Circular Economy and Public Procurement

Dialogues, Paradoxes and Innovation

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CIRCULAR ECONOMY AND PUBLIC PROCUREMENT: DIALOGUES, PARADOXES AND INNOVATION

BY
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AALBORG UNIVERSITY
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CV

In 2012, I obtained a Bachelor's degree in Environmental Engineering from the Iberoamerican University at Torreon, Mexico. Afterwards, I worked as a sustainability specialist in Metalsa, a manufacturing company from the automotive industry and as an environmental consultant in ERM, an international consultancy, where I specialized in contaminated soil investigation and management.

In 2015, I enrolled in the "Environmental Management and Sustainability Science" Master's program at Aalborg University, Denmark. Where I researched various topics including eco-labels, strategic environmental assessments, maritime spatial planning regulations and indigenous peoples' rights.

After graduation, I began working as a research assistant at the Sustainability, Innovation and Policy group, where I carried out my PhD studies for the next three years.

In September 2021, I resumed my career in Nilfisk, an international company focused in developing cleaning equipment, working as an eco-design compliance specialist.

PREFACE

This dissertation is the result of almost four years spent as a research assistant and PhD fellow at the Sustainability Innovation and Policy (SIP) research group at the Planning Department of Aalborg University.

The format of this doctoral thesis is hybrid. It includes academic articles as well as chapters written specifically for the dissertation. The articles are published or under review at international academic peer-reviewed journals.

The list of academic contributions included in the dissertation as well as other publications developed throughout my PhD studies, are presented in the following page.

LIST OF ACADEMIC CONTRIBUTIONS

Included in the dissertation

Paper I. Huerta Morales, Alberto. Exploring Paradoxical Tensions in Circular Business Models—Cases from North Europe. Published. *Sustainability* 2020, *12*, 7577. https://doi.org/10.3390/su12187577

Paper II. Huerta Morales, Alberto; Remmen, Arne. Market consultations in circular public procurement: process and tensions. In review after major revisions. *Journal of Purchasing and Supply Management*.

Report I. Huerta Morales, Alberto; Alternative business models available for circular procurement. Available at project website. http://circularpp.eu/wp-content/uploads/2019/11/WP2.2-report.pdf 2020

Report II. Huerta Morales, Alberto; How to advance Circular Public Procurement? Available at project website. http://circularpp.eu/wp-content/uploads/2021/01/2.3-report-from-Alberto.pdf 2021

Other publications

Guidance Note. Larsen, Sanne Vammen; Hansen, Anne Merrild; Dahl, Parnuna Egede; Huerta Morales, Alberto; Guidance Note on Indigenous and Local Community Participation in Environmental Impact Assessment in the European Arctic Published. *European Investment Bank* 2019 https://www.eib.org/attachments/guidance_note_on_indegenous_and_local_community_en.pdf

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One year into my master's education I decided that after graduating, I would like to continue in academia as a PhD student. At that time, I was unaware of the marvelous journey I was about to begin. Full of joyful challenges, daily learnings, and personal growth. However, my journey was also riddled with obstacles to overcome, steep learning curves, moments of self-doubt and frustration. It was in those times that people around me, in one form or another, helped me keep in track and eventually reach my destination. I would like to take this opportunity to give particular thanks to some of you who offered me counsel, encouragement, motivation and support. This PhD journey would have not been the same without you.

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To my colleagues in SIP, thank you Henrik for sharing your passion for teaching sustainability. Thank you Søren for entertaining any foolish research idea that burst into my head and helping me channelize it into my research. Thank you Rikke and Anja, for reminding me more than once, that no matter the outcome, time and energy spent in the PhD would never be a waste. And to my office mates, Yana, Sybrith Edward, Heidi, Emil and Juanita, thank you for all the good times at the office -my favorite working days where the ones with a full house.

To my supervisor Arne, thank you for always being calm, positive, and making sure that the PhD kept moving forward. Your professional support and guidance were valuable and your positive attitude contagious and a gift to carry forward. To Rebeka, thank you for giving me a burst of confidence when I needed it the most.

To my family, in both Mexico and Denmark, thank you for being next to me, even while being physically apart. For riding with me the highs and lows of the PhD, for carefully listening to what I had to say, letting me vent when I needed and celebrate when I felt like it and for constantly telling me how proud you are of me. I miss you every day.

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Alberto Huerta Morales
December 2021,
Aalborg, Denmark.

ENGLISH SUMMARY

A Circular Economy (CE) is one where resources embedded inside products are maintained inside the economy for as long as possible and at their highest potential value. Developing CE can alleviate pressure from economic activities on ecosystems by reducing resource exploitation and waste generation and help create a more sustainable economy.

Public sector organizations can help drive a transition towards circularity by increasing the uptake of products and services derived from Circular Business Models (CBM). These business models offer solutions to the market, including products designed to circulate in society and the services that facilitate their circulation. Procuring such product and services involves practices that differ from institutionalized forms of procurement. As a result, a unique practice and academic field has formed around this procurement strategy under the name of Circular Public Procurement (CPP).

Implementing CPP in practice can improve the resource efficiency of public sector organizations and due to the volume of their purchasing power, it can incentivize the development and diffusion of CBM. While the benefits of CPP are widely accepted, its implementation is at an early stage and significant knowledge gaps remain regarding how to manage this process. Similarly, CBMs have proven to be effective in delivering competitive circular products and services to the market. However, their growth and diffusion remains limited, since they face inherent contradictions within an economic system that is predominantly set up to promote linear business models.

In this context, **the goal of the dissertation is to provide research-based insights and recommendations that can help in the development and implementation of CPP and CBM.** To operationalize this goal, three research questions are formulated and answered across three content chapters thesis**.**

Analyzing and advancing the concept of CPP is the focus of chapter 3. This is achieved through a systematic literature review, which results in a new CPP conceptual framework that advances and systematizes current knowledge on the topic of CPP. The framework integrates a variety of research streams related to the field into a coherent structure that provides conceptual clarity by dividing CPP into four main components: procedure, scope, supporting tools and organizational context. In turn, each is divided into subcomponents which denote a specific aspect of CPP that so far has been analyzed in

literature. Such framework sets a new baseline for the field and facilitates its advancement by framing further analysis of its constituent elements.

Chapter 4 is focused on the analysis of one of the main tools that can facilitate the implementation of CPP, namely market consultations. In the legal framework of the Procurement Directive (2014/24/EU) from the European Union, market consultations consist of interactions between buyers and potential suppliers, taking place in the pre-competitive phase of procurement, conducted with the objective of improving the execution of a procurement project. Direct dialogues between buyers and potential suppliers are considered crucial in CPP projects, as these interactions can facilitate the inclusion of circularity at the core of the procurement project. An empirical investigation of market consultations is presented in the chapter, and an overview of their processes and tensions is provided. By identifying key subprocess and the main tensions faced in market consultations, it was possible to develop practice recommendations which can address such tensions and improve the effectiveness of market consultations in CPP.

Paradoxical tensions in CBM are explored in chapter 5. These tensions are unique, as they arise from conflicting, yet interconnected elements within the business model. Drawing from paradox theory, which helps explain conflicts in organizational management, this chapter outlines the main tensions faced by CBM, and their related management strategies, based on an empirical investigation supported by a literature review. Understanding the tensions faced by CBM is crucial to promote the implementation of CPP and to conduct procurement in such a way that these challenges are taken into consideration.

Lastly, Chapter 6 integrates insights from the previous three chapters into a cross-cutting discussion of the innovation dynamics of CPP and their influence on both the development of innovative CBM as well as innovative practices (beyond procurement) in public sector organizations. Moreover, the discussion addresses the potential benefits of bridging paradox theory into the field of CPP.

Overall, the dissertation meets its main goal of advancing the development and implementation of CPP and CBM in four ways. Firstly, it develops a state of the art as well as new conceptualization of CPP which structures the diffuse and increasing knowledge of the field. Secondly, it provides an in-depth empirical and conceptual analysis of market consultations, which is one of the main tools for facilitating the implementation of CPP in practice. Thirdly, it outlines the main paradoxical tensions faced by CBM, which not only helps

in the management of such business models, but in developing procurement practices taking such tensions into consideration. Lastly, the main theoretical insights are translated into practice-oriented recommendations that can help facilitate the implementation and diffusion of CPP.

DANSK RESUME

En cirkulær økonomi (CE) er den økonomi, hvor ressourcer, der er indlejret i produkter, bevares i økonomien så længe som det nu er muligt og med deres højeste potentielle værdi. Udvikling af CE kan afhjælpe presset fra økonomiske aktiviteter på økosystemer gennem reducering af ressourceudnyttelse og affaldsgenerering og bidrage til at skabe en mere bæredygtig økonomi.

Offentlige organisationer kan hjælpe med at fremme en overgang til cirkularitet gennem forøgelse af udbredelsen af produkter og tjenester, som afledes af cirkulære forretningsmodeller (CBM). Disse forretningsmodeller tilbyder cirkulære løsninger på markedet, herunder produkter, der er designet til at cirkulere i samfundet og de tjenester, som letter deres cirkulation. Indkøb af cirkulære løsninger, der adskiller sig fra institutionaliserede former, involverer indkøb. Som følge heraf dannes der et unikt praksis- og akademisk felt omkring denne indkøbsstrategi under navnet Cirkulære Offentlige Indkøb (CPP).

Implementering af CPP i praksis kan forbedre ressourceeffektiviteten for organisationer i den offentlige sektor og på grund af størrelsen af deres købekraft kan det tilskynde til udvikling og spredning af CBM. Mens fordelene ved CPP er bredt accepteret, er implementeringen på et tidligt stadium og der er stadig betydelige informationshuller med hensyn til, hvordan denne proces skal kunne styres. På samme måde har CBM'er vist sig at være effektive til at kunne levere konkurrencedygtige cirkulære produkter og tjenester til markedet. Deres vækst og udbredelse er dog fortsat begrænset, siden de står over for iboende modsætninger i et økonomisk system, der overvejende er bygget op til at fremme lineære forretningsmodeller.

Målet med denne afhandling er i denne sammenhæng **at give forskningsbaseret indsigt og anbefalinger, som kan hjælpe i udvikling og implementering af CPP og CBM**. For at operationalisere dette mål behandles og besvares tre forskningsspørgsmål på tværs af tre indholdskapitler.

Analysere og fremme begrebet CPP er fokus i kapitel 3. Dette opnås gennem en systematisk litteraturgennemgang, som resulterer i en ny CPP begrebsramme, som afspejler feltets seneste fremskridt og integrerer indsigt fra relaterede forskningsstrømme. Rammen systematiserer viden om CPP som afledes af en række forskningsstrømme til en sammenhængende

struktur, som giver begrebsmæssig klarhed ved at opdele CPP i fire hovedkomponenter: procedure, omfang, understøttende værktøjer og organisatorisk kontekst. Til gengæld opdeles hver del i underkomponenter, som betegner et specifikt aspekt af CPP, som hidtil er blevet analyseret i litteraturen. En sådan ramme kan hjælpe med at sætte en ny baseline for feltet og lette yderligere udforskning af de forskellige elementer af CPP, som allerede er inkluderet i rammen eller til at skubbe feltet frem gennem analyse af elementer, som endnu ikke er blevet undersøgt.

Kapitel 4 er fokuseret på analyse af et af de vigtigste værktøjer, der kan lette implementeringen af CPP, nemlig markedskonsultationer. I den retslige ramme for Den Europæiske Unions indkøbsdirektiv (2014/24/EU) består markedshøringer af interaktioner mellem købere og potentielle leverandører, der finder sted i den prækonkurrerende fase af indkøb, som blev udført med det formål at forbedre udførelsen af et indkøbsprojekt. Direkte dialoger mellem købere og potentielle leverandører anses for at være afgørende i CPP-projekter, da disse interaktioner kan lette inddragelsen af cirkularitet i kernen af indkøbsprojektet. En empirisk undersøgelse af markedskonsultationer præsenteres i dette kapitel og der gives et overblik over deres processer og spændinger. Ved at identificere centrale delprocesser og de vigtigste spændinger, som markedshøringer står over for, har det været muligt at udvikle praksisanbefalinger, som kan adressere sådanne spændinger og forbedre effektiviteten af markedshøringer i CPP.

Paradoksale spændinger i CBM bliver udforsket i kapitel 5. Disse spændinger er unikke, da de opstår fra modstridende, men dog indbyrdes forbundne elementer i forretningsmodellen. Med udgangspunkt i paradoksteorien skitserer dette kapitel de vigtigste spændinger, som CBM står over for og deres relaterede ledelsesstrategier, der er baseret på en empirisk undersøgelse som er understøttet af en litteraturgennemgang. At forstå de spændinger, som CBM står over for er afgørende for at fremme implementeringen af CPP og for at gennemføre indkøb på en sådan måde, at disse udfordringer bliver taget i betragtning

Endelig integrerer kapitel 6 indsigter fra de foregående tre kapitler i en tværgående diskussion af innovationsdynamikken i CPP og deres indflydelse på både udviklingen af innovativ CBM såvel som innovativ praksis (ud over indkøb) i offentlige organisationer. Desuden behandler denne diskussion de potentielle fordele gennem at bygge bro over paradoksteorien til CPP-området.

Alt i alt opfylder denne afhandling sit hovedmål om at fremme udviklingen og implementeringen af CPP og CBM på fire måder. For det første udvikler man et kunstværk sideløbende med den nye begrebsdannelse af CPP, som strukturerer udbredt og voksende viden om feltet. For det andet giver det en dybdegående empirisk og konceptuel analyse af markedshøringer, som er et af de vigtigste værktøjer til at lette den praktiske implementering af CPP. For det tredje opsummerer den de vigtigste paradoksale spændinger, som CBM står over for, hvilket hjælper ikke kun med at styre sådanne forretningsmodeller, men også med at udvikle indkøbspraksis under hensyntagen til sådanne spændinger. Endelig omsættes grundlæggende teoretisk viden til praktiske anbefalinger, som kan hjælpe med at lette implementeringen og formidlingen af CPP.

RESUMEN EN ESPAÑOL

Una Economía Circular (EC) es aquella en la que recursos materiales que forman parte de productos se mantienen dentro de la economía por el mayor tiempo posible y en su máximo valor. Desarrollar una EC puede aliviar la presión que ejercen las actividades económicas sobre los ecosistemas al reducir la explotación de recursos y generación de desechos y así ayudar a crear una economía más sustentable.

Las organizaciones del sector público pueden ayudar a impulsar una transición circular al incrementar su consumo de productos y servicios derivados de Modelos de Negocio Circular (MNC). Estos modelos de negocio ofrecen soluciones al mercado incluyendo productos diseñados para circular en la sociedad y servicios auxiliares que permiten su circulación. La contratación pública de estos productos y servicios involucra prácticas que difieren de las formas institucionalizadas de contratación lo cual ha resultado en la formación de un campo académico y de prácticas alrededor de esta estrategia de contratación bajo el nombre de Contratación Publica Circular (CPC).

Implementar CPC en la práctica puede mejorar la eficiencia en el uso de los recursos de las organizaciones del sector público y debido al volumen del poder de compra de estas organizaciones, puede incentivar el desarrollo y difusión de MNC. Los beneficios de CPC son ampliamente reconocidos, sin embargo, su implementación se encuentra en una etapa temprana. Así mismo, existen importantes brechas de conocimiento en cuestión del manejo del proceso de implementación. De la misma manera, los MNC han demostrado ser capaces de presentar de manera eficiente productos y servicios circulares al mercado, sin embargo, su difusión y crecimiento se mantiene limitado ya que se enfrentan con contradicciones inherentes a un sistema económico predominantemente establecido para promover modelos de negocio lineares.

En este contexto, el objetivo de esta tesis doctoral es proporcionar conocimientos y recomendaciones que puedan avanzar el desarrollo e implementación de la CPC y los MNC. Para operacionalizar este objetivo tres preguntas de investigación son formuladas y respondidas a lo largo de los capítulos de la tesis.

El foco del capítulo 3 es el análisis y desarrollo del concepto de CPC. Esto se lleva a cabo a través de una revisión sistemática de literatura la cual resulta en un nuevo marco conceptual de CPC que avanza y sistematiza el conocimiento existente en el tema de CPC. El marco conceptual presentado integra conocimientos de corrientes de investigación relacionadas al tema en una estructura coherente que provee claridad conceptual al dividir CPC en 4 componentes principales: proceso, alcance, herramientas de soporte y contexto organizacional. A su vez, cada componente es integrado por subcomponentes los cuales indican un elemento de CPC el cual ha sido objeto de análisis en la literatura existente. Este marco conceptual define una nueva línea base en el campo académico de CPC y facilita su avance al enmarcar la subsecuente exploración de los diferentes elementos que lo integran.

El capítulo 4 se centra en el análisis de una de las principales herramientas de soporte en la implementación de CPC, en concreto, las consultas de mercado. En el marco de la Directiva 2014/24 de la Unión Europea, las consultas de mercado son consideradas como las interacciones entre compradores y proveedores potenciales, llevadas a cabo en la etapa precompetitiva de la adquisición, con vistas de preparar y mejorar la ejecución del proyecto de contratación. El diálogo directo entre compradores públicos y proveedores potenciales es considerado como un elemento crucial en los proyectos de CPC, ya que esta interacción puede facilitar la incorporación de elementos circulares en el núcleo del proyecto de compra. El capítulo 4 presenta una investigación empírica de las consultas de mercado y proporciona una descripción general de sus procesos y tensiones. Tras identificar los subprocesos clave y las principales tensiones enfrentadas en las consultas de mercado, fue posible desarrollar recomendaciones prácticas que pueden abordar tales tensiones y mejorar la efectividad de las consultas de mercado en CPC.

El capítulo 5 explora tensiones paradójicas en MNC. Estas tensiones son únicas ya que emergen de elementos conflictivos y a la vez interconectados dentro del modelo de negocio. Partiendo de la teoría de paradoja, la cual ayuda a explicar conflictos en la gestión organizacional, este capítulo describe las principales tensiones paradójicas a las cuales los gestores de MNC se enfrentan, así como las estrategias utilizadas para manejar dichas tensiones. El estudio se basa en datos empíricos respaldados por una revisión sistemática de literatura.

El capítulo 6 integra las ideas clave de los tres capítulos anteriores en una discusión transversal centrada en las dinámicas de innovación de las CPC y su influencia tanto en el desarrollo de MNC innovadores, así como innovación en las prácticas organizacionales del sector público que trascienden los procesos de adquisición. Además, la discusión aborda los beneficios potenciales de trasladar la teoría de la paradoja al campo de la CPC.

