 51, 263–272. <https://doi.org/10.1016/j.rser.2015.06.010>
- Dalhammar, C. (2016). Industry attitudes towards ecodesign standards for improved resource efficiency. *Journal of Cleaner Production*, 123, 155–166. <https://doi.org/10.1016/j.jclepro.2015.12.035>
- Directive 2011/65/EU, no. 2011/65/EU (2011). <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:02011L0065-20160715&from=EN>
- Dzhengiz, T., Miller, E. M., Ovaska, J.-P., & Patala, S. (2023). Unpacking the circular economy: A problematizing review. *International Journal of Management Reviews*, 25(2), 270–296. <https://doi.org/10.1111/ijmr.12329>
- Ellen MacArthur Foundation. (n.d.). *Circular economy introduction*. Retrieved 27 April 2023, from <https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview>
- Ellen MacArthur Foundation. (2021). *France’s Antiwaste and Circular Economy Law: Eliminating waste and promoting social inclusion*.
- EPRS. (n.d.). *Circular economy*. Retrieved 30 January 2023, from [http://www.europarl.europa.eu/thinktank/infographics/circulareconomy/public\(EU\)2017/821,\(2020\).http://data.europa.eu/eli/reg/2017/821/2020-11-19/eng](http://www.europarl.europa.eu/thinktank/infographics/circulareconomy/public(EU)2017/821,(2020).http://data.europa.eu/eli/reg/2017/821/2020-11-19/eng)
- European Commission. (n.d.-a). *A European Green Deal* [Text]. European Commission - European Commission. Retrieved 10 January 2022, from https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
- European Commission. (n.d.-b). *About the energy label and ecodesign*. Retrieved 11 May 2023, from https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign/about_en
- European Commission. (n.d.-c). *Circular economy action plan*. Retrieved 16 February 2022, from https://ec.europa.eu/environment/strategy/circular-economy-action-plan_en
- European Commission. (n.d.-d). *Circular Procurement—GPP - Environment—European Commission*. Retrieved 30 January 2023, from https://ec.europa.eu/environment/gpp/circular_procurement_en.htm
- European Commission. (n.d.-e). *Ecodesign for sustainable products*. Retrieved 11 May 2023, from https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/sustainable-products/ecodesign-sustainable-products_en
- European Commission. (n.d.-f). *Public procurement*. Retrieved 9 December 2021, from https://ec.europa.eu/growth/single-market/public-procurement_en
- European Commission. (n.d.-g). *Regler för offentlig upphandling i EU*. Your Europe. Retrieved 27 April 2023, from https://europa.eu/youreurope/business/selling-in-eu/public-contracts/public-tendering-rules/index_sv.htm

- European Commission. (2016). *Buying green! :A handbook on green public procurement : 3rd edition*. (Vol. 2016). Publications Office. <https://data.europa.eu/doi/10.2779/246106>
- European Commission. (2017). *Public Procurement for a Circular Economy. Good Practice and Guidance*. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52008DC0400>
- 2019/771/EU, 2019/771/EU, EP, CONSIL, 136 OJ L (2019). <http://data.europa.eu/eli/dir/2019/771/oj/eng>
- European Commission. (2013, November 15). *Methodology for ecodesign of energy-related products (MEErP 2011): Methodology report. Part 2, Environmental policies & data*. [Website]. Publications Office of the European Union. <http://op.europa.eu/en/publication-detail/-/publication/b7650397-32f1-436c-82c4-df39aef297a3>
- European Commission. (2021, July 14). *Delivering the European Green Deal*. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en
- European Commission. (2022). *Public tendering rules in the EU*. Your Europe. https://europa.eu/youreurope/business/selling-in-eu/public-contracts/public-tendering-rules/index_en.htm
- European Parliament. (2020, December 23). *E-waste in the EU: Facts and figures (infographic) | News | European Parliament*. <https://www.europarl.europa.eu/news/en/headlines/society/20201208STO93325/e-waste-in-the-eu-facts-and-figures-infographic>
- European Parliament. (2023). *Circular economy: Definition, importance and benefits | News | European Parliament*. <https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits>
- Fischer, A., Pascucci, S., & Dolfmsa, W. (2022). Designing a circular contract Template: Insights from the fairphone-as-a-Service project. *Journal of Cleaner Production*, 364, 132487. <https://doi.org/10.1016/j.jclepro.2022.132487>
- Gomm, R., Hammersley, M., & Foster, P. (2009). Case Study and Generalization. In R. Gomm, M. Hammersley, & P. Foster, *Case Study Method* (pp. 98–115). SAGE Publications Ltd. <https://doi.org/10.4135/9780857024367.d9>
- Grafström, J., & Aasma, S. (2021). Breaking circular economy barriers. *Journal of Cleaner Production*, 292, 126002. <https://doi.org/10.1016/j.jclepro.2021.126002>
- Hamel, J., Dufour, S., & Fortin, D. (1993). *Case Study Methods*. SAGE Publications, Inc. <https://doi.org/10.4135/9781412983587>
- Johnson, J. M., & Rowlands, T. (2012). The Interpersonal Dynamics of in-Depth Interviewing. In J. Gubrium, J. Holstein, A. Marvasti, & K. McKinney, *The SAGE Handbook of Interview Research: The Complexity of the Craft* (pp. 99–114). SAGE Publications, Inc. <https://doi.org/10.4135/9781452218403.n7>
- Jones, M., Kinch Sohn, I., & Lysemose Bendsen, A.-M. (2017). *Circular_Procurement_Case_Study_Collection.pdf*. ICLEI. https://circulars.iclei.org/wp-content/uploads/2021/01/Circular_Procurement_Case_Study_Collection.pdf
- Konkurrensverket. (n.d.). *LOU i korthet | Konkurrensverket*. Retrieved 21 February 2023, from <https://www.konkurrensverket.se/upphandling/lagar-och-regler/lou-i-korthet/>

- Lugnet, J., Ericson, Å., & Larsson, T. (2020). Design of Product–Service Systems: Toward An Updated Discourse. *Systems*, 8(4), 45. <https://doi.org/10.3390/systems8040045>
- Marrucci, L., Daddi, T., & Iraldo, F. (2019). The integration of circular economy with sustainable consumption and production tools: Systematic review and future research agenda. *JOURNAL OF CLEANER PRODUCTION*, 240. <https://doi.org/10.1016/j.jclepro.2019.118268>
- Milios, L. (2018). Advancing to a Circular Economy: Three essential ingredients for a comprehensive policy mix. *SUSTAINABILITY SCIENCE*, 13(3), 861–878. <https://doi.org/10.1007/s11625-017-0502-9>
- Milios, L., & Dalhammar, C. (2023). *Consumer Perceptions of Product Lifetimes and Labelling: Implications for Introducing a Durability Label*. <https://circulareconomyjournal.org/articles/consumer-perceptions-of-product-lifetimes-and-labelling-implications-for-introducing-a-durability-label/>
- Nightingale, A. J. (2020). Triangulation. In A. Kobayashi (Ed.), *International Encyclopedia of Human Geography (Second Edition)* (pp. 477–480). Elsevier. <https://doi.org/10.1016/B978-0-08-102295-5.10437-8>
- Nilsson Lewis, A., Kaaret, K., & Piirsalu, E. (2022). *Decarbonizing the EU's road and construction sectors through green public procurement: The case of France and Germany*. Stockholm Environment Institute. <https://doi.org/10.51414/sei2022.044>
- Porter, J. (2023, March 7). *Fairphone 2 gets its final software update, seven years after original release*. The Verge. <https://www.theverge.com/2023/3/7/23628602/fairphone-2-final-update-end-of-life-android-10-seven-years-support>
- Qazi, A., & Appolloni, A. (2022). A systematic review on barriers and enablers toward circular procurement management. *SUSTAINABLE PRODUCTION AND CONSUMPTION*, 33, 343–359. <https://doi.org/10.1016/j.spc.2022.07.013>
- Reuter, M., Schaik, A., & Ballester, M. (2018). Limits of the Circular Economy: Fairphone Modular Design Pushing the Limits. *World of Metallurgy - ERZMETALL*, 71.
- Richter, J. L., Svensson-Hoglund, S., Dalhammar, C., Russell, J. D., & Thidell, Å. (2022). Taking stock for repair and refurbishing: A review of harvesting of spare parts from electrical and electronic products. *Journal of Industrial Ecology*, n/a(n/a). <https://doi.org/10.1111/jiec.13315>
- Riisgaard, H., Mosgaard, M., & Zacho, K. (2016). Local Circles in a Circular Economy-The Case of Smartphone Repair in Denmark. *European Journal of Sustainable Development*, 5, 109.
- Saidani, M., Yannou, B., Leroy, Y., Cluzel, F., & Kendall, A. (2019). A taxonomy of circular economy indicators. *Journal of Cleaner Production*, 207, 542–559. <https://doi.org/10.1016/j.jclepro.2018.10.014>
- Sonnichsen, S., & Clement, J. (2020). Review of green and sustainable public procurement: Towards circular public procurement. *JOURNAL OF CLEANER PRODUCTION*, 245. <https://doi.org/10.1016/j.jclepro.2019.118901>
- Svensson-Hoglund, S., Richter, J. L., Maitre-Ekern, E., Russell, J. D., Pihlajarinne, T., & Dalhammar, C. (2021). Barriers, enablers and market governance: A review of the policy landscape for repair of consumer electronics in the EU and the U.S. *JOURNAL OF CLEANER PRODUCTION*, 288. <https://doi.org/10.1016/j.jclepro.2020.125488>