En general, la tesis cumple con su objetivo principal de promover el desarrollo y la implementación de CPC y MNC en cuatro maneras. Primero, desarrolla una nueva línea base y conceptualización en el campo de CPC la cual estructura el conocimiento creciente del campo el cual se encontraba difuso a través de varias corrientes de investigación. Segundo, proporciona un análisis empírico y conceptual a profundidad de las consultas de mercado, que es una de las principales herramientas para facilitar la implementación de la CPC en la práctica. Tercero, presenta las principales tensiones paradójicas a las que se enfrentan los MNC, lo cual no solo sirve en la gestión de dichos modelos de negocio, sino en el desarrollo de CPC ya que se pueden promover prácticas de contratación que tomen en cuenta dichas tensiones. Por último, traduce los principales conocimientos teóricos en recomendaciones orientadas a la práctica que pueden ayudar a facilitar la implementación y difusión de la CPC.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

Tables

Figures

SECTION I:

CONCEPTUAL FRAMEWORK

CHAPTER 1. INTRODUCTION

Circular economy is introduced in this chapter as the general topic of the dissertation, elaborating the specific areas where research was conducted, namely circular public procurement and business models. Afterwards, the aim of the dissertation and the main research questions are presented. The chapter concludes by presenting the context upon which the PhD was conducted and providing a reading guide.

1.1. INTRODUCTION TO CIRCULAR ECONOMY

In 1973, the report "Limits to Growth" raised international awareness of the ecological consequences of an economy perpetually aiming to grow within a planet of limited resources (Jackson, 2009). Since then, the understanding of the impact of human economic activities has only increased, and undeniable evidence that climate change, biodiversity loss and mass extinction is a direct result of human activity is mounting (Masson-Delmotte *et al.*, 2018). Following "business as usual" not only threatens the biological systems of the planet but also undermines the achievement of human development goals such as poverty alleviation, social equity, and inter-generational justice (O'Neill *et al.*, 2018). To have an economy that respects the ecological boundaries of the planet but also allows equitable human flourishing, it is necessary to transform the systems of production and consumption of society (Bengtsson *et al.*, 2018). In this context, the concept of circular economy (CE) has emerged in recent years as a potential solution for developing sustainable systems of production and consumption.

The precise definition and scope of CE are still under debate, and it is more appropriate to consider the variety of CE discourses rather than a unified understanding of the concept (Korhonen *et al.*, 2018). However, at its core, CE can be considered as a resource management strategy whose goal is creating a cyclical flow of resources within the economy to minimize the need to incorporate further resource inputs and to reduce waste (Cecchin *et al.*, 2021). Resources, i.e., energy and matter, can be found inside the economy, embedded in its products, components and materials. Overall, CE is focused on keeping products, components and materials in use at their highest possible value, for the longest possible time and in the most efficient manner (Kirchherr, Reike and Hekkert, 2017). This can be achieved by creating resource "loops" through reuse, repair, refurbishment, remanufacture and recycling (Stahel and Clift, 2015). A precise definition of these interventions is provided in Table 1-1.

The first loop, reuse, refers to utilizing products or components for their intended purpose after their initial use-life has ended (European Parliament and Council, 2009). The following loops, which are repair, refurbishment and remanufacture, are service interventions that allow product lifetime extension by preserving the integrity of the product, i.e., maintaining its original function (den Hollander, Bakker and Hultink, 2017). Service interventions differ in terms of their technical complexity and, often, the geographical scale and volume in which they can be performed (Stahel and Clift, 2015). For example, reuse and repair can be performed locally, whereas remanufacturing in most cases involves transporting faulty products internationally to the original manufacturing facilities. Overall, the necessary resources for each intervention can vary significantly. Therefore, as a rule of thumb, products should be reused if possible and repaired, refurbished or remanufactured only when necessary, always performing the minimum necessary service intervention in order to restore a product to its original state (den Hollander, Bakker and Hultink, 2017).

The last loop, recycling, means transforming waste into secondary raw materials. This takes place at the material level, rather than the product or component level. The limitations of recycling are well documented, including the progressive loss of quality from recycled materials, the need for increased inputs from virgin raw materials and the increasing energy requirements for subsequent recycling processes (Cooper, 2020). Furthermore, the over-emphasis of industry on recycling, instead of implementing other loops of CE, has been criticized since it fails to address consumption patterns and perpetrates a culture of waste production (Valenzuela and Böhm, 2017). Therefore, while necessary; recycling should be considered the last resort in a CE course of action.

While resource circulation is crucial, developing CE also requires reducing the amount of resources that are introduced into the system in the first place. This can be achieved through a combination of efficiency and sufficiency (Jaeger-Erben *et al.*, 2021). Efficiency refers to reducing the amount of resources used in the production, distribution and use-phase of products, whereas sufficiency refers to an absolute reduction in the volume of consumption (Figge, Young and Barkemeyer, 2014). From this perspective, reduce (efficiency) and refuse (sufficiency) are important CE strategies for reducing resource use (Reike, Vermeulen and Witjes, 2017).

CE Principles	Description	Related Strategies	Definition	Reference
Slowing	Prolonging the time that resources flow inside the economy by preserving product integrity and collaborative consumption	Reuse	Any operation by which a product or its components, having reached the end of their first use, are used for the same purpose for which they were conceived	European Parliament and Council, 2009
		Repair	Fixing a fault in a product without extending a guarantee on the whole product	European Environment Agency, 2018
		Refurbishment	Returning a product to good working condition by replacing major components and making "cosmetic" changes to update its appearance	
		Remanufacture	Returning a product or component to the performance specification of the original equipment manufacturer	
Closing	Creating a closed loop between waste streams and production, preventing waste from being released into the environment and providing secondary raw materials	Recycling	Reprocessing in a production process the waste materials for the original purpose or for other purposes but excluding energy recovery	European Parliament and Council, 2009

Narrowing	Reducing the use of resources through efficiency, sufficiency and reliance on renewable resources	Reduce	Lowering resources used in and by products from a life-cycle perspective	Figge et al., 2014
		Refuse	Reduce volume of consumption	

Table 1-1: Circular economy principles and strategies

In order to facilitate the implementation of the different CE loops (reuse, repair, remanufacturing, etc.) it is necessary to "design-out waste" (Kirchherr, Reike and Hekkert, 2017). This means embedding CE principles in the design phase of products, services and systems (Ceschin and Gaziulusoy, 2016). This might mean designing products with high durability and which can be easily repaired. Moreover, circular design can involve the transition from non-renewable to renewable energy and material sources, which is necessary for the regeneration of natural systems and creating an economy that is restorative and regenerative by design (Brais Suárez-Eiroa *et al.*, 2019).

Building on the work of Stahel (2016), Bocken et al. (2016) argued that CE can be summarized in three main resource management strategies: slowing, closing and narrowing. Closing resource flows involves stopping resources from leaving the economic system; slowing resource flows means prolonging and preserving the time that resources circulate inside the economy; and narrowing means reducing the use of resources introduced into the system in the first place (Bocken *et al.*, 2016). These three resource flows, in addition to a circular product design, can be considered CE principles as they denote the foundations for creating circular systems of production and consumption. An overview of CE principles and strategies is provided in Table 1-1.

To achieve a societal transformation towards CE, the cooperation between private companies, consumers, the public sector and civil society is necessary The interaction between multiple social actors can help consolidate the drive towards circularity as well as set up synergies (Fratini, Georg and Jørgensen, 2019). For example, supply chain limitations in terms of critical raw materials may create an incentive to certain industries for adopting CE practices related to take-back of products for remanufacturing. Such drive can be strengthened by consumer demands for accessible and high-quality remanufactured products. Standardization organizations can support such drive by

developing standards that detailed remanufacturing requirements whilst the public sector can support this transition by putting in place a regulatory framework that incentivizes product remanufacture. Lastly, civil society organizations can help push the CE agenda and provide input and monitoring for the development of such policies and practices.

While a CE transition requires such multi-actor collaboration, research on CE so far has mostly focused on exploring and promoting the implementation of CE principles in commercial companies (Kirchherr and van Santen, 2019). In comparison to commercial companies, the role of the public sector in CE has been less explored (Klein and Ramos, 2020). However, this gap in the literature as well as the importance of the role of the public sector in a CE transition is more and more recognized (Droege, Raggi and Ramos, 2021). This has led to the emergence of a sub-field within the CE literature focused on exploring the role of public sector organizations in a CE transition.

Overall, the role of the public sector in a CE transition is two-fold: developing an adequate regulatory framework for facilitating a transition toward CE and transforming its own consumption practices. In the following section, the latter role (as a strategic consumer) is introduced.

1.2. THE PUBLIC SECTOR AS A STRATEGIC CONSUMER

The term "public sector" captures a broad range of public sector organizations (PSOs). Some have direct responsibility for policy development and enforcement, such as ministries, regional authorities or municipalities. Others, like schools and hospitals, focus on delivering a variety of services for society such as healthcare and education.

PSOs with legislative responsibilities have a direct influence in developing an adequate institutional framework for incentivizing circularity by other companies and consumers (Ellen MacArthur Foundation, 2015). A relevant examples of such policy development has been taking place at the European Union (EU) level with the two CE action plans released by the European Commission, the first in 2015 and the second in 2020 (European Commission, 2020). The CE action plans set the agenda for a CE transition in Europe and comprise a variety of policies, targets and recommendations related to product manufacturing, public consumption, consumer information and labeling, waste handling and secondary markets (McDowall *et al.*, 2017).

Regardless of their participation in the legislative process, all PSOs require resources, i.e., materials and energy, to perform their functions and fulfil their objectives. At the same time, these processes generate waste (Klein and Ramos, 2020). Therefore, the implementation of resource management strategies is also relevant in the context of PSOs. Unlike manufacturing firms, PSOs are service providers; therefore, their inputs are not raw materials but rather finished goods, such as equipment in public hospitals, furniture in public schools, catering services in parliament, government buildings, etc. These inputs are obtained from the market through public procurement (PP), which can be broadly understood as the process through which PSOs obtain the necessary products and services from the market to fulfil their tasks.

In the EU, PP is regulated by EU Directive 24, which defines it as the "acquisition by means of a public contract of works, supplies or services by one or more contracting authorities from economic operators chosen by those contracting authorities, whether or not the works, supplies or services are intended for a public purpose" (European Union, 2014). On average, PSOs spend around 14 percent of the total Gross Domestic Product (GDP) on procuring products, works and services from the market (European Comission, 2019). This represents a significant purchasing power, which, if used strategically, can act as a tool for influencing the market toward sustainable production and consumption practices (Sjåfjell and Wiesbrock, 2016).

A long tradition exists of using the purchasing power of the public sector strategically to achieve social and economic objectives in European countries (McCrudden, 2015). The most institutionalized policy is green public procurement (GPP), where environmental considerations, i.e., minimum requirements or award criteria, are developed by the European Commission for selected products groups, and made available for all PSOs to incorporate into the procurement process (Cheng et al., 2017). Other procurement policies promoted at the EU level are socially responsible public procurement (SRPP), aimed at creating social value and taking social responsibility for consumption in the public sector, and innovative procurement (IP), which is a way of promoting innovation in the private sector and in the way public services are delivered.

Since the release of the first CE action plan, the European Commission has emphasized the importance of levering PP to promote CE. Some of the strategies outlined in the document include developing GPP criteria on

reparability and remanufacturing, making some GPP mandatory, and improving GPP monitoring (European Commission, 2020). However, the European Commission did not push the concept of circular public procurement until 2017 (European Commission, 2017).

1.2.1. CIRCULAR PUBLIC PROCUREMENT

In broad terms, circular public procurement (CPP) refers to a variety of strategies used by PSOs to create effective demand for circular products and services in the market. In this way, CPP can drive the uptake of circular solutions from the market, making the purchasing power of the public sector a direct tool for incentivizing a CE transition (Milios, 2017). Besides being a tool for incentivizing the market to offer CE products and services, CPP is also a key strategy for improving the environmental performance of PSOs by helping them reduce their own resource consumption and waste generation (Klein and Ramos, 2020).

In practice, CPP can take the form of procuring "circular" products (Alhola *et al.*, 2019); "circular" is a broad label used to describe products with certain characteristics, such as outstanding quality, ease of repair, high recycled material content, energy efficiency, etc. These product characteristics can improve resource efficiency and facilitate the use of service interventions (Bocken et al., 2016). PSOs can set different forms of requirements and award criteria that incentivize suppliers to deliver these types of circular products, for example, awarding increasing points to suppliers who deliver higher percentages of recycled content or provide extended commercial guarantees.

Another way to implement CPP is through commercial agreements in which products are not purchased by the PSO but rather leased or rented, or when simply their functionality is purchased (Witjes and Lozano 2016). Examples include lighting instead of lamps, multi-modal transportation services instead of a car fleet and working spaces instead of furniture. To incentivize the offering of such functional contracts, public sector organizations must translate their organizational needs into functional requierements rather than, or in some cases, in addtion to, product specifications.

Lastly, besides product caracteristics and functional contracts, CPP can also be implemented in the form of novel systemic solutions (Yeow, Uyarra and Gee, 2015). This involves creating new product and service arrangements, for example by comibinig previously separate services, into new systemic solutions provided based on circular products and services.

As Kristensen et al. (2021) explain, procurement should be conducted in a way that prioritizes CE principles. Therefore, from a procedural perspective, CPP begins by reconsidering whether purchasing is necessary to fulfill the emergent needs of an organization or if a solution can be achieved by resources already existing inside it (European Commission, 2017). If a purchase is inevitable, then it should be conducted in a manner that facilitates resource circulation and aligns with the inertia principle, i.e., prioritizing reuse, then repair, refurbishment and remanufacturing and, lastly, recycling.

The main task of PSOs in CPP is to create an effective circular demand by expressing their organizational needs in such a way that the market can use circularity as a value proposition. As elaborated above, this can be translated in practice into requests for circular products, services or systemic solutions (Alhola, 2018). After the organizational needs of the purchasing organization have been translated into requests to the market, contracting authorities must assess the bids received by the different economic operators interested in obtaining the contract. In line with Article 67 of the Procurement Directive, purchasers must award the contract to the tender with the a) lowest price, b) best cost-effectiveness or c) best price-quality ratio, where quality can include qualitative, environmental or social criteria linked to the subject matter of the contract.

The assessment of tenders in CPP projects is preferably undertaken using a price-quality ratio, where "price" is evaluated based on a life-cycle costing methodology such as the total cost of ownership and quality includes circularity aspects (Jacobson, Carlson and Lindahl, 2021). Circularity can be translated into requirements or award criteria related to resource-saving potentials. Once objective and measurable award criteria have been established for both functionality and circularity, purchasers must assign a relative value (weighting) to each criterion. Assigning a high value to circularity aspects and utilizing life-cycle costing methodologies is crucial for incentivizing the market toward offering circular value propositions (Braulio-Gonzalo and Bovea, 2020).

CPP is focused in procuring circular solutions which at times may be innovations to the market, or innovative to the procuring organization. In this context, market consultations can be conducted in the pre-competitive phase of the project (i.e. before the call for tenders is released) to increase knowledge of market capacities, discuss risks and opportunities, and overall prepare better procurement documents (Semple, 2015).

Purchasers can conduct market consultations in a variety of ways, from phone calls, desktop research, plenary meetings or one-on-one technical dialogues. (Lenferink et al., 2014). From this array of options, (Alhola, Salo, *et al.*, 2017) considered that market dialogues are the most beneficial in the context of innovative procurement projects i.e. CPP. They define market dialogues as a two-way interaction between buyers and suppliers, conducted in the pre-competitive phase of procurement, where the potential service providers provide expertise on the topic, and the procurement unit retains power of decision-making regarding the direction of the procurement project.

1.3. CIRCULAR BUSINESS MODELS

So far, CPP has been adressed from the perspective and tasks related to the purchasing organization. However, equally important is to adressed the role of suppliers in the development of CPP. From a supplier perspective, CPP requires unique business models that allow creating, delivering and capturing value through circularity. In other words, it requieres Circular Busines Models (CBM).

CBM represent a system of value creation, delivery and capture that allows companies to slow, close and narrow resource flows in an economically profitable manner (Guldmann and Huulgaard, 2020). To create such a system of value creation, firms must reorganize both the way their products are designed, manufactured, and distributed and their revenue models and cost structures, thereby creating value through circularity (Jørgensen and Remmen, 2018). For example, a firm whose main business model is selling vacuum cleaners can transition to a CBM by selling the functionality of its machines in the form of a guaranteed functional time for its customers. From a product design perspective, this transition to a CBM requires the development of more durable, functional and repairable machines. Moreover, marketing strategies, channels of communication, consumer service and even legal aspects need to be reorganized to match the new business model. Overall, CBM are the main mechanism in which CE can be implemented in private sector organizations since they transform circularity interventions into sources of value creation which makes them adequate to deal with the constant pressure that companies have in relation to remain profitable and competitive in the market.

In practice, CBM can take a wide variety of forms depending on a variety of factors—e.g., the market in which the firm operates, industry practices and technological development (Ramsheva et al. 2020). This makes each CBM

different, considering the unique combination of value propositions, target customers, revenue and cost structures as well as the particular set of activities, resources, partners and distribution channels used in the business model (Lüdeke-Freund, Gold and Bocken, 2018). Regardless of this potential variety, practitioners and scholars tend to organize CBM into the form of general archetypes, which to a certain extent are useful ways to communicate some of the most common forms of CBM found in the market (Rosa, Sassanelli and Terzi, 2019). A recent report by the Organization for Economic Co-operation and Development (OECD), building on the work of Lacy et al. (2014) and Bocken et al. (2016), described five major CBM archetypes: circular supplies, resource recovery, product-life extension, sharing models and product-as-a-service (OECD, 2019):

- Circular supplies: This relates to supplying material inputs to other firms that then use these inputs to create products and components. Circular supplies are bio-based, renewable and mostly free of hazardous chemicals to facilitate their potential circulation.

- Resource recovery: This model is based on the production of secondary raw materials or products from waste streams. Generally, this includes three key steps: collection, sorting and transformation. Resource recovery can take the form of downcycling (generating lower-value materials or products compared to the source), upcycling (generating a higher-value material or product compared to its source), or industrial symbiosis, which is the direct circulation of waste streams from one firm into the production process of another.

- Product life-extension: This model involves extending the useful life of products through repair, refurbish or remanufacture. As a support activity, manufacturing firms use product-design strategies that facilitate such interventions, e.g., by making the product modular or designing products for ease of repair and disassembly.

- Sharing models: This form of CBM involves platforms that allow users to share or rent under-utilized assets to other consumers. These peer-to-peer platforms are particularly applicable for high capital and low-intensity used products, such as household power tools, luxury clothing items and automobiles.

- Product-service systems: This form of CBM involves the combination of a physical product and a service component. Product service systems (PSS) can be divided into three major variants: product-, access- or result-based PSS. In product-based PSS, firms manufacture and sell products and include after-sales services such as maintenance contracts or take-back agreements as part of their value proposition. Access-based PSS focus on providing consumers temporary access to products, while the service provider retains ownership of the product. Lastly, in result-based PSS, firms do not sell products but instead market the services or outcomes provided by these goods, such as selling lighting instead of lamps or workspaces instead of office furniture.

These five examples of CBM are generic and by no means exhaustive. However, they can exemplify the activities and value propositions associated with CBM. Overall, the availability of circular products and services in the market depends on the capacity of firms of conducting the necessary activities for developing and maintaining a competitive CBM (Lüdeke-Freund et al., 2018).