- TCO. (n.d.). About TCO Certified. *TCO Certified*. Retrieved 30 January 2023, from <https://tcocertified.com/tco-certified/>
- Tight, M. (2017). *Understanding Case Study Research: Small-scale Research with Meaning*. SAGE Publications Ltd. <https://doi.org/10.4135/9781473920118>
- Upphandlingsmyndigheten. (n.d.-a). *Ändringar av avtal*. Retrieved 12 May 2023, from <https://www.upphandlingsmyndigheten.se/regler-och-lagstiftning/olika-sorters-avtal-och-kontrakt/andringar-av-avtal/>
- Upphandlingsmyndigheten. (n.d.-b). *Cirkulär ekonomi i inköpsprocessen*. Retrieved 27 April 2023, from <https://www.upphandlingsmyndigheten.se/om-hallbar-upphandling/miljomassigt-hallbar-upphandling/upphandling-for-att-framja-cirkular-ekonomi/cirkular-ekonomi-i-inkopsprocessen/>
- Upphandlingsmyndigheten. (n.d.-c). *Hållbar upphandling*. Retrieved 18 January 2023, from <https://www.upphandlingsmyndigheten.se/om-hallbar-upphandling/>
- Upphandlingsmyndigheten. (n.d.-d). *Myter om dialog i offentlig upphandling*. Retrieved 8 March 2022, from <https://www.upphandlingsmyndigheten.se/inkopsprocessen/forbered-upphandling/tidig-dialog/myter-om-dialog/>
- Upphandlingsmyndigheten. (n.d.-e). *Om offentlig upphandling*. Retrieved 18 January 2023, from <https://www.upphandlingsmyndigheten.se/om-offentlig-upphandling/>
- Upphandlingsmyndigheten. (n.d.-f). *Upphandling för att främja cirkulär ekonomi*. Retrieved 27 April 2023, from <https://www.upphandlingsmyndigheten.se/om-hallbar-upphandling/miljomassigt-hallbar-upphandling/upphandling-for-att-framja-cirkular-ekonomi/>
- Upphandlingsmyndigheten. (n.d.-g). *Välja upphandlingsförfarande*. Retrieved 10 March 2023, from <https://www.upphandlingsmyndigheten.se/inkopsprocessen/forbered-upphandling/valja-upphandlingsforfarande/>
- Upphandlingsmyndigheten. (2022). *Statistik om annonserade upphandlingar i Sverige 2021*. <https://www.upphandlingsmyndigheten.se/statistik/upphandlingsstatistik/statistik-om-annonserade-upphandlingar-i-sverige-2021/>
- Warren, C. A. B. (2001). Qualitative Interviewing. In J. Gubrium & J. Holstein, *Handbook of Interview Research* (pp. 83–102). SAGE Publications, Inc. <https://doi.org/10.4135/9781412973588.n7>
- Williamson, K. (2018). Chapter 13—Ethnographic research. In K. Williamson & G. Johanson (Eds.), *Research Methods (Second Edition)* (pp. 311–335). Chandos Publishing. <https://doi.org/10.1016/B978-0-08-102220-7.00013-3>

Appendix A. Interview questions

Questions for procurers in Swedish

1. Berätta lite allmänt om dig, din position, och erfarenhet med offentliga upphandlingar?
 1. Vad är er kännedom om hållbarhet och cirkularitet? Har ni fått någon träning eller dyl i det?
2. Vad är en cirkulär ekonomi enligt dig (definiera din uppfattning av cirkularitet) när det kommer till upphandling av ICTs (i detta fall är vi enbart intresserade av de bärbara IT produkter: Laptops, tablets och smartphones)
3. Hur ser upphandlingsprocessen (inköpsprocessen) ut för er just nu?
 1. Vilken är den vanligaste upphandlingsförfarande: öppen, selektiv, förhandlat med föregående annonsering, förhandlat utan föregående annons, konkurrenspräglad, innovationspartnerskap, eller projekttävling.
 2. Följer ni något ramverk med hållbara och miljöanpassade riktlinjer för ICTs?
 1. Ställer ni miljökrav på ICTs?
 2. Ecolabeling?
 3. Har ni implementerat cirkularitet i upphandlingsprocessen?
 1. Om ja, var i processen?
 2. Vad innebär det och vilka resultat har ni kunnat se?
 3. Om nej, varför inte (vilka hinder har ni stött på och var i processen)?
4. Vilka avtalstyper för upphandling av ICTs är de vanligaste som ni brukar ingå i, och varför? (PSS såsom PaaS/HaaS, leasing, traditionellt köpeavtal, osv)
 1. Samordnade upphandlingar?
5. Kan ni identifiera samt rangordna (ur ert perspektiv) de största utmaningar för upphandlare att övergå/accelerera övergången till cirkulära offentliga upphandlingar? (Detta omfattar inte enbart upphandlings/inköpsprocessen utan även externa faktorer såsom leverantörer, end-users, marknaden, kunskaps- och/eller kommunikationsbrist osv.)
 1. Finns det utvärderingsfaktorer som motverkar/försvårar cirkulära upphandlingar av ICTs, ie. kostnad, kvalitet, eller andra krav?
6. Vad hade ni behövt (verktyg, ramverk, samarbeten, diverse styrande instrument, etc.) för att accelerera cirkulära upphandlingsprocesser i framtiden;

1. För er upphandlare?
 2. För upphandlingsavdelningen?
 3. För hela organisationen?
7. Ordet är ditt: här kan du fritt lyfta fram antingen något som du tycker har missats under intervjun gällande cirkulära upphandlingar samt om du vill lyfta fram något som du anser vara extra viktigt/avgörande för en framgångsrik cirkulär upphandlingsprocess.