The main objective of CPP is to promote a transition towards a CE which, can be summarized, to maintainng resources circulating inside the economy. From this perspective, purchasing of circular products is necessary, but not sufficient, since a product can be design with circular caracteristics such as ease of disassembly, high durability, etc. In order for its emebeded resources to be kept in the economy, it requires to actually be circulated (i.e. reparied, remanufactured, recycled) (Van Oppen, Croon and Bijl de Vroe, 2019). In other words, product circulation requieres a structure that incentivices socio-economic actors to mainten them at their highest possible value for the longest possible time in the economy.

In this context, access- and result-based PSS, can create a natural incentive for the supplier to maintain the quality of their products at their highest possible value since these create ongoing revenues for the firm (Hopkinson *et al.*, 2018). This is why PSS models are considered as one of the main pillars of CPP (Thiebault and Tonda, 2018). However, some products and services are not suitable to be delivered in the form of PSS, making other CBM relevant in the context of CPP (Alhola *et al.*, 2019). For example, catering services can be procured with a focus on minimizing packaging or using recovered "waste" food, while construction projects can focus on material reutilization and

designing buildings with flexible layouts to reduce the need for resources (Salonen and Vangsbo, 2019). Overall, while PSS are fundamental for promoting circularity in procurement, in practice, CPP projects can draw from a wide variety of CBM.

All forms of CBM are important for the development of CPP, however, some forms are more relevant than others in the context of public sector organizations. For example, circular supplies (which are raw materials) are not purchased directly by the public sector, in turn, public organizations behave like service industry organizations and their spending is mostly associated with finished goods.

1.4. PROBLEM FORMULATION

CPP is a key lever in a CE transition in society since it helps improve resource efficiency in the organizational practices of the public sector, incentivizes the market of circular solutions and promotes the development of CBM. Whilst the benefits of circular procurement are widely recognized, its implementation is not widespread which can be explained in part due to challenges and limitations related both to procurement capabilities of public sector organizations (demand) and current limitations of CBM, from which circular products and services are derived (supply).

From the perspective of procurement organizations, CPP presents challengues since it involves procurement practices that differ from the standarized off-the-shelf purchasing such as the utilization of functional contracts for durable goods, development of circular product criteria and extended and closer interactions between buyers and suppliers (Jacobson, Carlson and Lindahl, 2021). A lack of familiarity of such procedures along with the resource demands for conducting such innovative forms of procurement places a significant barrier in the diffusion of CPP practices in the public sector (Kristensen *et al.*, 2021)

From the perspective of market actors providing circular solutions, CPP may phase limitations of CBM to supply goods and services according to the unique size and specific requierements that public sector organizations demand (Dalhmar 2019). Such limitations may be derived from a lack of development of the business model, or a lack of diffusion across the industry. This is particularly relevant in public markets which prioritize the use competition as a way of driving the value for money obtained in each purchase. Furthermore, market actors may be dettered from participating in

CPP processes due to a perception of overly cumbersome procedures (Uyarra *et al.*, 2014).

To adress the challengues stated above, promote the implemention of CPP and contribute to the development of a circular economy transition, it is necessary to facilitate development of public and private sector organizations capabilities. The former, related to procurement capabilities and management of effective and efficient CPP projects. The latter related to management of tensions derived from the use of CBM to supply the public sector with circular solutions and insights regarding the participation in public tenders.

1.5. AIM OF DISSERTATION AND RESEARCH QUESTIONS

The goal of the dissertation is to provide research-based insights and recommendations that can help in the development and implementation of circular public procurement and circular business models.

To operationalize this goal, four research questions (RQ) are formulated and answered across the content chapters of the dissertation. The RQs are introduced in detail below, but overall, RQ1 is focused on the review of available literature regarding the field of circular procurement. RQ2 analyzes circular procurement projects in practice, particularly focused in market dialogues conducted in the pre-competitive phase. RQ3 explores paradoxical tensions of circular business models RQ4 integrates insights generated from the previous three RQ into a cross-cutting discussion focused on exploring innovation dynamics in CPP and the potential for bridging theoretical concepts between CPP and CBM literature. Figure 1-1 provides an overview of the RQ, their main topics and their location in the thesis

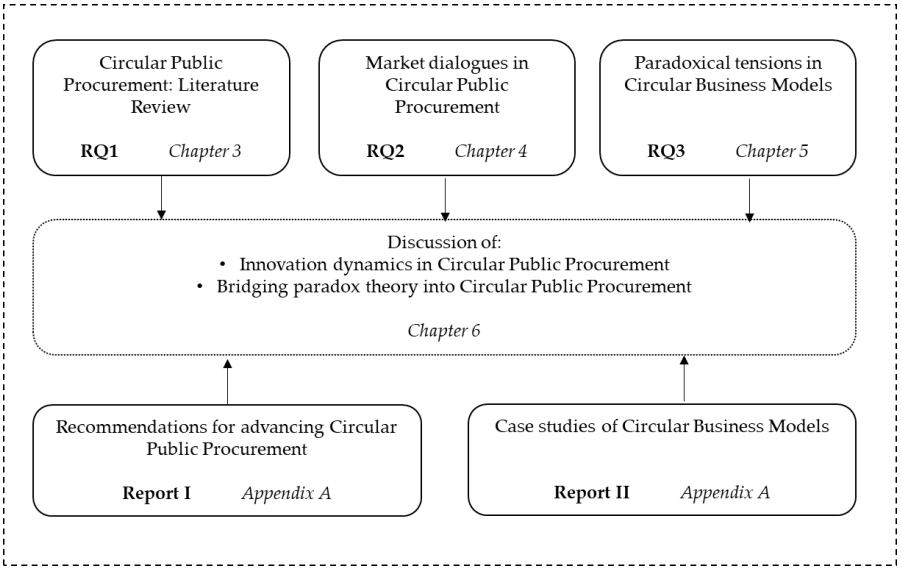


Figure 1-1: Overview of the dissertation and main research content

1.5.1. LITERATURE REVIEW ON CIRCULAR PROCUREMENT

CPP is high on the political agenda at the EU level (European Commission, 2017), and Member States have begun taking action to implement it at the national level. Taking Denmark as an example, the national government's strategy for developing CE emphasizes CPP as one of its key initiatives, highlighting that "by demanding circular solutions it becomes more attractive for designers and producers to offer circular products and services" (Ministry of Environment and Food and Ministry of Industry, 2018, p. 27). As part of the strategy for promoting CPP, a report commissioned by the Ministry of the Environment, which analyzed different CBM applicable for lighting and washing machines, concluded that CPP offers more environmental benefits and economic benefits than linear alternatives (Lundsgaard *et al.*, 2020).

Regardless of the political support and expected benefits, the implementation of CPP is in its early stages. One of the main barriers for implementation raised by public sector organizations is the lack of a clear conceptualization of CPP (Kristensen *et al.*, 2021). Which have lead for calls for a clearer operationalization of the CPP concept in relation to other procurement strategies such as green or innovative procurement (Grandia and Voncken, 2019)

Since the academic field of CPP is just emerging, there is still a wide variety of conceptualizations available. Conceptual diversity is an indicator of the development of a research field (Temesgen, Storsletten and Jakobsen, 2019). However, a lack of conceptual clarity can also become a challenge for knowledge accumulation and presents a barrier to newcomers to the field (Kirchherr, Reike and Hekkert, 2017). In this context, a systematic literature review of CPP can offer a valuable addition to the CPP literature to help structure this emerging and fast-evolving field. Therefore, the research question (RQ1) raised in this dissertation is the following:

How can CPP be conceptualized to reflect its recent development and related research streams?

1.5.2. MARKET DIALOGUES: PROCESS AND TENSIONS

CPP may be considered as another way of greening procurement (European Commission, 2017) however, its implementation requires more than the traditional procurement processes applied in GPP. For example, CPP involves setting functional demands, evaluating circularity characteristics of products, and assessing bids from a life-cycle costs perspective. From this perspective, CPP involves changing both what is procured (product/service) and how procurement is conducted (procurement process) (Klein and Ramos, 2020). Moreover, CPP can involve solutions that have not been widely adopted by the market, are new to the organization, or are simply new products or services that were developed specifically for the project (Alhola *et al.*, 2019). Overall, CPP projects may take place in a context of innovative processes and solutions which carry inherent uncertainties for the participants.

In order to manage the unknowns of the project, market dialogues are an important tool that can allow suppliers and other actors to gain insight into the possibilities and limitations of circularity and how to embed it into the procurement project (Witjes and Lozano, 2016). The key role of market dialogues in facilitating the development of CPP has been continuously emphasized in the literature (Dalhammar *et al.*, 2019). However, this particular area of PP is significantly understudied in the broader procurement literature (Patrucco, Luzzini and Ronchi, 2017) and, besides a few notable exceptions such as Rainville (2021), there a limited studies which address the process of market dialogues in CPP projects.

Considering the importance of market dialogues in the development of CPP projects and the lack of available studies on the topic, it is clear that further conceptual and empirical analysis is necessary regarding market dialogues in CPP projects. Therefore, the following is elaborated:

How are market dialogues conducted in CPP projects, what tensions emerge in the process and how can they be conducted more effectively?

1.5.3. PARADOXICAL TENSIONS IN CIRCULAR BUSINESS MODELS

The academic field of CBM has grown in the past few years building upon established fields such as the study of PSS and corporate responsibility. However, there is still a significant gap between societal and research interest on CBM and the implementation and widespread diffusion across industries (Kirchner 2019). In order to reduce this gap, literature provides variety of barriers faced by commercial firms engaged in the process of developing, operating or transitioning to a CBM (Guldmann and Huulgaard, 2020). These barriers (such as a lack of government support or fiscal incentives) can help explain the lack of implementation and diffusion of CBM from a structural perspective, however, their explanatory power is reduced when analyzing the challenges of the on-going operation of CBM which have already been implemented (De Angelis, 2021). To explore the ongoing challenges of CBM the concept of tensions provides a more dynamic resource.

Tensions are not external factors that prevent the implementation of CBM (such as barriers) but inherently part of the operation of the CBM. Tensions can point towards pressure points of everyday operations in CBM and help illuminate underlying limitations of such business models. For example, Daddi et al., (2019) explored CBM that are based in developing products from secondary raw materials and found an on going tension between incresaing circularity (in this case the use of secondary raw material) and creating commercial value (for example, competitivenes of their products in the market). This tension is considered as paradoxical, since it is derived from conflicting yet interrelated goals and it is not possible to be solved by abandoning either of the poles creating the tension. (Poole and van de Ven, 1989). In other words, companies operating such CBM cannot abandon the

use of recycled content nor can they abandon their need for creating commercial value.

The concept of paradoxical tensions or paradox theory in general, has been applied widely to understand a variety of situations in which companies have interconnected yet at times conflicting goals, tasks or activities. For example, it has been used to analyzed corporate social responsibility strategies, workers-owned cooperatives or the development of sustainable business models (Hahn *et al.*, 2018). However, only a handful of studies have used the paradox lens to analyze CBM Greer et al., 2021).

Considering that at their core, all CBM are based on the logic of creating commercial value through increasing circularity, it is expected that similar paradoxical tensions are present at other forms of CBM, yet these tensions remain largely unexplored. Against this backdrop, the RQ3 posed in this dissertation is the following:

What paradoxical tensions can be identified in the CBM literature and practice?

1.6. CONTEXT OF PHD

The research presented in this dissertation was conducted while simultaneously taking part in an project called "CircularPP." This project had a profound influence on the manner and scope in which the PhD study unfolded; therefore, the following section introduces the project CircularPP and the way it influenced the thesis.

1.6.1. INTRODUCTION TO CIRCULARPP

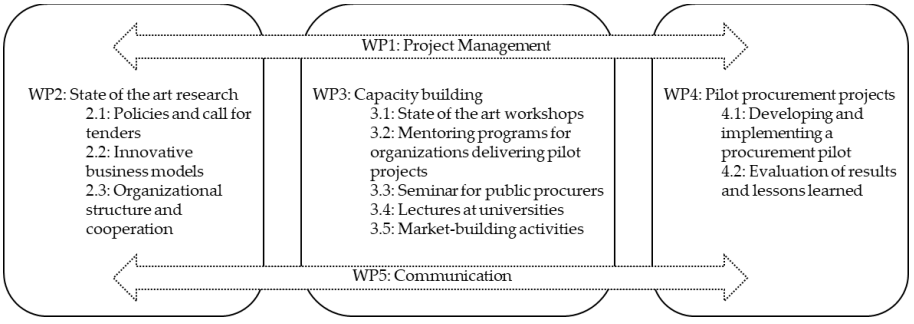
CircularPP was an international, multi-partner project supported by the European Regional Development Fund that ran from October 2017 to April 2021. Its main goal was developing capacity across the entire value chain of the Baltic Sea region, including private and public sector actors, to incorporate circularity into public procurement practices and facilitate the uptake of CE-related products and services by engaging in close dialogue with small and medium enterprises (SMEs).

The partnership brought together a variety of partners, including municipalities, universities, procurement and industry support organization in order to achieve four parallel objectives:

- Research the state of the art in CPP and identify improvement potential
- Build capacity through seminars, workshops and mentoring programs specifically aimed at public procurers, SMEs, and policy and decision-makers
- Conduct five CPP pilot projects at the contracting authorities (Aalborg and Malmö) as well as in other municipalities in Latvia
- Develop practical capacity-building material (e.g., training, guidance, future recommendations, etc.) to disseminate the project insights among public procurers and SMEs across Europe

The activities of CircularPP were divided into five parallel work packages (WP) with specific subtasks (presented graphically in Figure 1-2). The main tasks I was responsible were WP2.2 and WP2.3. This involved planning, conducting the investigation, creating the reports and communicating the outcomes of the studies. The outputs from these two WPs, Report I and Report II, can be found in Appendix A of this dissertation.

Figure 1-2: Overview of the CircularPP project



WP2.2. involved developing an overview of 50 examples of CBM used by SMEs in the partner countries of Denmark, Sweden, Finland, Latvia, Russia, Poland and the Netherlands. From these 50 examples, 10 cases were analyzed to explore their benefits and barriers based on interviews conducted with managers, owners or key representatives from these organizations. The report concluded with recommendations for PSOs regarding how to adapt their

procurement practices to improve the uptake of products and services from CBM.

WP2.3 focused on the organizational and institutional analysis of the different pilot projects implemented by the CircularPP partners. Six pilot projects were analyzed: two by the city of Aalborg, two by the city of Malmö and two by two municipalities in Latvia. Based on their analysis, a series of recommendations was made for municipalities to advance the systematic implementation of CPP.

Conducting these two investigations served as the cornerstone of the dissertation and provided valuable insights regarding CPP and CBM which helped frame and achieve main goal of the dissertation. For example, by translating insights from the analysis of CBM into recommendations for how procurement processes can be conducted to improve the uptake of such CBM, the interconnection between CPP and CBM began to be explored. Regarding Report II, while analyzing the implemented pilot projects, I collected data from the various actors involved, including the participating SMEs. This provided insights regarding the understanding of CPP from a supplier perspective.

Overall, CircularPP influenced the PhD study on multiple levels, including scoping the research, facilitating the data collection and collaborative analysis, and determining the forms of knowledge dissemination.

- **Scope**: The geographical scope of Circular PP (i.e. Baltic Sea region) helped determining this scope of the research presented in the disseratation, which also drew mainly from data collected in a North European Context. Compared to broader scope such as multiple regions or beyond the EU, this limited scope helped establishing an underlying regulatory framework of public procurement (i.e., the EU Procurement Directive) and faciltiated the search for best practices and relevant reports and documents related to CBM and CPP.
- **Access**: CircularPP provided access to relevant stakeholders, which is a crucial asset in qualitative research. This included access to theoretical and practical insights from leading experts in the field and, most importantly, access to empirical data in ongoing CPP projects. Without such access, it would have been difficult to explore how CPP develops from the perspective of project participants, and a

retrospective analysis would have been more likely e.g., through tender document review.

- **Collaborative research**: the set-up of CircularPP facilitated conducting collaborative research, particularly in terms of data analysis. This benefited the study as involving external participants in research can be a source of richer insights and more relevant conclusions and recommendations (Taylor, Bogdan and Devault, 2015). For example, CircularPP partners aided in collectively deciding which product/service groups would be worth investigating and suggested a variety of CBM from their specific countries. Furthermore, in the process of developing recommendations for advancing the implementation of CPP, all partners provided feedback, input and eventually validation of such recommendations.
- **Communicating research**: international projects such as CircularPP require a particular form of output communication. The main audience of such reports is not the academic community but rather procurement professionals, managers of commercial firms and politicians. Therefore, I developed reports that differed from conventional forms of research communication such as academic papers. Instead, WP2.1 and WP2.3 were published as shorter, more concise and visually appealing outputs.

1.7. READING GUIDE

The dissertation consists of 7 chapters divided in three sections. A reference list and the Appendices. Section 1 frames the totality of the research. Section 2 presents the research findings. Section 3 integrates insights in a cross-cutting discussion and presents the general conclusions. The dissertation concludes with a reference list and an appendix with complementary documents and data.

Section 1: Conceptual framework

Chapter 1: Introduction

This chapter introduced the main concepts and research areas of the dissertation (circular economy, circular public procurement and business models). It presents the aim of the dissertation and the main research questions and elaborates on the context upon which the PhD was conducted

Chapter 2: Methodology

This chapter positions the dissertation in relation to the major scientific

paradigms, provides an overview of the research design and methods employed and reflects upon the methodological choices.

Section 2: Research findings

Chapter 3: Literature review on Circular Public Procurement
This chapter presents a systematic literature review on CPP, including an overview of the state of the art, research gaps and avenues and a reconceptualization of CPP.
Chapter 4: Market dialogues: process and tensions
This chapter analyses market dialogues in CPP projects and conceptualizes this phase of a procurement project as a form of staging innovation spaces.
Chapter 5: Paradoxical tensions in Circular Business Models
This chapter explores a series of paradoxical tensions identified in the CBM literature and practice.

Section 3: Integrating insights

Chapter 6: Discussion
Drawing on the research findings, this chapter discusses three perspectives of potential interconnections between CPP and CBM across four different themes.
Chapter 7: Conclusions and recommendations
The main research conclusions and managerial recommendations generated based on the PhD study are elaborated in this chapter.

CHAPTER 2. METHODOLOGY

This chapter provides an overview of the research design, methods and key methodological choices made during the PhD. It positions the dissertation in relation to the major scientific paradigms and concludes with a discussion about research validity and reliability.

2.1. RESEARCH DESIGN

The overall aim of the PhD is to advance the academic research and managerial practices of CBM and CPP as well as their understanding as interconnected elements within a broader CE transition. The research unfolded as a qualitative and explorative design. Explorative research, according to Given (2008a), is adequate for topics where there is little knowledge but high interest. The specific elements considered worth exploring are reflected in the sub-research questions posed in the dissertation, including the paradoxical tensions in CBM, market dialogues in CPP projects, and the state of the art of the CPP literature.

The research conducted had an "emergent design" (Given, 2008a) since it began with a broad objective and, as the investigation advanced, specific research questions were formulated. The possibility to maintain an open and emergent research design is one of the strengths of qualitative-exploratory research since it allows researchers to make decisions on what is to be studied and how to approach it (Taylor, Bogdan and Devault, 2015). This reflects how the PhD study unfolded, since initial research questions were revisited in light of incoming data or relevant theoretical findings from the literature, in essence, maintaining the final of the objective of the dissertation open throughout the process.

Overall, the research design can be divided into three major phases, as represented in Figure 2-1: entering the field, finding a niche, and developing insights. The totality of the research and the activities in each phase were not sequential; instead, multiple processes (such as the literature review and data collection) took place simultaneously and different research avenues were pursued, e.g., CBM and CPP.

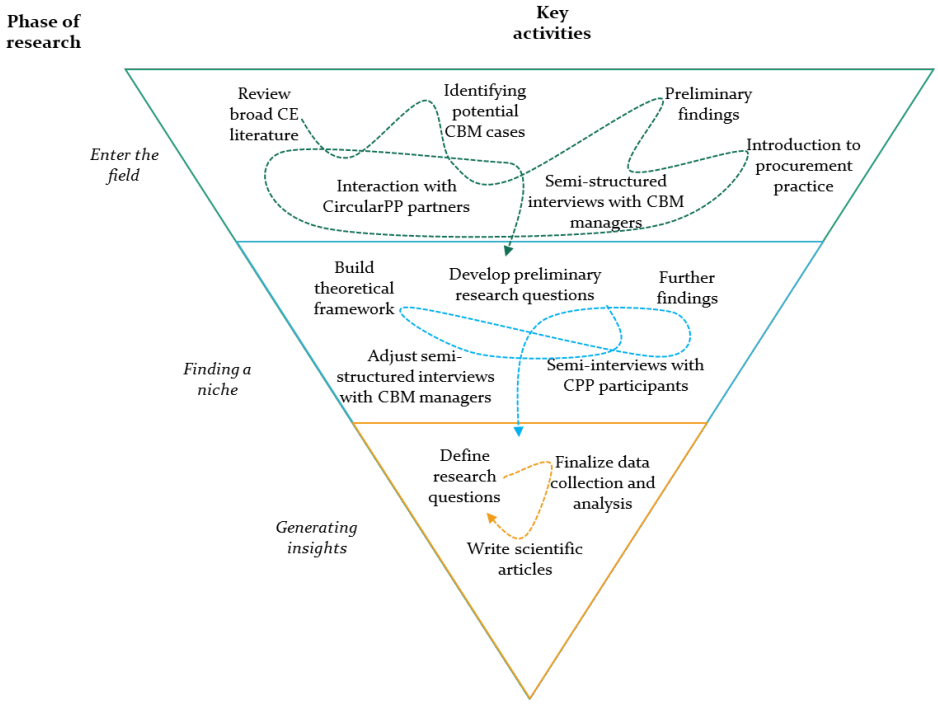


Figure 2-1: Graphical representation of the research design

Entering the field

This stage involved familiarization with the academic field and the practice of public procurement through meetings and seminars that took place as part of the CircularPP activities. The variety of partners also meant a variety of perspectives that could be used to develop an understanding of the public procurement practices and literature. This (semi-unstructured) interaction with CPP experts continued throughout the process and was a valuable source of insight and feedback as my understanding of the topic advanced.

In parallel, a structured but still preliminary form of data collection with managers of CBM took place, as did an ongoing review of the CE literature in order to develop a broader and more solid theoretical understanding and to determine the state of the art of the topic. The process of reviewing the literature was also ongoing throughout the PhD, although, as the

investigation advanced, the strategy and focus of the review changed. In other words, as more data were collected, the literature review exercise became more purposeful and focused.

Finding a niche

This phase was characterized by preliminary semi-structured interviews with managers of CBM. These interactions helped identify key insights that delineated more specific research paths. For example, during an interview with the manager of a restaurant whose CBM is based on recovered food as the main ingredient in preparing their meals (Case 1 in Report I), the manager mentioned that using recovered ingredients represented both benefits and disadvantages. This caught my attention and put me on the path of taking a paradox perspective as a theoretical approach to analyzing CBM.

Similarly, interviews were carried out with the different actors participating in CPP projects. This shed light on the variety of actors as well as the length and complexity of the "pre-tendering" phase of procurement (particularly in Case 1 from Report II), which led to a particular focus on this procurement phase. This meant that other phases in CPP that could have been analyzed, such as tendering or post-contract oversight, were only superficially explored.

Generate insights

In the later part of the study, once there was a clear understanding of the research objectives (i.e., exploring paradoxical tensions in CBM or exploring market dialogues in CPP), it was possible to conduct a purposeful and integrative literature review as well as begin a formal analysis of the collected data. From this analysis, insights regarding paradoxical tensions and market dialogues were derived.

2.2. OVERVIEW OF THE ACADEMIC OUTPUTS

The main research findings are presented in Chapters 3, 4 and 5, which respectively represent three unique research endevours. Chapter 3 was written specifically for the dissertation, while Chapters 4 and 5 were developed as "stand-alone" academic papers. Each of these studies followed a unique research design (an overview is provided in Table 2-1). The following sub-sections present an overview, discussion and reflection of the main methodological considerations of each chapter.

Table 2-1: Overview of research papers and chapters

Research Design Element	Chapter 3	Chapter 4	Chapter 5
Type of study	Review	Empirical	Empirical
Social phenomenon under study	State of the art of the CPP literature	Market dialogues in CPP projects	Paradoxical tensions in CBM
Unit of analysis (sample size)	Academic and gray material (41)	CPP projects (4)	CBM (12)
Primary method of data collection (amount)	Integrative literature review	Semi-structured interviews (N=10)	Semi-structured interviews (N=12)
Secondary method of data collection	Not applied	Integrative literature review	Integrative literature review
Analytical strategy	Inductive synthesis	Constant comparative method	Thematic analysis

2.2.1. REVIEW STUDY

Literature reviews are a common research method applied in various disciplines. This conceptual study did not collect empirical data through observations or interviews, but rather systematically identified, collected and analyzed the academic output available related to a specific phenomenon (Tranfield, Denyer and Smart, 2003). Literature reviews are often a key component in PhD studies as they allow researchers to immerse themselves in the field of study and become familiar with its main theories, methods and research questions. (Tracy, 2012).

A review can be conducted in ways that differ in terms of the search strategy and analytical approach (Snyder, 2019). Reviews can span from simple narrative reviews that present and criticize some of the main findings of a research field to systematic reviews, derived from a transparent and standardized search and appraisal protocol, that apply complex analytical methods and analyze complex data from a large sample of studies (Booth, Sutton and Papaioannu, 2016).

Systematic reviews are common in medicine and other well-defined disciplines and are considered the "gold standard" of reviews (Tranfield, Denyer and Smart, 2003). However, a highly systematic review might not be the best choice in certain situations, particularly when trying to analyze a phenomenon that has been differently conceptualized and studied within diverse disciplines (Snyder, 2019), such as with CBM or CPP. In such cases, other forms of review, e.g., semi-systematic or integrative, might be more adequate.

One alternative is an integrative review, which incorporates systematic and innovative search strategies to counter the conceptual ambiguity of the phenomenon under study (Torraco, 2005). This includes, e.g., developing a list of potential keywords that could help catch the diverse conceptualizations of the topic, incorporating gray literature, and applying other methods such as reference mining. The key feature of integrative reviews is their objective, which is building preliminary theoretical frameworks and offering new perspectives of a research topic (Snyder, 2019).

With these considerations in mind, an integrative review on CPP (Chapter 3) was chosen. This choice is justified, firstly, because it is an emergent field that has yet to be consolidated through a systematic review, and secondly, because its diversity of conceptualizations requires consolidation—not to eliminate variety, but to take stock of the broad practices and understandings of CPP.

2.2.2. EMPIRICAL STUDIES

According to Taylor et al. (2015), qualitative research is mainly concerned with the meanings people attach to the phenomena they experience. From this perspective, Chapters 4 and 5 are qualitative studies since the main goal was exploring the perspectives of the actors involved in two unique social phenomena: market dialogues in CPP projects (Chapter 4) and tensions derived from CBM (Chapter 5). Moreover, the data in both papers is sourced

from the social actors involved in the phenomena; hence, both papers are empirical.

Since Chapters 4 and 5 are focused on understanding a specific social phenomenon in its "natural" context, compared to alternatives such as experimentation, it can be said that they are inspired by the case-study method (Flyvbjerg, 2014). Consistent with case-study research (Yin, 2015), the primary form of data collection was semi-structured interviews. Interviews allow the researcher to explore the meanings, experiences and perspectives of the people involved in the phenomenon they wish to study (Taylor, Bogdan and Devault, 2015). Also in line with the case-study methodology, empirical data from each case were supported with document analysis, including a review of the firms' websites, CSR reports and other publicly available documents in Chapter 5, and a review of tender documents and procurement policies in Chapter 4.

These empirical studies present certain similarities, such as their inductive analytical approach. Induction is a logical reasoning process wherein the researcher begins by collecting observations, which in turn are used to develop tentative claims that can potentially be tested to generate theory (Tracy, 2012). As induction does not require a pre-determined and fixed theoretical framework, it provided the necessary flexibility for conducting an exploratory study.

In particular, two inductive analytical strategies were applied: the constant comparative method and thematic analysis. Both strategies were chosen as they provide guidance for conducting a systematic analysis of qualitative data and are compatible with an emergent analysis process, whereby the focus of the analysis can change during its actual process (Given, 2008a). Moreover, both strategies embrace iterative analysis (Taylor, Bogdan and Devault, 2015) or, in other words, moving from data to theory and vice versa, which offers richer findings by continuously revisiting theories as the data were analyzed in addition to the testing of different theoretical frameworks.

2.3. CRITICAL REFLECTION ON DATA COLLECTION METHODS

Since qualitative interviews were the main form of data collection, it is important to reflect upon the strengths and weaknesses of this method to assist in the interpretation of the findings and the overall assessment of the study.

Compared to other qualitative methods, such as participant observation, interviews provide access to phenomena which, for a variety of reasons, cannot be directly observed (Taylor, Bogdan and Devault, 2015). In my case, the phenomenon could not be "observed" because the management of CBM and CPP projects is an ongoing process and cannot be captured in a snapshot observation. However, interviews are not the only way to analyze CPP projects. For example, Uttam and Le Lann Roos (2015) analyzed a procurement case through action research, which provides an in-depth and "insider" perspective of the process. However, due to the intensity of resources required, this form of study is more appropriate for single cases. This would have presented a challenge considering that my tasks in CircularPP required analyzing multiple cases that took place in different countries and at different temporal scales. From this perspective, the choice of relying on semi-structured interviews can be justified.

Procurement and business model research can also draw exclusively from secondary sources, such as tender documents (Mendoza, 2019) or public databases on business practices (Ünal and Shao, 2018). This approach allows the analysis of a larger sample of "cases" and is useful for providing a descriptive analysis, for example in relation to the procurement practices of a country (Mendoza, 2019) or developing CBM typologies (Ünal and Shao, 2018). Nevertheless, the objective of my research was to capture the interpretations of the actors involved in CBM and CPP projects, thereby justifying the selection of qualitative interviews as the main data collection method.

Complementary methods could have been applied in the study. For example, for the study presented in Chapter 4, participation and observation in the actual market dialogues would have been a valuable source of information that would have provided the opportunity to take field notes and observe how the meetings unfolded; these data could eventually have been used to obtain a more rich interpretation of the phenomenon. Nevertheless, while these visits did not occur, the close and ongoing interaction with the CircularPP partners in charge of arranging and conducting such meetings provided a richer perspective of the event beyond the scope of the interviews.

Overall, the choice to rely on semi-structured interviews can be justified. However, there are still critical reflections on how the method was followed. The main limitation of my research was the lack of follow-up or recurrent interviews with the key informants, which would have enabled the further

exploration of specific aspects that might have become evidently interesting only after the analysis of the initial interview.

2.4. POSITIONING THE DISSERTATION

Positioning a study can be understood as reflecting on the way research was conducted in relation to major scientific paradigms. According to Guba and Lincoln (2013), all major research paradigms can be distinguished based on three basic beliefs: 1) ontology, which deals with the nature of reality, 2) epistemology, referring to the nature of knowledge, and 3) methodology, which focus on the procedural aspects for obtaining or creating knowledge. In order to position a research practice, it requires making a clear connection between the main elements of paradigms and the way in which research was conducted (Brinkmann, 2017). This exercise of critical reflection helps explore the legitimacy of the research practice as well as clarifying underlying assumptions that support it (Slawecki, 2018).

In the following sections, three paradigms are introduced (constructivism, phenomenology and hermeneutics) as the main paradigms supporting the study. Ontology, epistemology and methodology are described for each paradigm and the alignment with the way research was conducted is outlined.

2.4.1. CONSTRUCTIVISM

Ontology, or the nature of reality, is often presented, in broad terms, as a spectrum between realism and relativism (Moon and Blackman, 2014). Realists believe there is an external world with certain characteristics independent of humans' capacity to know them. In contrast, relativists deny such an idea and embrace the premise that knowing (as a human activity) creates what is known (Brinkmann, 2017). Considering this ontological spectrum, the research presented in this dissertation is supported by a relativist ontology that understands reality as being socially constructed and which embraces the idea that knowledge is co-constructed through and by the interactions of different actors (including the researcher). Moreover, the goal of the dissertation is advancing the understanding and practice of CE by focusing on the interconnection of CPP and CBM. According to Lincoln and Guba (2000), social constructivism aims to develop more sophisticated constructions of social phenomena. Therefore, the dissertation is aligned with a social constructivism.

This relativist position can be identified in the overall research approach of the investigation (section 3.1) and the specific research design of the individual studies (section 3.2). Specifically, looking at the research questions posed in this dissertation, it is possible to identify a relativist worldview since these are focused on understanding and exploring a phenomenon based on the experiences and interpretations of the actors involved in the phenomenon rather than claiming to observe and measure the phenomenon itself.

Moreover, a constructivist perspective is evident in the way "data" is conceived for this study, namely in the form of interpretations of social actors involved in the phenomenon of interest, e.g., the way managers experience tensions in the ongoing process of managing a CBM (Chapter 5). Moreover, the objective of the inquiry is aligned with constructivist approaches.

While scientific paradigms are often presented as distinct entities, in practice, their boundaries may be blurry and dynamic and, hence, hard to define (Lincoln and Guba, 2000). Moreover, bricolage (i.e., drawing from distinct paradigms) is not considered as contradictory but in some forms of inquiry it is even encouraged as long and argumentation is presented for the reasons and value of such eclecticism (Brinkmann, 2017). Upon this context, the following section elaborates on some elements of phenomenology and hermeneutics which can also be identified in this dissertation.

2.4.2. PHENOMENOLOGY AND HERMENEUTICS

Knowledge in phenomenology is conceived as *descriptions* of the experiences of the actors involved in social phenomena, from which potentially essential properties of the human experience can be distilled (Brinkmann, 2017). Phenomenological research is particularly useful for complementing cognitive-focused research since it can help explore thinly described cognitive bias and heuristics (Berglund, 2015). The phenomenology perspective can be identified, for example, in the research design of Chapter 4, where the key informants were asked to describe their experiences regarding market dialogues. In this investigation, cognitive frames, as ere one element of the study, were complemented by other elements to help explain the way market dialogues unfold.

In turn, hermeneutics focuses on the *interpretation* of experiences (Brinkmann, 2017). In this research, and particular in Chapter 5, the idea of a hermeneutic cycle was embraced in which interpretations from key informants were collected (i.e., the benefits and barriers of CBM), which then were interpreted

in light of paradox theory. This allowed the development a more nuanced and sophisticated explanation of the phenomena, which is the main goal in hermeneutics.

Lastly, a common feature of constructivism and hermeneutics concerns the active role of the researcher in shaping and constructing the research findings in addition to the potential of such findings to spark change in the original communities in which research was conducted (Lincoln and Guba, 2000; Brinkmann, 2017). This can be observed in the manner of reporting conclusions in both the papers and this dissertation, which include recommendations intended to spark reflection among the actors involved and potentially contribute to changing the actual practices related to CPP and CBM.

2.5. VALIDITY AND RELIABILITY OF THE RESEARCH

After clarifying the underlying philosophical positions supporting this dissertation, it is possible to perform a more appropriate critical reflection of the investigation (Guba and Lincoln, 2013). As elaborated above, this is a qualitative research investigation, closely aligned with a constructivist paradigm. Therefore, concepts such as objectivity, reliability and generalizability are not relevant to evaluating it; instead, the quality of the research is more appropriately assessed in terms of rigor, credibility and coherence

Rigor

Rigor refers to carrying out research in an appropriate manner, including data collection and analysis (Tracy, 2012). One of the main questions arising in this regard is whether enough data were collected. While there is no general answer to this, a rule of thumb is associated with a specific amount of hours spent in the field for ethnographic studies or a particular number of interviews for interview-based studies. However, as Tracy (2012) explains, rigor is determined less by the total amount of data than by the uniqueness and density of the data. The former is related to the novelty of the data compared to what is available in the literature, while the latter refers to how much the data help in the analysis (i.e., richness). From this perspective, sufficient data was collected considering the exploratory nature of the studies (both Chapters 4 and 5). For example, the data in Chapter 4 were derived from 10 interviews with 10 different actors involved in 4 different market dialogue events. Though the number of interviews is not outstanding, the phenomena

under study are mostly absent from the literature; therefore, what may be considered a small sample of data can in fact be sufficient to provide new insights.

Rigor implies more than following the steps provided in an analytical strategy, e.g., the first- and second-level coding process in the constant comparative method (Boeije, 2002). Instead, it requires explaining to the reader with enough detail how the data were transformed into findings. In that regard, each of the papers includes a detailed explanation of the analytical approach taken in its respective methodology section, complemented by a bird's-eye view of the methodology provided in this chapter.

Credibility

The notion of credibility can be associated with trustworthiness since it refers to expressing a reality that is plausible or seems true. There are several ways to achieve credibility, including providing thick descriptions, crystallization, multivocality and engagement in reflections with others. (Tracy, 2012).

Crystallization is very similar to triangulation—a concept developed from positivist paradigms—however, this term is prefered when the study is located within the interpretative paradigm. Crystallization is a characteristic of a study where the researchers engage in multiple types of data collection, at multiple points in time, and in collaboration with different people, which can lead to the construction of a multifaceted version of reality, much in line with the constructivist paradigm (Tracy, 2012). Engaging with multiple perspectives is a clear feature of the study as insights from procurement experts, company managers, and procurement and public officials from multiple countries were collected and incorporated into the analysis. In a more specific situation, Chapter 4 is a good example of crystallization, wherein a single event (i.e., a market dialogue) was analyzed by incorporating the perspectives from both the buyers and suppliers engaged in the process. In this way, it was possible to approach such an event from a variety of perspectives, or by looking through the various facets of a crystal. Multivocality, or presenting the voices from different actors, is one way of showing crystallization in academic writing (Taylor, Bogdan and Devault, 2015). This can also be observed in all of the papers, which included quotes from different actors interviewed during the investigation.

Thick description is achieved when the context of a specific phenomenon is explicated, which can be achieved by providing the necessary details about people, processes and activities (Tracy, 2012). The papers included in this dissertation do not provide a thick description of the cases due to the word limits established by the scientific journals to which they were submitted for publication. For example, the Journal of Purchasing and Supply Chain, to which Paper II is submitted, has a relatively low limit of 8,500 words. However, thick descriptions of the cases discussed in Chapters 4 and 5 are present in the supporting reports attached in the Appendix. .