Questions for suppliers in Swedish

1. Berätta lite allmänt om dig, din position, och erfarenhet med utlysningar för offentliga upphandlingar?
2. Vad är en cirkulär ekonomi enligt dig (definiera din uppfattning av cirkularitet) när det kommer till upphandling av ICTs (i detta fall är vi enbart intresserade av de bärbara IT produkter: Laptops, tablets och smartphones)
 1. Har ni någon erfarenhet av att jobba med att miljöanpassa produkter?
3. Har ni verktyg eller principer för att anpassa era produkter (ICTs) eller processer för cirkularitet?
 1. Har ni utsatta mål för detta, ingår detta i er policy, rapportering etc?
 2. Följer ni upp och ser ni resultat?
 3. Om nej, varför inte?
 4. Vilken cirkulär anpassning ställer ni er mest positiv till? Eg. förlängda garantier, design for ease of dismantle, reparationer, osv.
4. Vad erbjuder ni för avtalstyper? Eg. köpavtal av ICT eller erbjuder ni även servicelösningar såsom HaaS/PaaS (product/hardware as a service)?
 1. Har ni något avtal gällande återbruk av era produkter (ICTs)?
 2. Hur funkar det i så fall och vilka resultat har ni sett (servicelösningar och/eller återbruk)?
5. Inför upphandlingar: hur interagerar och kommunicerar ni med era kunder relaterat till hållbarhet och cirkularitet?
 1. Vilken information är tillgänglig för er?
 2. Vilken information är tillgänglig för era kunder?
 3. Har ni upplevt krav från upphandlare som berör cirkularitet?
 1. Hur är dessa krav formulerade?
 4. Vem och/eller vad anser ni har störst inverkan på er att möjliggöra/accelerera en övergång till cirkularitet och hur?
6. Kan ni identifiera samt rangordna (ur ert perspektiv) era största utmaningar med att övergå/accelererar övergång till en cirkulär ekonomi för er? (pris, råvaror, kvalitet, lagstiftning osv).
 1. Vilka hinder har ni stött på från era kunder?
 2. Vilka hinder har ni stött på inom företaget?
 3. Vilka hinder har ni stött på under avtalstiden (samarbetet mellan er och kunden)?

7. Vad hade ni behövt (verktyg, ramverk, diverse styrande instrument, etc.) för att accelerera en övergång till en cirkulär ekonomi?
8. Ordet är ditt: här kan du fritt lyfta fram antingen något som du tycker har missats under intervjun gällande cirkulär ekonomi samt om du vill lyfta fram något som du anser vara extra viktigt/avgörande för en framgångsrik övergång till cirkulära ekonomi/framgångsrik implementering av cirkulära processer.

Appendix B. Literature search for overview

Table 1. Literature overview search.

A clarification of the literature overview search, including searched keywords with filters for inclusion and exclusion criteria. The number to the left of the arrow in the #articles column represents the number of hits from the initial search before any filtering has been applied. The number to the right of the arrow represents the number of hits obtained after inclusion filters and lastly the number within the parenthesis represents the remaining number of articles after the exclusion process, including the omission of duplicates. A total of two different searches were made in WoS and one at the IIEE publication webpage.

Database	Fields	Keywords	Inclusion	Exclusion	# articles
Web of Science	Topic	"green public procurement" OR GPP OR GP OR "sustainable public procurement" OR SPP OR SP OR "circular public procurement" OR CPP OR CP AND CE OR "circular econom*" OR circularity	GEO: EU LANG: ENG Years: 2008 - 2023 (March) Peer review	Title and abstract	2649 --> 54 (4)
Web of Science	Topic	"circular econom*" OR CE OR circularity AND barriers	GEO: EU LANG: ENG Years: 2008 - 2023 (March) Peer review	Title and abstract	4936 --> 163 (3)
IIEE publications	X	circularity, CE, circular economy, ICTs, smartphones, laptops, tablets, regulations and policies	LANG: EU	Title and abstract	1475 --> 5 (3)