Participants reflections

Asking the research participants (informants, interviewees, etc.) to validate the findings of an investigation is a common practice. However, interpretative studies include participants in a more active manner beyond validation, wherein they can become a source of insight and interpretation and shed new light on the findings. This not only increases credibility but can also set the path for further research (Tracy, 2012).

Member reflections were particularly sought for Report II (as elaborated in section 2.3. of this dissertation). From this perspective, partners from CircularPP were simultaneously informants, participants of the analysis, and a source of validation of the results.

SECTION II:

RESEARCH FINDINGS

CHAPTER 3. LITERATURE REVIEW ON CIRCULAR PUBLIC PROCUREMENT

This chapter presents an integrative literature review on the topic of CPP. First, it explains why a literature review is necessary; this is followed by a detailed explanation of the methodology used. It concludes by outlining the state of the art and a concludes with a new conceptual framework of CPP. The chapter was written specifically for this dissertation in order to answer RQ1.

3.1. INTRODUCTION

With the adoption of the European Green Deal, the EU has reaffirmed its commitment to achieving mid- and long-term climate-related and socio-economic goals, such as net-zero greenhouse gas (GHG) emissions by 2050. A key element in this transition is mobilizing the industry toward a green and circular economy (European Commission, 2019). The circularity transition in the EU is guided by the recently adopted 2020 CE Action Plan, which sets out a variety of key policies and regulations. Applied in synergy, they are expected to embed CE principles at all stages of the value chain, from production and consumption to waste management (European Commission, 2020). One of the key elements in the CE transition is CPP since it can act as a tool for reducing Scope 3 GHG emissions from the public sector, which is fundamental since the majority of GHG emissions included within the inventory of organizations is derived from supply chain activities (Farsan *et al.*, 2018). Considering the strategic importance of CPP, it is important to have a solid conceptual framework that can facilitate its implementation and diffusion across PSOs.

Table 3-1: Definitions of CPP found in the literature

Source	Definition	Key Elements
Jones et al. (2017)	"Circular procurement is about making agreements to ensure that the products that you procure for your organization are produced in accordance with the principles of the	Post-use management of products

	circular economy and will be further processed after use."	
European Commission (2017)	"The process by which public authorities purchase works, goods or services that seek to contribute to closed energy and material loops within supply chains, whilst minimising, and in the best case avoiding, negative environmental impacts and waste creation across their whole life-cycle."	Objectives of a procurement process
Thiebault and Tonda (2018)	"Circular procurement focuses on closing energy and material loops within supply chains and helps value retention along the entire value chains."	Value retention
Alhola et al., (2019)	"a procurement of competitively priced products, services, or systems that lead to extended life spans, value retention, and/or remarkably improved and non-risky cycling of biological or technical materials, making use of and supporting the circular business models and related networks"	Circular business models and networks

Several organizations from the public and private sector as well as non-governmental organizations and academia have been working with CPP for several years, creating rich insights and configuring an emerging research field around CPP. In this context, a variety of definitions of CPP are available, emphasizing unique aspects of the practice (an overview is provided in Table 3-1. While some definitions of CPP do exist, most consider it as an extension or a part of other procurement policies, such as green, sustainable, or innovative procurement. Indeed, CPP shares similarities with other

procurement policies; for example, it requires skilled procurers, engaged managers and political support to set the appropriate organizational conditions for its development (Jones, Kinch Sohn and Lysemose, 2017). However, CPP involves unique processes and practices for its implementation that distinguish it from other procurement policies and warrant its individual analysis (Grandia and Voncken, 2019).

While CPP as a concept is relatively novel, zits practices are not new. For example, procuring functions rather than products has been advocated for more than a decade as a way to incentivize and promote sustainability in the industry and the public sector (Ceschin and Vezzoli, 2010). In the past, the term CPP was not used, and these practices were instead referred to as functional procurement, innovative closed-loop procurement or clean-tech innovations. Due to this variety of framings, valuable insights regarding CPP remain scattered across disciplines and research fields. Therefore, in order to improve the conceptual foundation of CPP, this chapter presents an integrative literature review focused on CPP.

Useful for topics that have been conceptualized differently across disciplines (Snyder, 2019), integrative reviews are a type of systematic literature review aimed at reconceptualizing and expanding the theoretical foundation of an emergent or scattered research field (Torraco, 2005). Overall, an integrative review on CPP will help advance practice and research by attempting to reconceptualize the topic based on the state of the art of the CPP literature and other circularity-related procurement practices. With this foundation, the research gaps and potential research directions were identified.

Two literature reviews related to CPP have been conducted. The first was by Sonnichsen and Jesper (2020), who analyzed GPP and sustaniable public procurement (SPP) literature to explore potential pathways toward CPP. This review did not incorporate gray literature (conference papers, book chapters, industry or government-commissioned reports, etc.), which can be considered as a limitation since CE receives significant attention from industry and other organizations and the academic literature is lagging in many areas (Kirchherr and van Santen, 2019). Lastly, Sonnichsen and Jesper (2020) included studies published up until only early 2019, which, for a rapidly developing field such as CPP, can make the review somewhat outdated. The second review was by Klein and Ramos (2020), who explored the public sector practices related to CE. This review has a broader scope since it incorporated both academic and gray literature. However, the focus of the study was not exclusively on

procurement, and hence CPP was only one element in the analysis. Overall, while Klein and Ramos (2020) and Sonnichsen and Jesper (2020) have (partially) consolidated the early developing literature on CPP, neither of these studies fulfills the proposed objective of this chapter, which is reconceptualizing CPP following the integration of literature addressing circularity practices in procurement, regardless of whether the term CPP is applied.

Aim and overview of the chapter

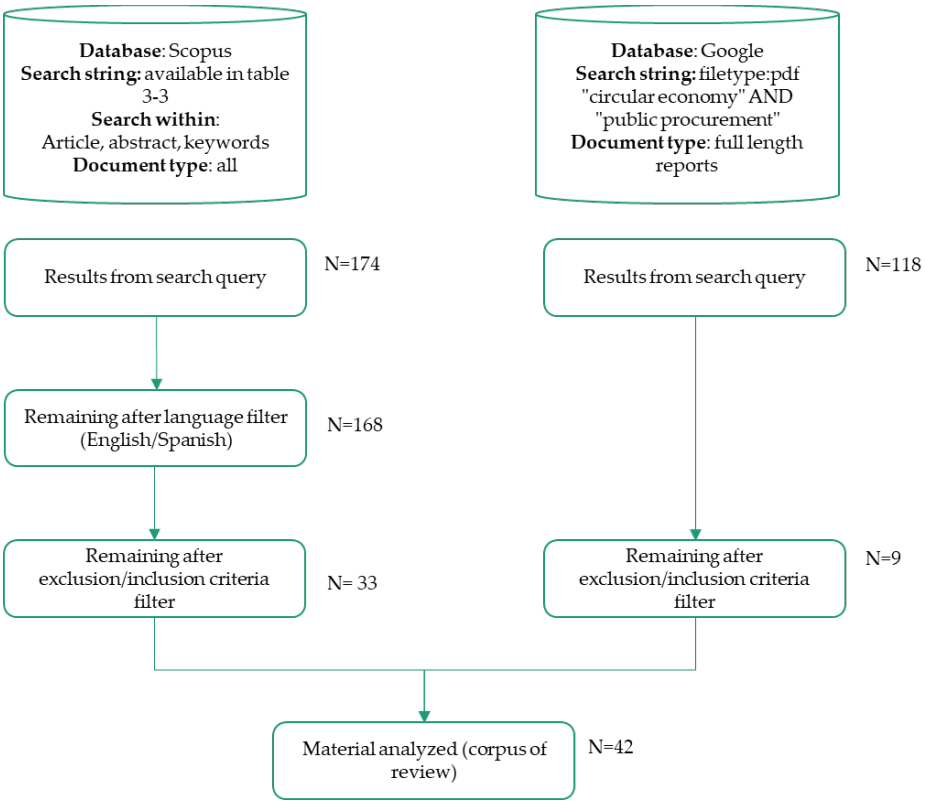
This chapter presents an integrative literature review of the field of CPP. It builds upon previous reviews and addresses their main methodological limitations. The presented review includes academic and gray literature as well as explicit and implicit studies on CPP. The aim is to reconceptualize CPP in light of an updated and broader understanding of CPP. Based on this renewed state of the art, knowledge gaps are identified and research directions are proposed.

The next section presents the methodology followed during the review. Afterward, the results are divided into a descriptive analysis of the sample and a state of the art derived from the material collected. The chapter concludes with a new conceptualization of CPP derived from the review and highlights potential research avenues based on the identified gaps and limitations.

3.2. METHODOLOGY

The methodology followed in this integrative literature review is divided into four main phases: planning, screening, analysis and synthesis. This is consistent with the accepted guidelines for systematic literature reviews provided by Tranfield et al. (2003). The following sections briefly describe each of the phases. Table 3.2 provides an overview of the search process.

Figure 3-2: Literature review process diagram



Planning

The key outcome of this phase is designing the search strategy that will be used in the study (Tranfield, Denyer and Smart, 2003). Firstly, this review includes both academic and gray literature related to CPP; therefore, the electronic database SCOPUS was chosen as the main search platform since it is one of the largest repositories of academic sources and includes peer-reviewed academic articles, conference papers and book chapters.

Considering the objective of the investigation, i.e., identifying the state of the art in regard to CPP, the two main keywords for the search string were "circular economy" AND "public procurement." However, as already elaborated, circular-related procurement has various framings; thus, additional keywords were employed. These were identified based on other CE-related reviews. Firstly, following the search strategy of Simone and

Alberg (2020), circular economy was substituted by the term *circular* *econom* since this form of wildcard can help capture variations of the term (e.g., circularity or circular economics). Secondly, to capture CE-related practices, other terms were included, such as repair, remanufacturing, refurbishment, etc. These terms were identified based on Batista et al. (2018), who used a detailed keyword list in their systemic review of CE. Moreover, Klein and Ramos (2020) identified procurement strategies related to CPP, such as procurement from PSS or procurements with outcome-based specifications; hence, these terms were included in the search. Lastly, different variations of the term public procurement were used, including "governmental procurement," "public purchasing" and "contracting authorities". The overview of key terms can be found in Table 4.3

Table 3-3: Keywords and search string used in the literature review

Main Keywords Arranged by Themes		
Public procurement	**Circular economy**	**CPP strategies**
"public procurement"	*circular* AND *econom*	"PSS"
"public purchasing"	"closed loop"	"product service systems"
"government purchasing"	reus*	"result based"
"government procurement"	repair*	"outcome based"
"public contract"	recondition*	"functional sales"
"public contracting"	refurbish*	
"contracting authority"	remanufactur*	
"contracting authorities"	recycl*	
	cascad*	
Final Search String		

(TITLE-ABS-KEY ("product service systems" OR "PSS" OR "result-based" OR "outcome-based" OR "functional sales" OR (circular* AND econom*) OR "closed loop" OR repair* OR reus* OR recondition* OR refurbish* OR remanufactur* OR recycl* OR cascad*) AND TITLE-ABS-KEY ("government procurement") OR TITLE-ABS-KEY ("public procurement") OR TITLE-ABS-KEY ("public purchasing") OR TITLE-ABS-KEY ("government purchasing") OR TITLE-ABS-KEY ("public contract") OR TITLE-ABS-KEY ("public contracting") OR TITLE-ABS-KEY ("contracting authority") OR TITLE-ABS-KEY ("contracting authorities") OR TITLE-ABS-KEY ("public sector" AND "procurement"))

Screening

The main objective of the screening phase is determining if the material found through the search query is relevant for inclusion in the analysis. For this, it is necessary to define inclusion/exclusion criteria that can be applied systematically (Tranfield, Denyer and Smart, 2003). The exclusion/inclusion criteria were designed to be as broad as possible, as the main objective of the review is to provide an overview of CPP research and consolidate scattered knowledge. For that reason, studies dealing specifically or partially with CPP were considered relevant. The exclusion/exclusion criteria were applied on two levels, first in the title and abstract of the document (when available), and then in full-text screening. Studies that simply recommended the use of CPP without further analysis or exploration were excluded.

To increase the validity of the search strategy, citation mining was conducted, which included screening bibliographies of similar literature reviews on the topic and the citations of selected publications (Hempel, 2020). In this case, related reviews (Klein and Ramos, 2020; Sonnichsen *et al.*, 2020) and key publications (Kristensen *et al.*, 2021; Ntsondé and Aggeri, 2021; Rainville, 2021) were screened to identify additional sources. To further increase the validity of the search, the "recommended articles" or "related research" suggested on the website where the material was downloaded were also screened.

Integrating gray literature

As a complement to academic research, industry and government-related outputs were searched through Google, which is a common search engine employed in gray literature reviews (Sandin and Peters, 2018). Using Goggle

was useful due to the breadth of results and potential for including Boolean operators. The search strategy was limited to two single keywords (circular economy AND public procurement), and the review was limited to the first 10 pages of results. Only full-length reports commissioned by public organizations or as outcomes of international partnership projects were included. This decision also functioned as a form of quality assessment of the material since commissioned reports and multi-partner projects involve a thorough review of project applications. From this perspective, it is possible to assert that at least the research plan was peer-reviewed by organizations funding the project or commissioning the report. An overview of the included studies can be found in Table 10-1 in Appendix B.

Analysis

The analysis was performed in two stages. First was a descriptive analysis of the material based on bibliometric indicators (i.e., publication outlet, date, methods, etc.), followed by an inductive analysis of the content of the study. Inductive analysis is a grounded-theory inspired analytical strategy that consists of a multi-level and iterative coding process (Gibbs, 2012). The process started with an in-depth reading of the material and a preliminary coding exercise. As more studies were analyzed, new labels were generated and previous codes confirmed, consolidated or modified. After coding all studies, groups and categories were formed and incorporated into a framework (presented in Section 4.5). Once a preliminary framework was created, the process of writing up the results began, and as this phase advanced, adjustment to the first and second orders of codes was continuous (hence the iterative nature of the process).

3.2.1. SAMPLE DESCRIPTION

In total, 42 materials were selected for analysis: 9 project reports and 33 academic studies. The detailed list is presented in Tables B-1 and B-2, are available in Appendix B. This section presents a descriptive analysis of the sample. Academic studies were analyzed following structural aspects, such as publication outlet, research methods, geographical context and product groups. The analysis of the sample of reports is presented in the form of a development narrative.

Academic studies

The academic studies integrated in the study comprised 26 articles published in peer-reviewed academic journals, 2 book chapters and 3 conference papers. Academic output was consistent from 2006 to 2016, with one or two papers published yearly on the topic. However, from 2017, this increased exponentially, reaching a maximum of eight papers during 2020, and the trend suggests that 2021 will continue to see an increase. The publication of Witjes and Lozano (2016) is the most influential academic study based on the number of citations, having been cited more than 200 times, which represents more than 30% of the total citations of the sample.

The studies included in the review are published across various publication outlets. This reflects the multidisciplinary nature of CPP. Only the *Journal of Cleaner Production* (8) and *Sustainability* (3) had more than two published papers on the topic. The remaining material is distributed across 18 different outlets. Based on this distributed publication, it can be argued that CPP knowledge is dispersed and multidisciplinary and that there is a need to create links between such dispersed knowledge. Furthermore, this distribution suggests that CPP is a strategy being developed by and for outsiders of the procurement discipline since none of the outlets is exclusively focused on public or private procurement.

Most articles (15) are qualitative case studies (e.g., Rainville, 2021). A common strategy followed in these case studies is the analysis of a single procurement project, collecting empirical data through semi-structured interviews with actors involved in the process (procurers, business representatives, etc.) and supplementing this with document analysis such as the calls for tender (if available) or procurement policies. In other words, the focus is still on analyzing single projects related to CPP. The second-most recurrent research strategy (9) is conceptual (Witjes and Lozano, 2016) and policy-based studies (Milios, 2018). Together, case studies and conceptual papers account for more than a third of the sample, which reflects the emerging nature of the research field.

As CPP implementation advances, other research designs can be expected. For example, empirical studies (e.g., Soto et al., 2020) rely on the analysis of the tender documents of CPP projects. Moreover, with increased evidence on CPP, quantitative studies may become more prevalent. In the sample collected, only Grandia and Voncken (2019) conducted a purely quantitative

study, whilst Dahlbo et al. (2017) and Jacobson et al. (2021) applied a mixed-methods design, incorporating a life-cycle assessment (LCA) into the analysis.

The geographical context of the sample (i.e., the location of the phenomenon under study) is mostly Nordic countries (Sweden, Denmark and Finland), with 10 studies. However, the majority of studies (9) can be labeled as "international" since they incorporated multiple countries or did not specify any jurisdiction for their investigation. Understanding the geographical context is important since procurement is influenced by a complex multi-level regulatory arrangement that varies across the globe and even at a regional level (Wiesbrock, 2015). And while regulatory frameworks do not directly explain how procurement is carried out, they have a significant influence (Dale-Clough, 2015).

Most studies (22 of 33) are explicit about the product group under study, and the construction and related activities were recurrently analyzed, including building renovation, road infrastructure and construction demolition waste (CDW). The remaining studies (9) did not specify a product group since the analysis focused on generic procurement practices (Campbell-Johnston *et al.*, 2019; Kristensen *et al.*, 2021) or policy analysis (Milios, 2017). Procurement involves the acquisition of a great variety of products, goods and services, which creates significant variation in how procurement is conducted (Yeow, Uyarra and Gee, 2015). Therefore, it is important to consider the product groups being analyzed. Table 3-4 provides an overview of the product groups analyzed.

Table 3-4: Product groups analyzed in the CPP literature

Product Group	Reference
Automobile industry	Ceschin and Vezzoli, 2010
Building renovation	Soto et al, 2020
Building energy consumption	Peñate-Valentín et al., 2021; Lohse and Riel, 2017

CDW and road infrastructure	Chateau, 2007; Bougrain, 2020; Bao et al., 2019; Luciano et al., 2020
Furniture	Ntsondé and Aggeri, 2021; Braulio-Gonzalo and Bovea, 2020; Öhgren et al., 2019
ICT equipment	Crafoord et al., 2018; Gåvertsson et al., 2020
Indoor lighting	Jacobson et al., 2021
Paper management	Yeow, Uyarra and Gee, 2015
Textiles	Rainville, 2021; Dahlbo et al., 2017
Waste management	Gee and Uyarra, 2013
Multiple product groups	Bratt et al., 2013; Alhola and Nissinen, 2018; Alhola et al., 2019; Milios, 2021

Project Reports

In total, nine project reports were selected for analysis. The earliest report was the result of the Green Deal initiative developed in the Netherlands. The Green Deal for Circular Procurement started in 2013, spearheaded by a partnership between public and private organizations in the Netherlands, and brought together 45 public and private organizations that pledged to implement CPP pilots over three years.

The Green Deal was linked to the UK-based REBus project, which explored various CBM, including PSS, hire-and-leasing and long-life models. The Dutch Green Deal and the British REBus project began interlinking to address CPP from a procurement and business model perspective. The results of the interconnected projects were used to create a comprehensive CPP guide that includes knowledge, tips and examples aimed at different actors involved in CPP, including executives, project managers and procurers (Inkopen and Green Deal Circulair Inkopen, 2020).

Insights from the Green Deal were used in the development of the European Commission's best practice and guidance document (European Commission, 2017). This brochure, written by the organization Local Governments for Sustainability (ICLEI), also incorporated insights on SPP Regions, an EU-funded ICLEI-managed initiative aimed at creating and expanding regional networks of municipalities collaborating in sustainable and innovative procurement. Overall, the European Commission documents provided a platform for sharing and expanding upon the knowledge developed on CPP practices at the national level in the UK and the Netherlands as well as the international lessons learned from the SPP Regions project.

In parallel, the Nordic countries were developing their own insights and understanding of CPP. The report by Alhola et al. (2017a), commissioned by the Nordic Council of Ministries, defined the framework and dimensions of circular procurement and presented some best practices of CPP in Nordic countries. A year later, the United Nations Environment Program (UNEP) published a report on the use of sustainable procurement to promote circularity, which helped to export and translate the CPP concept to a global context and audience (Thiebault and Tonda, 2018). Moreover, some reports focused on a specific aspect of CPP. For example, Vanacore et al.'s (2018) main focus was on developing a CPP indicator, Salonen and Vangsbo (2019) focused on construction projects, and van der Zande et al. (2019) proposed a roadmap for transforming the Dutch public sector in a manner that would enable CPP to be widely implemented and monitored.

Overall, based on the material collected, it was identified that industry and government reports began with broad conceptualizations of CPP and began building a theoretical foundation through developing insights of practice. More recently industry reports have pivoted towards analyzing specific sectors or aspects of the procurement process. The breath of actors involved includes international and EU institutions, national and regional authorities, non-governmental organizations and networks and private-sector organizations.

3.3. STATE OF THE ART ON CPP

Following the description of the sample of academic and project reports, this section elaborates on the state of the art of CPP, as derived from the critical integration of insights from the collected material. The section is divided into five interconnected themes. Table 3-5 presents an overview of the themes and

the most relevant references used, however, since the themes overlap, some publications are used in several sections.

Table 3-5: State of the art of CPP literature divided by themes

Theme	Description
Policy Framework	CPP as a policy instrument, interaction with other policies and regulations and the design of a smart policy mix for circularity.
Supporting tools	An array of tools used in the implementation of CPP, including GPP criteria, ecolabels, guidance documents, intermediation, collaboration platforms, and environmental and cost assessments.
Contractual arrangements	Commercial contracts that result from CPP projects, including integrated waste contracts, access-based and functional or performance contracting.
Project management and organizational practices	Insights related to CPP project management as well as broader organizational practices relevant at the procurement department and municipal levels.
Innovation potential	Exploring the potential of CPP as a driver of business models and systemic innovation.

3.3.1. POLICY FRAMEWORK

Overall, CPP policy is a direct policy lever that can be used to promote a CE transition in various ways (Milios, 2017). For example, implementing procurement criteria regarding the recycled content of textiles can lead to an increase in textiles' circularity at the national level (Dahlbo *et al.*, 2017). This can also be aimed at a specific industry, such as the automotive industry, which can be incentivized toward circularity by procuring mobility as a product-service system (Ceschin and Vezzoli, 2010). Alternatively, it can be used to increase the procurement of remanufactured goods by framing

appropriate criteria for product life extension to create sizeable market effects and upscale circular business operations (Milios, 2021).

As a stand-alone policy, CPP may have a limited effect on increasing material circulation (Dahlbo *et al.*, 2017). Therefore, CPP should be integrated as part of a circularity policy mix (Milios, 2017). A smart policy mix means a variety of instruments that are designed to act in synergy to promote a general goal—in this case, a CE transition. In the EU context, such a policy mix includes GPP, the EU Flower (a type I ecolabel) and the Eco-Design and Labeling Directives (Faure and Dalhammar, 2018). When designing such a policy mix, it is important to create synergies and minimize tensions between the instruments. For example, there is currently a tension between GPP criteria essentially excluding the purchase of remanufactured goods due to the inability to provide detailed information on the product materials. One way of creating synergy would be to develop specific GPP criteria for remanufactured products.

Some countries, regions and cities have policies in place specifically addressing CPP; for example, the city of Amsterdam sets specific targets for recycled content as part of all textile procurement (Campbell-Johnston *et al.*, 2019). Another way to embed circularity in procurement policy is by extending or enhancing an established procurement policy, such as GPP. However, from an international perspective, there is still limited integration between CE principles and GPP (Iannone et al., 2020). Overall, Marrucci et al. (2019), analyzing the integration of CE with GPP as well as other instruments for sustainable consumption and production, found a weak integration and the need for a more systemic and interconnected approach toward embedding CE in the policy landscape.

3.3.2. SUPPORTING TOOLS

This section introduces a variety of tools that can facilitate the implementation of CPP, including GPP criteria, ecolabels, guidance documents, intermediation and collaboration platforms as well as life-cycle costing and life-cycle assessments.

GPP criteria

The European GPP policy mandates the development of core and comprehensive "green criteria" that are readily available to be included in public tenders as a form of requirement or award criteria (Neubauer *et al.*,

2017). Before GPP criteria were available, member states developed their own practices for green procurement, such as the incorporation of secondary raw materials into road construction (Chateau, 2007). Currently, there are GPP criteria for 20 products and services.

Broadly speaking, GPP includes some circular aspects that promote extending the product life span, more efficient use of products, the recyclability and incorporation of recycled content, and the limitation of hazardous materials to facilitate further circulation (Alhola et al., 2019). However, GPP is a voluntary instrument in most cases, and even if public authorities choose to implement it, the applied criteria are not uniform (Alhola and Nissinen, 2018). For example, Braulio-Gonzalo and Bovea (2020) found that most circular-related elements of the GPP criteria for furniture, e.g., take-back and reuse, were not used by Spanish public organizations. Moreover, circularity-related criteria did not always award additional points to the potential tender, which limited their potential influence.

Bratt et al. (2013) explored the process of developing national GPP criteria in Sweden for two product groups. They identified that criteria development meetings did not aim to explore innovation potentials, lacked a diverse set of stakeholders (e.g., academia or other experts) and had a restrictive agenda that precluded discussions about innovations. Moreover, the criteria development process did not take a full life-cycle perspective, while the focus was exclusively on existing products and services and failed to explore functional requirements. Bratt et al. (2013) shed light on one of the inherent limitations of the process of developing GPP that limits its efficacy as a tool for implementing CPP: GPP criteria only cover the well-established circularity practices of the market and thus GPP fails to drive innovative solutions.

Overall, if properly applied, GPP can be a direct supporter of established circularity practices. However, studies conducted so far have also identified several limitations of driving CPP based solely on green criteria, namely that GPP criteria are only available for 20 product groups and only some elements of circularity are incorporated in the criteria (Alhola *et al.*, 2019). Furthermore, the existence of such circularity-related indicators in the GPP documents does not guarantee their implementation in practice (Braulio-Gonzalo and Bovea, 2020) as public buyers are free to choose which criteria to include in any specific tender.

Ecolabels and other labeling schemes

CPP can be supported by ecolabels and other labeling schemes since they can significantly reduce information asymmetries and incentivize the uptake of circular products. For example, a type I environmental label such as the EU Flower can act as a verification scheme that facilitates the assurance process from supplier to consumer concerning the environmental characteristics of a specific product or service from a full life-cycle perspective (Paganin, 2020). While current ecolabels already include some circularity aspects, for ecolabels to drive CPP further, they must be strengthened and adapted to reflect a greater spectrum of circularity (Thiebault and Tonda, 2018). Besides environmental characteristics, labeling schemes can also help communicate and assure the quality of reused products. For example, the exploratory study by Gåvertsson et al. (2020) analyzed the development of a reused ICT quality label. Such a label would facilitate the uptake of reused ICT by public authorities.

Another way in which ecolabels support CPP is by providing inspiration on specific and measurable circularity metrics related to product characteristics. In this regard, Vanacore et al. (2018) introduced a product-level indicator that measures the recirculated content of products. Their "C" indicator is calculated by dividing the economic value of the recirculated parts of a product by the economic value of all its parts. Using this simple calculation, Vanacore et al. (2018) provide an option for public buyers to be explicit about the share or content of recycled parts that is desired in their procurement and progressively increase such value in subsequent projects.

Guidance documents

Laws, directives, regulations and guidelines derived from public bodies, such as authorities or procurement support organizations, can offer valuable guidance and information to facilitate the implementation of CPP (Soto *et al.*, 2020). Another common type of guidance document is best practice reports (Thiebault and Tonda, 2018). These practice-oriented outputs provide accessible introductions on the topic of CPP (Jones, Kinch Sohn and Lysemose, 2017) or offer sector-specific insights, for example for textiles (Sustainable Global Resources Ltd, 2017) or construction (Salonen and Vangsbo, 2019). Such reports provide an overview of the relevant stakeholders and discuss challenges and opportunities from a value chain perspective. Furthermore, they identify areas of concern pertaining to specific product groups as well as elaborate upon potential circular criteria that could be included in procurement projects.

Intermediation and market dialogues

CPP projects may entail developing innovative solutions and the incorporation of a broad group of stakeholders in the process of embedding circularity into procurement. Market dialogues are a specific way for potential suppliers to be included in the development phases of a procurement project. They can be used by the buyer to improve their knowledge of market capabilities and by the supplier to better understand the buyer's needs. Overall, market dialogues can aid in the co-creation process of a CPP project. Chapter 5 of this dissertation analyzes market dialogues in depth.

In the process of market dialogues, as well as in the tendering phase of procurement, intermediation can be used to facilitate the interactions between public and private actors as well as the inclusion of circularity aspects (Rainville, 2021). Intermediaries are third parties that are not involved in the tendering procedure (e.g., knowledge experts, consultants) and can help in particular by aligning goals between government and industry, facilitating cooperation between various potential suppliers, and supporting the buyer in their effort to push for higher circularity levels. (Rainville, 2021).

Collaboration platforms

Besides direct intermediation, collaboration platforms can help in coordinating the involvement of various stakeholders in CPP projects. Luciano et al. (2020) presented the case of a platform named DECORUM, which facilitates interaction between all stakeholders involved in both the demolition and construction phases, including procurer, designer, contracting company, and recycling plant. The platform is meant to create synergies between all decision-making phases and to align the production and use of secondary raw materials in order to increase resource efficiency in a holistic manner and across all phases of the project, from public tender and design to construction, maintenance and decommissioning.

Environmental and cost assessments

Life-cycle costing (LCC) and life-cycle assessments (LCA) can be used as tools to support the claim that CPP is preferable to traditional procurement. LCC methods can also be used to demonstrate that CPP responds to the procurer's needs in a cost-effective manner since it reflects a broader spectrum of costs (investment, maintenance, replacement, end-of-life management, etc.) rather

than simply displaying the upfront price (Alhola and Nissinen, 2018). In turn, LCA can be used to compare the environmental impact between alternative procurement options, and hence to provide evidence of the environmental benefits of CPP.

In order to evaluate the economic costs or environmental impact from a life-cycle perspective, it is necessary to define the boundaries of the system. For example, Jacobson et al. (2021) conducted an LCC and LCA in a CPP project comparing two options of lighting procurement: a functional sale, which includes the provision and maintenance of lighting systems, and a product sale, where the buyer purchases only lighting equipment. It is important to define a system that includes to the greatest extent possible the "secondary" benefits of functional sales, such as the flexibility and adaptability of the solution, in order for LCC and LCA to reflect the actual superior performance of result-oriented procurement (Jacobson, Carlson and Lindahl, 2021). Overall, if a system is well defined, CPP can present circular alternatives as being more cost-efficient and environmentally superior to simple purchases.

3.3.3. CONTRACTUAL ARRANGEMENTS

Commercial contracts stipulate the rights and duties of the different parties entering the arrangement, and as such, they define the scope of the commercial transaction. Different contractual arrangements are relevant in the context of CPP.

Firstly, CPP projects can be simple based on acquisition contracts stipulating product and delivery characteristics, payment methods, etc. This particular scope of procurement can also be considered as "off-the-shelf" purchasing. These contracts can be complemented with specific end-of-life clauses that help guarantee future circularity (Jones, Kinch Sohn and Lysemose, 2017). Such clauses include the so-called "buy-back" or "buy-resell" clause, where the supplier or a third party is committed to buying back, refurbishing and reselling the products used by the public organization after a certain time.

Besides off-the-shelf purchasing, CPP projects can purchase from PSS business models, whereby the use- and result-oriented PSS models are relevant. In use-oriented PSS, users gain access to a product that is used simultaneously or in sequence with other users. These business models are often referred to as the sharing economy or collaborative consumption platforms (Klein and Ramos, 2020). Access to such sharing platforms can be purchased by public buyers, including open platforms with other, external

users, or internal platforms that facilitate collaborative consumption within the public organization (Dalhammar *et al.*, 2019). In turn, result-oriented PSS are built around an expected result or solution that the supplier must deliver to the customer (Kjaer *et al.*, 2018). PSS, in both variants, are governed by functional contracting.

Functional contracts differ from acquisition arrangements since they regulate functions, results, and product use throughout the duration of the contract. Ownership exchange is not stipulated in functional contracts since the supplier remains the owner; in some cases, this can present complex tasks in determining the liability of and responsibility for products (Jacobson, Carlson and Lindahl, 2021). Negotiation in functional contracts is based on a price-per-delivered service, rather than price-per-product (Witjes and Lozano, 2016). Certain product characteristics may be stipulated; however, these are tied to the functional result (Jacobson, Carlson and Lindahl, 2021). For example, if a buyer is procuring lighting, the contract might stipulate that the luminaries supplying such lighting should conform to specific standards. Functional contracts have a long life compared to product acquisitions, and they create a need for ongoing communication between buyer and supplier. In some cases, functional contracts may also include the involvement of end-users and stipulate the way the supplier will engage with the end-users during the contract (Jacobson, Carlson and Lindahl, 2021). To develop successful functional contracts that incentivize the buyer and supplier (and even the end-users) toward circularity as well as deliver effective solutions, collaboration between buyer and supplier is necessary, particularly in the preparation phase of the tender (Witjes and Lozano, 2016).

Performance-based contracts are similar to functional contracting in the sense the subject matter is not products, but specific objectives or results. The key feature of performance-based contracts is that the expected performance (e.g., resource savings) is stipulated and the payments received by the supplier are dependent on meeting the objectives (Lohse and Riel, 2017). This makes performance contracting a flexible financial option since it lowers the initial investment and facilitates risk-sharing between buyer and supplier (Lohse and Riel, 2017). One example is energy performance contracting (EPC), where an energy-saving company (ESCO), through a variety of services, guarantees energy savings for the contractor. These savings are monitored and verified and the ESCO derives its payment from them (Peñate-Valentín and Sánchez-carreira, 2021). Similar to EPC, Bougrain (2020) proposed circular economy performance contracting (CEPC) wherein a contract is made based on

verifiable material savings. Procuring performance requires the buyer to set performance objectives in tenders, rather than simply stipulate the product characteristics. This process can be facilitated through continuous close dialogue between buyer and supplier, which makes procurement procedures such as competitive dialogues appropriate when developing performance contracts (Peñate-Valentín and Sánchez-Carreira, 2021).

3.3.4. PROJECT MANAGEMENT AND ORGANIZATIONAL PRACTICES

As more and more CPP projects are being carried out, various insights on CPP projects and organizational and even municipal-wide practices are being derived. Overall, CPP projects tend to include a variety of stakeholders in the process (Rainville, 2021). Therefore, it is important for purchasing organizations to identify which actors might be involved and design the procedure accordingly. For example, if intensive dialogue between buyer and supplier is required, then multiple rounds of market consultations or a competitive dialogue procedure might be necessary (Alhola and Nissinen, 2018). Similarly, if there is a need for additional knowledge partners, then consultancy firms or academics might be invited to participate as facilitators (Ntsondé and Aggeri, 2021). Furthermore, CPP procedures may require pre-studies, such as market analysis or feasibility studies, which help improve the knowledge baseline of the procuring organization and provide crucial information for suppliers in their tender preparation (Alhola and Nissinen, 2018). Overall, CPP projects can be more resource-intensive due to extended market dialogues or preparatory studies. This makes financial flexibility and support key success factors in CPP (Ntsondé and Aggeri, 2021).

Procuring solutions that are in the early stages of diffusion or which require high investment costs may be considered particularly high-risk for the procuring organization (Yeow, Uyarra and Gee, 2015). In order to share the risks (and benefits) with the private sector, different forms of collaboration can be established. Two in particular have been explored in the context of CPP: Public-private partnerships (PPP) and innovation partnerships (IP). PPP are long-term contractual arrangements between the public and private sectors with a focus on providing public services and often relate to the construction sector. Compared with traditional procurement, where design, build and operation are performed as separate contracts, PPP adopts an integrative strategy, whereby a full performance contract is granted. From this perspective, CE principles can be incorporated by taking a life-cycle perspective of the project (Bao *et al.*, 2019). In turn, IP is a specific procurement

model regulated at the EU level, with a public buyer and supplier entering into a collaboration, whereby the buyer will procure R&D services and potentially the outcome of the R&D process, i.e., the innovation.

Municipalities may seek to increase the implementation of CPP beyond the single project level, that is, make CPP widespread or institutionalized. To achieve this, they cannot simply rely on established procurement practices; instead, tailored measures must be developed and implemented (Grandia and Voncken, 2019). For example, one of the main drivers of GPP is end-user pressure and the demand for greener products; however, relying on end-users might limit the development of CPP, and thus, other knowledge partners must be incorporated (Kristensen *et al.*, 2021). Furthermore, inter-departmental communication must be strengthened to ensure an entire municipal transition. This is particularly relevant in municipalities that have mixed procurement settings, involving both centralized and decentralized procurement (Kristensen *et al.*, 2021). Overall, to promote CPP as a widespread practice, municipalities have to change not only procurement routines but also a variety of other organizational practices. For example, to stimulate ICT circularity, public organizations can make their own used ICT equipment available for reselling to remanufacturers in a timely manner (Crafoord, Dalhammar and Milios, 2018). From this perspective, CPP needs to be embedded within a comprehensive policy strategy that incorporates CE across different levels and functions of the municipality (Campbell-Johnston *et al.*, 2019).

Lastly, raising the level of implementation of CPP from a municipality to an entire country requires widespread changes to the entire procurement system, with a particular focus on monitoring and evaluation (van der Zande, Vervoordeldonk and Thorin, 2019). This is particularly relevant when CPP is considered part of the strategy for meeting national goals concerning the reduction of CO2 emissions or primary material use. In this context, a monitoring framework is necessary to track the implementation of CPP projects. One of the main features identified by van der Zande et al. (2019) is that the monitoring framework must be tailored for the unique characteristics of different product groups while also being able to aggregate results to the organizational impact level to track the progress made across the country by all public buyers.