Appendix C. Literature overview

3.1 Literature review

3.1.1 Governance

Regulations & Policies

Marrucci *et al.*, (2019) explain that the use of less hazardous substances in products can increase the recyclability, which has a positive impact on the environment by more efficient resource management but also by restricting the use of environmentally damaging materials. Dzhengiz *et al.*, (2023) mentions that CE often focuses on eco-design and near endless reuse of product and/or components. Milios (2018) identified recyclability as a barrier as materials have a definite number of cycles. The materials are downcycled at some point due to the quality, ultimately discarding it. Milios (2018) suggests creating policies and innovative business models regarding lifetime extension of products. NAPP & LFASA predict a greater focus on lifetime extension of ICTs as well as further development of procuring for remanufactured units (Crafoord *et al.*, 2018). However, in order for this to work, appropriate infrastructure, facilities, and systems are needed to increase the recovery rate at each step and life cycle. The current EU legislation and policy-mix fail to do this (Milios, 2018). Some legal documents may be either obstructing efficient adaptation of CE or simply inadequate to ensure proper implementation of the CE concept, lacking in regulation of waste management and treatment, including ease of dismantle, recyclability, reusability, etc., which are key aspects of CE (Marrucci *et al.*, 2019). Grafström & Aasma (2021) support this notion of weak and inconsistent policies regarding CE on both national and international level. It is considered a widespread problem and limiting for a transition towards CE. The issues range from waste classification disparities and high costs of waste management to lack of cross-border cooperation when creating policies and laws. Many policies in the EU are waste-focused but are unsuccessful in recovering most materials and promoting reuse and repair (Milios, 2018). Dzhengiz *et al.*, (2023) elaborates, eco-designs and eco-standards, and certifications are currently considered enablers and barriers at the same time. Their inherent purpose is on a par with CE and can be used to facilitate and signal sustainable efforts, however, the lack of standardisation is a major barrier. Therefore, DfM/D may be futile as EOL processes are underdeveloped due to soft regulations. Additionally, it is stated that "soft" policy

regulations from the EU do not have as great of an effect on circular public procurement as committed politicians and public officials, knowledge, and the organisational structure (Sonnichsen & Clement, 2020).

An identified argument against implementing EOL treatment in the form of reusability is perceived risk of security, however, a study found no trade-off between CE proposed EOL treatments and potential security issues. The study further confirms that EOL treatment strategies need to be made regulatory and mandatory in order to have the needed effect of improved resource utilisation. Currently, there are several barriers to successfully implement EOL treatments, ie. repairs. Svensson-Hoglund *et al.*, (2021) mention both legal barriers and the limited profitability of repairs due to the costs of spare parts and labour. It is further argued that policies and regulations are key to overcoming this obstacle and exemplify the EU Ecodesign Directive, which promotes a "right to repair" and incentivises OEMs to provide tools and spare parts (Svensson-Hoglund *et al.*, 2021). Feedback from various EU suppliers corroborates the notion that certain waste management options are preferred, such as improved durability over extended consumer warranty and dismantling (Dalhammar, 2016). Durability labelling is associated with quality and trust, and is shown to have a more positive connotation compared to repairability (Milios & Dalhammar, 2023).

An emphasis is put on the cradle-to-cradle mindset when it comes to resource use, giving both industrial and ecological balance to the system, recapturing value in "waste". Still, Dzhengiz *et al.*, (2023) highlights the issues of the quality of waste, which can be hazardous and impure to varying degrees, and consequently challenging since there is no standardisation.

A crucial issue is the lack of information about how to achieve the goals set in the assumptions of CE, this includes limited data on the internal processes, incentives, regulations, and other supporting materials (Dzhengiz *et al.*, 2023). Therefore, instruments, ie. legislation, policies, and support, and economic drivers are the powerful enablers that facilitate and encourage a transition to CE. Aloini *et al.*, (2020) explain that governmental interventions are pivotal for this transition as they have the potential to not only affect the economic choices of organisations but also urge various sectors and stakeholders to implement sustainable habits and processes through proper legislation. However, Dzhengiz *et al.*, (2023) explains that the transition towards CE is a slow process; it is time consuming to implement CE at all levels in the society. The results of CE are often debated and at times unclear, which can slow down the transition rate even further as today's society is very result oriented.

Lastly, waste management of EEE is regulated by the WEEE directive (2012/19/EU) which encourages recycling and recovering of precious materials to a certain extent which is in line with GPP/SPP but not circular public procurement. Going back to the 9 Rs, the WEEE directive does not promote reuse, refurbish, full recovery, and reduction, therefore these systems are neglected in favour of recycling (Qazi & Appolloni, 2022). Most environmental regulations are voluntary, therefore if no support is shown from politicians and management then implementing circular

solutions will be hard. Many authors claim that GPP/SPP can act as a springboard for circular public procurement (Milios, 2018; Sonnichsen & Clement, 2020) but Qazi & Appolloni (2022) give another perspective, that GPP/SPP can shift the focus away from circular public procurement, that the government and organisation unknowingly may dismiss circular public procurement in favour of GPP/SPP.