3.3.5. INNOVATION POTENTIAL

CPP is not only about choosing the most circular solutions from a series of already available alternatives: It can also be understood as the development of innovative circular solutions. For example, Yeow et al. (2015) presented a procurement project that was sparked by a data breach in the security system of a public organization in the UK. This led to the reconsideration of security, paper supply and waste management from a systemic perspective and the integration of such services into an innovative solution that created a closed-loop ecosystem of paper management in the organization. Lohse and Riel (2017) presented a similar argument, elaborating how a regional energy agency in Baden-Württemberg (Germany) helped shape the capabilities of the ESCOs in the region. The energy agency drove innovation in the private sector by aligning regulations, standards and demands and promoting a transition from single services (i.e., renovation of heating, ventilation and air conditioning systems) to companies being able to provide integral services, including building structural renovation. Overall, CPP not only supports existing circular markets but can also help create new ones (Ntsondé and Aggeri, 2021). In some circumstances, a procurement project can even be considered as a driver of innovation in large socio-technical systems (Gee *et al.*, 2013). The case presented by Gee et al. (2013) describes the transformation of a regional waste management system in Greater Manchester, UK. Public authorities used the expiration of the current waste-management contract as a chance to transform the entire system from being based on landfill to a multi-technology system that prioritizes recycling, energy recovery and composting. This required new practices from private actors as well as new sorting practices from citizens.

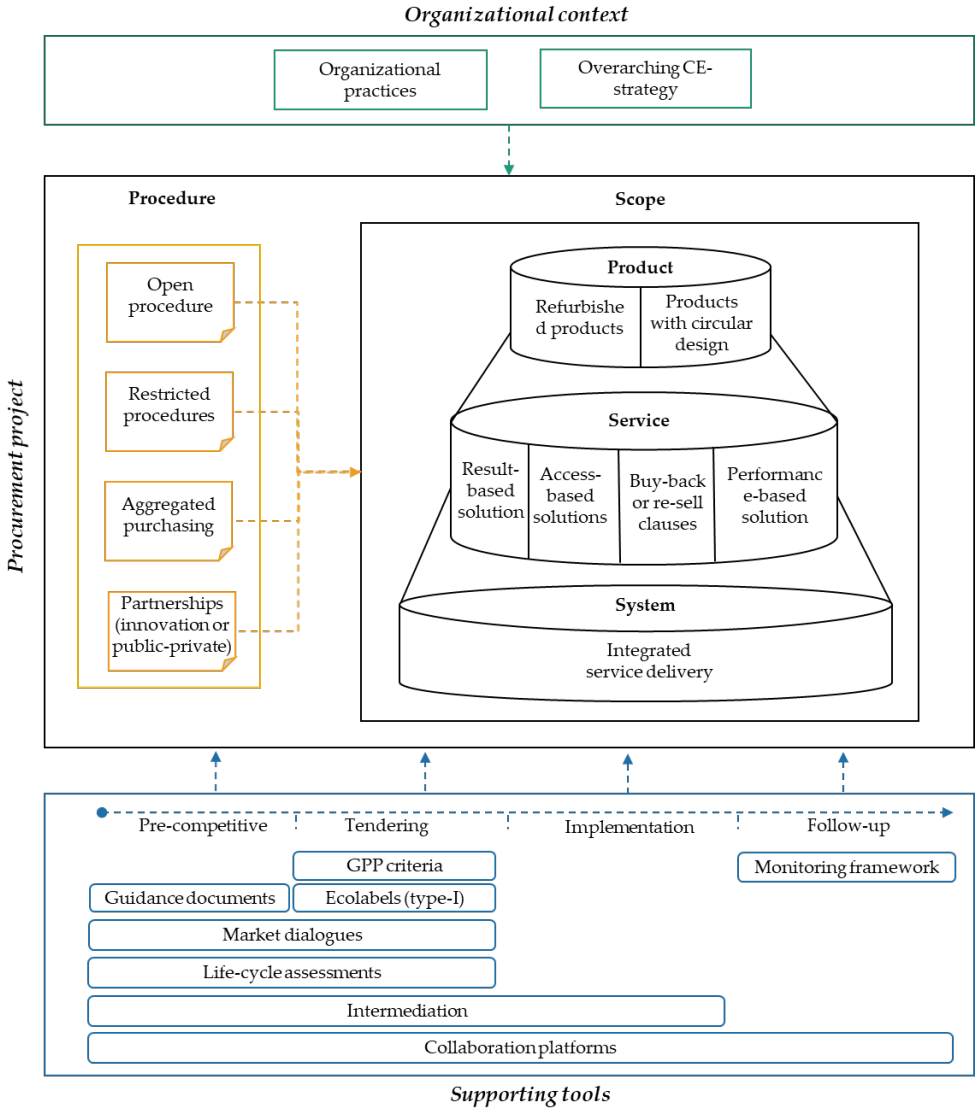
Overall, while CPP is closely associated with innovation potentials, few studies have analyzed this particular aspect. However, the limited sample offers insights into how CPP drives innovation in the form of business models and, to a certain extent, is part of the transformation of large socio-technical systems.

3.4. A (NEW) CPP CONCEPTUAL FRAMEWORK

After analyzing the sample and developing the state of the art on CPP, the last outcome of the review is developing a new conceptual framework on the topic. As the framework was developed based on the reviewed literature, it can be considered a comprehensive conceptualization of CPP. The studies found through the review were analyzed and their overlaps, repetitions and multiple conceptualizations of the same phenomenon were identified. The

conceptual framework is presented in Figure 3-1 and comprises four interconnected elements of CPP: 1) procurement scope, 2) procurement procedure, 3) supporting tools and 4) organizational context. Each of the elements is described in detail in the following sections.

Figure 3-1: New CPP conceptual framework developed from literature review



Procurement scope

Procurement scope refers to the subject of the contract. Other sources call it "approaches" (Alhola *et al.*, 2019), "pillars" (Thiebault and Tonda, 2018) or "models" (European Commission, 2017); nonetheless, these all refer to what is being procured. Three scopes are considered: product, service and system.

The product scope is focused on the direct purchase of two types of products: new circular and refurbished. New circular products are designed to be easily repairable, long-lasting, efficient, etc.; i.e., they are designed according to CE principles. Refurbished products have undergone a type of service intervention, i.e., repair, refurbishment, or remanufacture, and thus embody circularity by reusing existing products, components or materials.

The service scope of CPP deals with products (circular or refurbished) that are delivered in the form of a service that is governed by a result, performance or access-based contract. For example, durable products, such as furniture or ICT equipment, are delivered by PSS business models. Another form of service included in this scope is product transactions that have incorporated end-of-life contractual clauses, i.e., buy-back or resell clauses.

The broadest scope of CPP deals with systems, defined in this context as products and services that are integrated into a comprehensive solution. System solutions allow synergies and benefits to be created that otherwise would have been impossible to achieve if the individual products and services had been procured separately. For example, the case presented by Kristensen and Remmen (2019) describes a CPP project focused on learning environments (system) that integrates products (classroom furniture) and services (classroom layout design). Traditionally, these products and services were procured separately; however, by integrating them into a systemic solution, the case shows how it is possible to generate superior (sustainable) value for buyers, suppliers and end-users compared to conventional solutions.

As elaborated above, the three scopes of CPP are interconnected in a nested manner, that is, the lowest scope (products) is embedded within the middle scope (service), and both of those are part of the broadest scope (system). This categorization excludes purely service-oriented procurements, such as interior design services, software development or consultancy. These could be considered to be a different scope of CPP that can potentially be used to

support the implementation of circularity principles into the public sector; however, no reference to pure service solutions could be found in the literature.

Procurement procedure

The procurement procedure refers to the way in which the procurement project is conducted according to pre-determined procurement processes, thereby determining the specific rules and guidelines. Overall, CPP is flexible and can be conducted through a variety of procedural forms.

Based on the reviewed literature, CPP can be delivered through open or restricted procedures, such as competitive dialogues with or without negotiation. Other relevant procedures identified in the literature refer to more complex arrangements such as IP and PPP. Aggregated purchasing such as framework agreements were not found in the reviewed material, although they were used in one of the cases from the CircularPP project (Case 2 presented in Report II in the Appendix A).

Supporting tools

This element includes tools that support a CPP project. The various tools identified in the literature are arranged in an indicative manner according to the stage of procurement (pre-competitive, tendering, implementation and follow-up) in which they are more relevant. Depending on the scope and procedure of procurement, some tools might be more relevant. For example, the procurement of refurbished products (product scope) may not apply GPP criteria or ecolabels, which are useful tools when procuring new circular products. Furthermore, open procedures may require multiple market dialogues since there are no spaces for negotiation with suppliers allowed once the tendering process begins. In comparison, closed procedures such as competitive dialogues, which have built-in negotiation spaces, may not require intensive market dialogues.

Organizational context

The last element in the framework captures the influence of the organizational context on the procurement project. This includes the practices, rules and norms that influence the project. For example, if a CPP project is focused on the procurement of ICT equipment through an access-based contract, it is

relevant to understand the practices related to equipment delivery for new employees and the policies on equipment substitution, support and repair assistance, end-of-life management process, etc. Overall, this encompasses all the organizational aspects that can influence how the procurement project should be conducted. Furthermore, the presence and content of an overarching CE strategy, either in the organization or at a higher level (e.g., national strategy), play a relevant role in the organizational context as they may be instrumental in defining the circularity priorities in the CPP project.

3.4.1. CONCLUSION

The integrative literature review presented in this chapter clarifies and expands current knowledge on CPP mainly by presneting the state of the art of the field and propossing a new conceptualization. This new conceptualization incorporates three main elements: the tools that facilitate the implementation of CPP, the characteristics of the procurement project and the organizational context. The uniqueness of the review presented is the broad set of keywords that helped expand the scope of the review and enabled a more comprehensive revision of the literature which made possible to shed light on the rich field of CPP literature that is latent under various subfields or different conceptualizations. Although it should not be considered as a "final" conceptualization of CPP since the field and practice continues to develop, it can provide a clear and comprehensive foundation from which further research can be advanced, for for example by analyzing in-depth each of the elements introduced. Such as it is done in the following chapter, where one of the main tools of CPP (market dialogues) is analyzed in depth.

3.4.2. RESEARCH GAPS

By integrating the available studies on CPP, it was possible to identify research gaps and potential avenues for future research. Four main gaps and avenues are briefly presented here. Firstly, CPP research is mostly dominated by qualitative (single) case studies with a similar methodology. In this context, future research would benefit from embracing other methods of investigation, such as quantitative analysis or more in-depth ethnographic methods that explore the procedure "as it happens" rather than analyzing procurement cases after their conclusion. Secondly, most studies on CPP projects focused on the front-end of the process, including planning and tendering, and only a few studies considered the implementation and follow-up phases. This presents a significant research avenue to understand the mid- and long-term outcomes of CPP as well as to evaluate these against the expected results in terms of both economic and ecological performance. Thirdly, the innovation

potential of CPP has been only superficially explored, which presents a significant gap. Considering that CPP is expected to incentivize the market toward more circular practices, further research regarding its actual effect as an innovation driver is required, e.g., analyzing if and how CPP drives further (circular) business model innovation. Fourthly, there is a gap regarding the role and perspectives of the end-users in CPP projects. Addressing this gap is important considering the crucial role end-users play in the implementation phase of PSS as well as in the planning phase of CPP. Overall, these four research gaps and avenues can potentially help in the development of the research on and practice of CPP.

CHAPTER 4. MARKET DIALOGUES: PROCESS AND TENSIONS

This chapter includes Paper 2, entitled "Exploring process and tensions of market consultations in Circular Public Procurement" which is under revision in the Journal of Purchasing and Supply Management. Before presenting the submitted version of the paper, an introduction is provided and interconnection with the other chapters in the dissertation is explained.

Due to the innovative nature of CPP, both in terms of procurement processes and actual products and services being purchased, CPP calls for market dialogues to facilitate interaction between public and private organizations, in the pre-competitive phase of the project, to jointly explore possibilities and limitations of embedding circularity into the core of the project. This study contributes to the field of CPP and overall procurement literature by analyzing market dialogues conducted in four different CPP projects. Based on the cases analyzed, the process and tensions are explored and specific recommendations for conducting market dialogues are presented.

Market dialogues offer a key element for understanding the interconnection between CBM and CPP. Not only are they considered a tool for facilitating the development of innovative procurement projects such as CPP (Rainville, 2021), but studies also suggest that they offer a valuable arena for suppliers to explore potential innovations of their business models (Holma *et al.*, 2020). From this perspective, market dialogues are more than a procedural step in CPP but represent an arena for innovation, both for CBM and public-sector consumption practices.

Title:

Exploring the process and tensions of market consultations in circular public procurement

Abstract:

In its 2020 Circular Economy Action Plan, the European Commission proposed a variety of policy instruments that can drive the transition towards a resource efficient European economy. Amongst these instruments are included two public procurement initiatives, firstly implementing mandatory Green Public Procurement and secondly, leveraging public spending to incentivize the market of circular products and services – a stratategy referred to as Circular Public Procurement (CPP). Early CPP experiences amongst public sector organizations highlight the key role of market consultations in embedding resource efficiency (circularity) at the core of the procurement project. While this premise is widely accepted, there is still a significant gap in terms of in-depth empirical and conceptual work on market consultations, both in the broader procurement literature as well as in the emergent CPP sub-field. The aim of this study is to help close this gap in literature by exploring the processes and challenges of market consultations in four (4) CPP cases. The main findings of the study are divided in three main themes: 1) the process of staging of the negotiation space by the purchaser 2) issues discussed and main outcomes of the consultation and 3) the influence of the organizational context upon the market consultation. Based on the cases analyzed, recommendations for conducting more effective market consultations in CPP are proposed, amongst them, the fundamental aspects that need to be considered when developing a market consultation strategy are outlined.

CRediT author statement:

Alberto Huerta Morales: Conceptualization, Methodology, Investigation, Analysis, Writing -original draft

Arne Remmen: Supervision, Analysis, Writing – review and editing

1 INTRODUCTION

In the European Union (EU), Circular economy (CE) is a policy concept used to promote resource efficiency, address negative externalities of economic activities particularly related to continuous resource exploitation and waste generation, build resilient supply chains and deliver more value to consumers (Kirchherr et al., 2017). The Circular Economy Action Plans guide the circularity transition in the EU and set out a variety of key policies and regulations that, applied in synergy, are expected to embed material efficiency at all stages of the value chain, from production to consumption and waste management. (European Commission, 2020). Amongst these instruments, public procurement (PP) is identified as a key policy lever for promoting a circularity transition: firstly, by strengthening and expanding the scope of green public procurement (GPP); and secondly, mobilizing the purchasing power of the public sector to incentivize the market for circular products and services. The latter is commonly referred to as circular public procurement (CPP).

CPP can be broadly defined as "the process by which public authorities purchase works, goods or services that seek to contribute to closed energy and material loops within supply chains" (European Commission, 2017, p. 5). In practice, CPP implies purchasing circular products, which can be understood as products that are superior in terms of material efficiency, such as products with a high degree of recycled content or good repairability or durability, or products that use recovered parts or are entirely refurbished or remanufactured (Alhola et al., 2019). Alongside product characteristics, CPP also focuses on the use of service contracts in which products' functionality is accessed without direct purchasing, such as through leasing or rental agreements (Witjes and Lozano 2016). Examples include procuring lighting contracts instead of lamps, multi-modal transportation services instead of a car fleet, and serviced working spaces instead of office furniture. Such contracts can provide mutual incentives for both buyers and suppliers towards improving material efficiency in the design, use, and end-of-life management of products (Tukker, 2015). Overall, CPP involves the purchase of competitively priced circular products, preferably delivered through a functional contract.

The implementation of CPP has two main benefits. First, it incentivizes the market for circular products and services, by acting as a demand-side policy for promoting circular solutions. Second, it can improve the environmental performance of the public sector by increasing the resource efficiency of their operations (Klein and Ramos, 2020). From this perspective. CPP is promoted as way of "greening" procurement, however, its implementation has significant differences in relation to traditional GPP (Kristensen et al., 2021). For example, while GPP can rely on centrally derived green criteria, it often lacks CPP's focus on material efficiencies such as repairability, reuse, and remanufacturing. This requires public buyers engaged in CPP to develop ad hoc circular criteria in their procurement projects. Moreover, public buyers may resist engaging in the type of functional contracts promoted in CPP due to a lack of familiarity with their application in the context of durable products (i.e. furniture, lamps, vehicles, etc.) as well as a lack of a clear legal framework governing such contracts (Jacobson et al., 2021). Overall, while CPP holds significant potential for the promotion of a circular transition as well as increasing the environmental performance of public sector organizations, its implementation remains limited in part due to the complexities faced by procurers.

One way in which purchasers can reduce uncertainty in when procuring circular products or contracts is by improving their engagement with potential suppliers. This is particularly important in the early stages of procurement, since this is when buyers and potential suppliers have the greatest flexibility to explore the opportunity of embedding circularity (material efficiency) in the procurement project (Witjes and Lozano). In Directive 24/2014/EU (Procurement Directive), this form of buyer-supplier interaction is termed "market consultation" (Voda and Jobse, 2016). According to Article 40 of the Procurement Directive, contracting authorities may conduct market consultations before launching the procurement procedure, with a view to preparing procurement documents, informing economic operators of procurement plans and requirements, and refining functional specifications and performance requirements for the requested solution.

In practice, purchasing authorities can conduct market consultations in a variety of ways, including phone calls, desktop research, plenary meetings, and one-on-one technical dialogues. Regardless of the form these

consultations take, they must always be conducted in accordance with the principles of transparency, non-discrimination, and equal treatment established in the EU Procurement Directive **(**Lenferink et al., 2014). Direct interactions with potential suppliers are generally seen as the most beneficial option since they allow a more dynamic exchange of ideas and facilitate better understanding among the parties involved (Torvinen and Ulkuniemi, 2016). Planning, organizing, and executing market consultations for a procurement project implies the use of additional resources, presenting a significant barrier for their widespread use. However, studies suggest that if conducted effectively, market consultations can lead to improvements in project execution and overall performance (Torvinen, 2018). In brief, market consultations allow procurers to engage in pre-competitive discussions with external actors with the aim of improving a procurement project whilst at the same time respecting the competitive principles of the EU Procurement Directive.

While the importance of market consultations is recognized in the broader procurement literature (Wondimu et al., 2018), there remains a significant gap in the literature regarding their analysis. Patrucco et al. (2017) state that this gap is due to the traditional perception of PP as merely an operational task, a framing which overemphasizes the tendering process and sidelines pre- and post-tendering activities (such as market consultations). Similarly, while the emerging literature on CPP recognizes the importance of market consultations (Thiebault and Tonda, 2018), it still provides little insight into how they are conducted, what challenges exist in the process, and how they translate into circularity in public contracts.

1.1 AIMS AND OVERVIEW OF THIS STUDY

Overall, the benefits of CPP are clearly indicated in the literature, as well as the importance of market consultations when implementing CPP; however, there is a significant gap in terms of in-depth empirical and conceptual work on market consultations. This study aims to help fill this gap by exploring market consultations in four CPP projects and answering the following research questions (RQ):

RQ1: *How are market consultations conducted in the context of CPP?*

RQ2: *What challenges arise in this process?*

RQ3: *How can market consultations be more effectively conducted in CPP projects?*

RQ1 is answered in Section 4, which presents an overview of the process of market consultations in CPP. RQ2 is answered in Section 5, which discusses the main challenges identified in the process. Lastly, RQ3 is answered in Section 6, which offers conclusions and recommendations for conducting more effective market consultations.