Other Factors

The main difference between SPP/GPP and circular public procurement is how they handle the EOL stage of a product; circular public procurement aims to keep the product or components within the system loop for longer, thus reducing waste and promoting reuse of materials (Qazi & Appolloni, 2022). Sonnichsen & Clement (2020) state that GPP and SPP can aid in the transition towards circular public procurement as these processes move the focus away from the upfront (purchase) price and incorporate risk, timeliness, and true cost (LCA/LCC) into the tendering process. Both national agencies and suppliers believe that LCAs/LCCs and LCMs will play an essential role in circular public procurement in the (Crafoord et al., 2018). Marrucci *et al.*, (2019) highlights the issues of adopting various, by EU proposed, tools for sustainable production and consumption and linking them to CE; LCA/LCC is seemingly the one tool that is directly linked with CE, but the interconnection with other sustainable policies and strategies is far less common, thus often overlooked and unutilised/used incorrectly. Qazi & Appolloni (2022) highlight the problem of not thinking in a cradle-to-cradle perspective when designing a product. Designing for dismantling or modularity will inevitably facilitate LCM and waste management and promote CE.

Milios (2018) suggests that through circular public procurement and policies for reuse, repairs, and remanufacturing, in addition to policies for smoother and unified universal global waste market flows, are crucial for encompassing the resource efficiency of CE. It is further explained that the current policies need to be reevaluated for possible side effects that might disrupt CE along with the implementation of new policies throughout all levels in society. Aloini *et al.*, (2020) investigated the impact of critical success factors (CSFs), which are enablers of CE and can be anything from legislation, organisational capabilities to funding and awareness. Therefore, identifying and implementing long-term strategies, including CSFs (which may be business case specific), for circularity is essential for consistency and success.

Budget constraints can undermine other objectives such as circularity, opting for price-focused purchases (Sonnichsen & Clement, 2020). This is where well-thought through policies and frameworks can counteract this considering well designed environmental criteria is highly effective in circular public procurement. Aloini *et al.*, (2020) claim that economic incentives are ruled as an important ignition for CE implementation. Immature market has been identified as a great barrier, this includes insufficient funds and economic incentives, inadequate waste management capabilities, no standardisation of quality and pricing of remanufactured, recycled, and

recovered units and elements, insecure supplies, and high investment costs (Grafström & Aasma, 2021). In order to facilitate for procurers to incorporate sustainability criteria, NAPP and the LFASA have set up frameworks and guidelines that support CE. As these frameworks and guidelines are regulated by state agencies in cooperation with suppliers, actors, and the market, it can be used as a starting point for circular public procurement. Transparency throughout the SC needs to increase in order to enable implementation of activities, ie. standardisation, assessment, and pricing (Sonnichsen & Clement, 2020).

3.1.2 Organisational

Knowledge and awareness

According to Crafoord *et al.*, (2018), some common challenges include performance issues, low knowledge about circularity and lack of support for purchasing remanufactured units, supply issues, and product heterogeneity. These are some of the various factors that make circularity in procurement cumbersome. To support circularity, international collaboration between suppliers, manufacturers, and waste collectors are imperative for an efficient take-back scheme globally (Milios, 2018). Sonnichsen & Clement (2020) noticed a greater ratio of circular public procurement if senior management were supportive of it, setting up goals, strategies, and allocating resources for circular public procurement. The emphasis of successful circular public procurement lies in a supportive and knowledgeable organisation that regularly educates and updates procurers of current information on circular practices such as the use of environmental criteria and specifications (Sonnichsen & Clement, 2020). Advocating for utilisation of operational tools, ie. LCAs/LCCs are a way to increase knowledge and awareness and fight any fallacies. It is important to see the product value which encompasses everything from quality to risk, aside from cost only.

Qazi & Appolloni (2022) acknowledge that there is a conflict of interest between price, quality, and circularity, in which circularity is often down prioritised if it is not a part of the organisation policy. Therefore, it is essential to have support from management and a management team that prioritises circularity.

Criteria & requirements

Sonnichsen & Clement (2020) propose to use "fewer, but more stringent, criteria" to increase the positive impact and outcome of circular public procurement. But environmental criteria and award criteria, even though the use is encouraged in both GPP and circular public procurement, it cannot be too specific to hinder fair competition. Crafoord *et al.*, (2018) researched circular public procurement for computers and found that the main working point for procurers is to make use of stricter criteria as these are lacklustre. It is further explained that the future of procuring for computers is complex due to the nature of recurring software issues, not

hardware. The demand for remanufactured computers is limited; it is mostly procured for the administration and the educational sector as the processor demands are not as high (Crafoord et al., 2018). However, procuring for remanufactured computers is often limited by the procurers' demand for brand new units (Crafoord et al., 2018; Qazi & Appolloni, 2022). Therefore, remanufacturers are unable to participate in the procurement process (Crafoord et al., 2018).

Procuring for returns tends to occur but a specified EOL management is rare, and therefore not fully circular (Qazi & Appolloni, 2022). Most tend to settle for ecolabels which in itself is sustainable to a certain extent as ecolabels tend to mind sustainability by various aspects, but do not encompass the responsibility for EOL management.

Saidani *et al.*, (2019) underline the importance of using indicators, a measurement that reflects the change of an implementation. Indicators can be used for targets, policymaking, measuring and reporting, monitoring progress and such as, if proper indicators are chosen, which will serve as a foundation for making well-informed decisions, especially important for potential investments and settling trade-offs. A management that is versed with circularity can thus formulate appropriate indicators which will aid in the implementation of circular processes by acting as a universal standardised language, reducing possibilities for mistakes, and opening up the floor for cross-sectoral, and cross-border collaborations. It is further discussed that no one or set of indicators fits all, there will inevitably be a need for tailor making sustainability indicators across various sectors given the circumstances in each respective country and each business case, which the authors agreed is resources and time consuming. But a systematic approach towards choosing indicators is necessary for understanding and reaping the potential benefits of introducing circular indicators, and that lack of knowledge and information is the biggest obstacle for this implementation. This in turn is impeded by the lack of transparency throughout the SC and between businesses. It is concluded that indicators should be used in frameworks as a part of CE but highlight that in order for CE to be successful other key factors starting with the idea of a product to waste management and reverse logistics need to be managed in a synergistic manner.

Other factors

Grafström & Aasma (2021) found that organisational barriers occur either in the early stages of production or at the EOL stage, such as issues with integrated components (soldered elements) and lack of waste capacity, infrastructure, monitoring, and capability. Several authors noted apprehensiveness towards transparency throughout the SC which inevitably makes many aspects difficult if not impossible such as monitoring and LCA (Grafström & Aasma, 2021; Saidani et al., 2019; Sonnichsen & Clement, 2020). Grafström & Aasma continues stating that complex calculations and vague or abstract measurements for reporting tend to further solidify the unwillingness to transition towards CE.

Sonnichsen & Clement (2020) recommend that the senior management should encourage circular processes by creating internal policies that include CE factors and indicators. They further explain that the purchasing criteria should be based on the internal policy created, and together with appropriate indicators (CSFs), will aid in monitoring and measuring the results of an intervention (Aloini et al., 2020; Saidani et al., 2019; Sonnichsen & Clement, 2020). Traceability issues are prevalent, collaboration can be key in increasing the transparency (Sonnichsen & Clement, 2020). Entering a collaboration and dialogue with the suppliers and the market will not only confirm if the suppliers are in compliance with the purchasing criteria but also support information sharing and leave room for innovation to expand the circular public procurement capacity (Milios, 2018; Sonnichsen & Clement, 2020). Procurers can use important tools such as RFX (Request For X, where X can be information, quote, or proposal), which can give the procuring organisation a valuable insight into products, suppliers, and services offered.

3.1.3 Individual

Organisational and societal culture

Qazi & Appolloni (2022) state that most procurers tend to lean towards purchasing new products made from virgin materials and that the secondary market is a good idea but not a viable one. This ties into what Sonnichsen & Clement (2020) noted which is that one of the more halting barriers of implementing circular public procurement at management level is the misconception that sustainable products cost more; and due to the budgeting constraints of public actors many tend to be discouraged to implement circular public procurement if no support is shown higher up. Consequently, most procurers opt for the linear price model where the purchase price is the decisive factor. Grafström & Aasma (2021) found a CE apprehensive culture throughout several levels of society including: SC, management, and end-user due to low awareness or misconceptions. Therefore, it is suggested that collaboration by sharing information and knowledge is vital to tackle this challenge and spread awareness to both the internal organisation and suppliers (Sonnichsen & Clement, 2020). It is further explained that on an individual level knowledge is a far better driver for implementing circular public procurement than for instance any monetary benefit. Thus, it is critical for public actors to increase the knowledge throughout the organisation to create awareness of the benefits of implementing circular public procurement by training and continuous reporting.

There is a general consensus that the price of virgin materials is not true to actual cost, which is why the initial cost for recycled materials may seem high (Qazi & Appolloni, 2022). This misconception about the price, thinking that greener products automatically come with a higher price tag is therefore incorrect, but the society has been conditioned to believe that a laptop costing 2000 SEK is reasonable. The price

of the material is dependent on several factors, ie. extraction method, supply and demand, and labour costs among other factors (Richter et al., 2022). Naturally, labour costs in EU tend to be higher than labour costs in Asia. Richter *et al.*, (2022) highlight a trend that can be seen on the market, which is the increasing price tag of new materials, which will open-up the idea of creating a spare part market. Milios & Dalhammar (2023) explain that an increased product durability can regulate the spare parts market, and Richter *et al.*, (2022) advocate for a strategic harvesting for spare parts model in collaboration with OEMs that will result in economic gain. But a popular misconception that may halt this process is the misconception of believing that virgin materials are better than recycled. These misconceptions are amplified with staff members that are not onboard with circularity. This goes further than the organisation itself. Having a society and stakeholders that do not see the point in circularity will make the transition challenging if not impossible.

CE is market oriented, despite it being linked to degrowth and anti-consumerism (Dzhengiz et al., 2023). Dzhengiz *et al.*, (2023) argue that it ties in with natural capitalism; making use of the market and innovation to drive sustainable solutions while simultaneously experiencing economic growth. One of the main solutions presented in CE is the second-hand market, which in itself can increase consumption and resource use, which is paradoxical to one of the assumptions of CE. Additionally, the authors stress the fact that second hand products are associated negatively with poorer quality and generally low demand due to individual beliefs. A positive CE system is sharing or renting/leasing a product (the ownership and responsibility lies with the producer/seller and not the user). This type of "purchase" is under the PSS umbrella term in the form of PaaS/HaaS or rental/leasing. The greater public see no issues in a sharing economy, but it is less prominent in corporate settings, public actors, and organisations, usually because there is an economic barrier for businesses as they are unable to report the value of the assets.

Appendix D. Figures

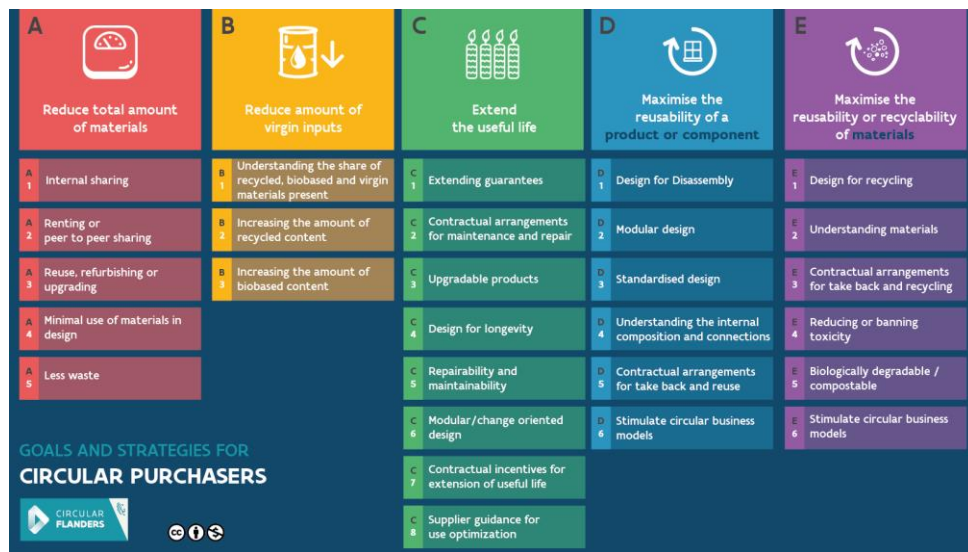


Figure 11. The ambition chart.

It is the original ambition chart for circularity created by Circular Flanders, which the Swedish NAPP has adapted and translated. The Swedish NAPP encourages procurers to use this as a model and tool for circular public procurement. *Source:* <https://aankopen.vlaanderen-circulair.be/en/getting-started/the-ambition-map>

Appendix E. CE definition

"A systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution. It is based on three principles, driven by design: eliminate waste and pollution, circulate products and materials (at their highest value), and regenerate nature. It is underpinned by a transition to renewable energy and materials. Transitioning to a circular economy entails decoupling economic activity from the consumption of finite resources. This represents a systemic shift that builds long-term resilience, generates business and economic opportunities, and provides environmental and societal benefits."

(Ellen MacArthur Foundation, n.d.)

'CE is defined as "an economic system that replaces the "end-of-life" concept with reducing, alternatively reusing, recycling, and recovering materials in production/distribution and consumption processes. It operates at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations".'

(Saidani et al., 2019)

'Circular Economy encompasses and builds upon a number of complementary approaches, including ecodesign (Brezet and van Hemel 1997), lean manufacturing (Nakajima 2000), industrial ecology (Erkman 1997), industrial symbiosis (Ehrenfeld and Gertler 1997), cradle-to-cradle (Stahel and Reday-Mulvey 1981), life cycle thinking (Dalhammar 2015), waste-to-resources (Kama 2015), sustainable consumption (Mont and Heiskanen 2015), dematerialisation (Andrews 2015), functional economy (Stahel 1997), and product-service systems (Tukker and Tischner 2006).'

(Milios, 2018)

"The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended. In practice, it implies reducing waste to a minimum. When a product reaches the end of its life, its materials are kept within the economy wherever possible thanks to recycling. These can be productively used again and again, thereby creating further value. This is a departure from the traditional, linear economic model, which is based on a take-make-consume-throw away pattern. This model relies on large quantities of cheap, easily accessible materials and energy."

(European Parliament, 2023)

"CE can be described as the opposite of the traditional, linear economy which dominates the market today. Instead of extracting raw materials for a make-take-waste economy, in CE the focus is on utilising what has been manufactured for as long as possible. Products are reused or recycled as far as possible to reduce resource use and waste. CE aims to keep the value of the already produced and procured products, components, and materials. The goal is to reduce the amount of newly produced products which consume resources during production leading to a negative environmental aspect. This encompasses production, waste management, and all forms of transportation."

(Upphandlingsmyndigheten, n.d.-f) [translated]