2 LITERATURE REVIEW

A literature review on market consultations was conducted to develop a theoretical grounding for this study. The first step in this review was determining relevant keywords that could help identify existing research published on the topic. A preliminary set of keywords was defined, which included "market consultations" and "market dialogues" (Alhola et al., 2019) and "market engagement" (Watt, 2017). The term market consultations is taken directly from the EU Procurement Directive. Similar terms such as "negotiation" and "dialogues" are also used in the EU Procurement Directive, however, these refer to interactions which occur at the tendering stage of competitive procedures and thus fall out of the scope of market consultations.

After the initial string of keywords was determined, the literature search was conducted in the database SCOPUS. The search engine was set for any type of document (articles, books, book chapters, etc.) which contained the selected terms in either title, abstract, or keyword. The results of this search were screened to determine whether the suggested documents focused on market consultations in PP and thus were relevant to this study. For the studies deemed relevant, a reference mining process was applied, whereby citations were reviewed to search for additional relevant sources.

Based on this literature search, it was found that the topic of the study (market consultations) is diffused across various academic fields and characterized by different conceptualizations; therefore, a systematic literature review was not deemed relevant. Instead, an integrative review was conducted. Integrative reviews are not meant to provide an overview of a well-defined topic, but rather to analyze a diffuse topic in the literature from which an initial theoretical framework can be (Snyder, 2019). Overall, the characteristics and objective of an integrative review is fit for the aim and topic of this study.

All sources that specifically dealt with market consultations were analyzed in-depth, categorized based on their topic of analysis, and grouped into broader themes. This was done in order to create an initial conceptual framework that captures existing knowledge on market consultations. The results of the review are presented in the following subsections and displayed graphically in Table 2-1.

Topic	Theme	Studies
Market consultations	Regulatory framework and legal interpretation	Voda and Jobse (2016)
	Strategies and set-up of consultations	Wondimu et al. (2020); Watt (2017); Lenferink et al. (2014); Koivisto (2018)
	Involvement of end-users	Torvinen and Ulkuniemi (2016); Torvinen (2018); Haukipuro et al. (2016); Holma et al. (2020)
	Sources of knowledge and intermediaries	Rainville (2016); Rainville (2017)
	Challenges and success factors	Farrell and Sunindijo (2020); Wondimu et al. (2016); Love et al. (2014)

Table 2-1: Studies found in the review categorized by themes

Regulatory framework and legal interpretation

The first theme relates to the legal interpretation of the provisions outlined in EU Directive 24/2014. Voda and Jobse (2016) analyze the legal risks and requirements related to market consultations. Their study explains the situations in which market consultations are appropriate, and then addresses the legal risks, including procedural considerations and responsibilities for procurers, intellectual property rights, recourse and complaints, and the manner in which the EU procurement law's principles of transparency, non-discrimination, proportionality, and equal treatment can be respected. The authors present a series of guidelines for procurers to ensure that no advantage is given to a supplier involved in the pre-tendering process, including providing all potential bidders with the same information, keeping records of activities, maintaining market consultations appropriate and

proportional to the interest and objectives of the project, and allowing sufficient time for market actors to express interest and participate in consultations.

Strategies and set-up of consultations

The second theme addresses the variety of formats in which market consultations can take place. Watt (2017) provides a general overview of these different strategies and gives process recommendations. Wondimu et al. (2020) construct a framework that incorporates a variety of approaches for conducting market consultations in the context of infrastructure development projects. Lenferink et al. (2014) analyze various forms of market consultations, with a particular focus on some of their key differentiating characteristics such as goals, incentives for creativity, and rewards for participation, as well as their added value and risks. Finally, Koivisto (2018) explores the potential for web-mediated market consultations and the benefits of this particular set-up for promoting co-design between various stakeholders. An non-exhaustive overview of different arrangements of market consultations is presented in Table 2-2.

Table 2-2: Overview of different forms of market consultations.

Type of market consultation	**Set-up**	**Benefits and limitations**		**References**
Phone calls, email correspondence	Direct consultation with suppliers	+	Offers a low-cost opportunity to engage in dialogue with suppliers.	(Voda and Jobse, 2016)
		-	Sampling limitations; time-consuming steps are required to guarantee fair competition.	
Industry trade-shows	Industry expositions that showcase the latest	+	Low-cost activity that can allow procurers to identify leading players in a specific market segment. Provides an	(Watt, 2017)

	innovations in specific markets		opportunity for informal dialogues.	
		-	Resources necessary for identifying and attending shows increases significantly for non-capital regions or and smaller municipalities.	
Questionnaires	Distribution of questionnaires to the market to assess levels of interest and capacity	+	Potential for broad assessment of the market. Quantitative analysis of surveys saves resources.	(Voda and Jobse, 2016; Watt, 2017)
		-	Limited tool for collecting qualitative input or reasons behind suppliers' answers	
Expression of interests	Early notification to the market through Prior Information Notices published in the official journal of the EU and Tenders Electronic Daily (TED) platform.	+	A comprehensive approach for collecting market input towards a future procurement procedure.	(Voda and Jobse, 2016; Watt, 2017)
		-	Formal procedure involving more resources for drafting documents and guaranteeing legal compliance.	
Meet the buyers	Plenary meetings organized by one or more purchasing	+	Offers an opportunity for buyers to present their needs in detail and obtain direct feedback from suppliers.	(Lenferink et al., 2014; Voda and Jobse,

	organizations to which multiple potential suppliers for specific products/services are invited.	-	Suppliers might be reticent to share specific information in open settings	2016; Watt, 2017)
Technical dialogues	One-on-one dialogues involving buyers, suppliers, and potentially end-users	+	Interaction between users and potential suppliers can lead to a better understanding of needs and greater value for users created through procurement.	(Torvinen and Ulkuniemi, 2016)
		-	Orchestrating these interactions is resource-intensive on the part of all stakeholders involved.	
Early Design Contest	Invitations to the market to generate innovative solutions to be evaluated by a judging panel, with the winner rewarded with a prize or cost compensation.	+	Provides a good incentive for innovation and participation from potential suppliers. Generates a pool of ideas that can be used in combination by the buyer.	(Lenferink et al., 2014)
		-	Difficulty defining the assessment criteria in advance, which leads to a high level of subjectivity. Complexities regarding the protection of intellectual property rights of solutions.	

Involvement of end-users

The third identified theme focused on the involvement of end-users in market consultations. Haukipuro et al. (2016) analyze the use of "living labs" which are spaces where end-users can interact directly with potential solutions, as a way to orchestrate usability tests of different prototypes as part of the procurement process. Torvinen and Ulkuniemi (2016) present an empirically grounded model that explains the active integration of end-users as value co-creators. Similarly focusing on the user-buyer-supplier triad, Holma et al. (2020) identify the main actors, episodes, and outcomes of the stakeholder engagement required for a collaborative design of service specification. Finally, Torvinen (2018) explores the variety of roles which end-users can take in innovative procurement projects - including during the phase of market consultations.

Sources of knowledge and intermediaries

Rainville (2016) identifies the sources of knowledge which buyers draw upon in the preparation of procurement documents, including colleagues, buyers from other public organizations, and end-users. Rainville (2017) also explores the role of intermediaries from external actors in pre-procurement phases, which can include coordinating goals between buyers and suppliers, facilitating supplier-supplier connections, and helping buyers articulate demand in procurement documents.

Challenges and success factors

Market consultations are a complex phenomenon, and several studies have focused on identifying the challenges and success factors involved in implementing them (Love et al., 2014). For example, Farrell and Sunindijo (2020) conclude that a major challenge relates to the restrictions on communication between buyers and suppliers that is in place to ensure that no advantage is given to any particular supplier. Communication constraints frustrate both buyers and suppliers due to the limited feedback that can be provided and the potential for misinterpretation concerning the project conditions. Early and detailed interaction between buyers and suppliers could be perceived as giving a supplier a specific advantage in a public contract. However, as suggested by Voda and Jobse (2016), as long as public purchasers guarantee an even playing field for all potential suppliers, market consultations can be conducted while respecting the principles of non-

discrimination, transparency, and equal treatment. Wondimu et al. (2016) similarly argue that involving contractors early in the process and having capable buyers able to manage the process represent significant success factors. They also emphasize that the building of trust between the involved parties and the reasonable distribution of risks were perceived as key success factors by the practitioners they interviewed.

3 METHODOLOGY

3.1 RESEARCH DESIGN

This study is an exploratory investigation drawing on empirical data collected from four CPP projects, which in this study are defined as "cases" and represent the unit of analysis. An exploratory approach is appropriate when analyzing understudied and undertheorized topics (Simons, 2012) such as market consultations. An overview of the key characteristics of the cases analyzed is provided in Table 3-1.

Case	Purchasing organization	Contract description	Circularity elements
1	Aalborg Municipality	Service contract focused on the collection of used information technology (IT) equipment, including personal computers and mobile phones	• Lifecycle extension through the repair or refurbishment of collected equipment and sale to new users. • Guaranteed recycling of equipment unable to be refurbished.
2	Malmö Municipality	Framework agreement focused on various services related to the refurbishment of furniture	• Purchase of refurbished furniture by the municipality. • Repair and refurbishing services for furniture already owned by the municipality.

3	Aalborg Municipality	Outdoor learning environment (playground) for a new school	• Purchase of playground equipment with circular characteristics, including durability, repairability, and absence of hazardous substances. • Modular design of playgrounds to reduce material footprint.
4	Malmö Municipality	Waste collection services for municipality buildings	• Efficiency in the waste collection process, including routes, vehicle characteristics, and fuels, in order to minimize CO2 emissions.

Table 3-1: Overview of the analyzed CPP cases

The cases were selected following a purposeful sampling approach focused on identifying cases that could provide rich and relevant data to achieve the study's objectives (Emmel, 2014). These four cases were considered relevant since a) they were identified as CPP projects by the procuring organizations and had clear circularity elements, b) they had all completed the phase of market consultations, and c) interviews were possible with key actors participating in the market consultations. Access was possible because all four cases were part of a broader umbrella of activities conducted under an international project called "*Using innovation procurement and capacity building to promote Circular Economy*" or shortly referred as "*CircularPP*", in which the authors of this study and the project managers of each of the cases were participants.

Overall, the roles (and assigned goals) within CircularPP were independent for the authors and the project managers. Moreover, by the time of writing of this study, CircularPP as a project has been finalized and the pilot projects concluded. These two factors, can be used to argue that although there was close interaction between authors and project managers of the CPP cases analyzed, due to the set-up and timing of the CircularPP project, there is no indication that this relationship had any negative influence of the integrity of the research process.

3.2 DATA COLLECTION

Empirical data was collected through semi-structured interviews with key actors involved in each case. Semi-structured interviews allow individuals' perceptions and interpretations of complex social phenomena to be captured (King, 2004). This makes them an appropriate data collection method considering the research objectives defined for the study, which include a) understanding the way market consultations are set up and conducted and b) exploring the tensions experienced in the process. In each case, at least one representative from the buyer and one from the supplier organization were interviewed. This allowed the authors to reconstruct interactions between the two sides based on testimonies from multiple actors (i.e., data triangulation), which helped to strengthen the validity of the study (Yin, 2015). The interviews were conducted in English and took place between July 2019 and October 2020, either face-to-face or through a video-conference platform. All interviews were conducted by one or both authors, recorded with the permission of the interviewee, and transcribed for further analysis. The length of the interviews ranged from 45 to 90 minutes. An overview of the interviews conducted is presented in Table 3-2.

Case	Market consultation description	Participants	#	Interviewees	Length
1	Two meetings: A meet-the-buyers event followed by one-on-one technical dialogues between the project manager, procurement official, and potential suppliers. Meetings were held individually on the premises of the municipality.	Suppliers (4), Project Manager (1). Procurement official (1)	1	Project Manager	60′
			2	Supplier	100′
			3	Supplier	65′
			4	Procurement Official	30′
2	Four one-on-one technical dialogues	Suppliers (5),	5	Project Manager	64′

	(site visits) with potential suppliers were conducted by representatives from the buyer organization, including the project manager, procurement official, and two other representatives from internal services.	Project Manager (1), Procurement Official (1)	6	Procurement official	55′
			7	Supplier	20′
3	Online workshop organized by the purchasing organization, which consisted of a presentation of the project and an invitation for potential suppliers to present their value propositions focused on CE.	Project manager and at least 59 other participants	8	Project Manager	54′
			9	Supplier	65′
4	One-on-one technical dialogues between project manager and potential suppliers. Meetings were held individually at the premises of the buyer's organization.	Suppliers (5), Project manager (1)	10	Project Manager	70′
			11	Supplier	52′

Table 3-2: Overview of the interviews conducted for the study

Following the relevant protocols for interview-based studies described by King (2004), the authors prepared interview guides in advance of the interviews. Two such guides were devised: one for interviewing buyers and one for interviewing suppliers. Once each interview was underway, follow-up questions were asked to explore specific lines of thought that appeared relevant to the topic. In each case, the first interview was conducted with the procurer and/or project manager. This was done to obtain a broad understanding of the procurement project. Another interview was then conducted with the suppliers, focusing specifically on the market consultation. Table 3-3 contains an overview of the interview guides (excluding follow-up questions).

Table 3-3: Interview guides

Interviewee	Theme	Questions
Project manager and/or procurer	Project overview	- What type of service is being procured? - Is this a new service or a change to an existing one? - What are the main goals of the project? - What are the main activities that have taken place so far? - Which procurement procedure is being used (e.g. open, restricted etc.) - Is the total value of the project above the national threshold for procurement projects?
	Stakeholders involved	- What is your role in the project? Are there people from other departments involved in the project? If so, how? - Is anyone from outside the municipality involved in the project? If so, how?

	Supplier interaction	- Have suppliers been engaged in the process? If so, how? - What was the setup of the meeting? - Who was present at this meeting? - What was the objective? - What was the main outcome? - How would you assess the success of this meeting? - How did the meeting translate into the procurement document?
Supplier	Company and contact overview	- What is your name and role in the company? - What types of services are offered by the company?
	Supplier interaction	- How did the buyer make contact? - Was any preliminary information provided? - How were circularity aspects addressed? - What were your expectations of the meeting? - What was the main outcome? - How could the consultation be improved? - What are the next steps in the process?

3.3 LIMITATIONS

The cases included in the analysis were temporally and geographically dispersed, as they were conducted in two different municipalities over a span of two years). Therefore, direct observation was considered unviable. Instead, the analysis relied on interviews with key actors after the events had taken place. In some cases, this was several months after the events. This decision carries a significant drawback due to the potential impact of recall bias, which represents the risk of the interviewed actors forgetting critical details of the event. Moreover, since the actual events were not recorded, it is not possible to conduct other forms of analysis, such as discourse or sequential analysis.

3.4 DATA ANALYSIS

The main analytical strategy used was the constant comparison method (CCM). This is a flexible and adaptable technique for the development of novel insights grounded in empirical data and informed by a prior theoretical understanding of the topic (Anderson and Jack, 2015). CCM was chosen in consideration of the exploratory objective of the study and the goal of developing theoretical insights into market consultations in CPP projects based on the empirical analysis of selected cases. CCM is characterized by an iterative and multilayered process of comparison. In this study, three layers of comparison took place: within cases, across cases, and between data and theory (graphically displayed in Figure 1).

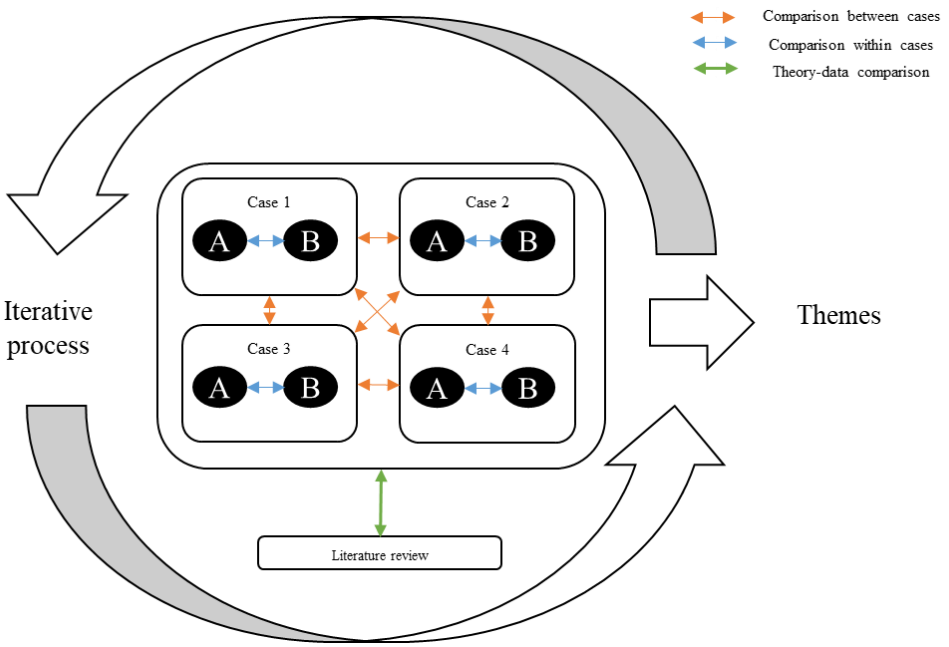


Figure 3-1: Graphical representation of the application of Constant Comparison Method in the analysis of the interviews

At each level of comparison, different forms of coding were conducted. Open coding (as described by Gibbs, 2020) was applied to individual interviews from each case, with initial codes derived from this process. This included coding and triangulating the responses from each of the interviewees from each case. After obtaining a list of codes from each case, a comparison across cases was conducted. This is known as axial coding (also described by Gibbs,

2020), which allows comparing, refuting, aggregating, or separating the codes identified in the various interviews and developing more abstract categories. With these categories, it was possible to revisit the literature and make the last layer of comparison, between theory and data, from which themes were identified; these comprise the findings presented in Section 4. (An example of data structured derived form the analysis is provided in table 3-4. The coding process was conducted in an iterative manner, with multiple iterations of single and axial coding and the authors discussing their interpretations at multiple moments until a consensus was reached on which relevant factors influence market consultations.

Table 3-4: Example of data structure derived form coding

Theme	**Codes**	**Interview**	**Empirical data**
Issues discussed during consultation	Priorities and capabilities	4	"we had a list on all of the environment criteria, and we talked about is this possible for you, would it be more expensive if you do this, and so on."
		2	"show what I should do to make you happy. How much emission savings do you want and what are the calculations behind it
		9	"We need some guidance as to what are the focus from the customer. Do they valuate, do they have some sort of interest on this area."
	Scope and terms of service	11	"We want them to not put in (…) that the packaging should be weighted, in every bin. Some municipalities even wants the price to be set for kilos or grams, and that is very difficult to the operator to get right"

		3	"I am not looking for a full contract, because we can't do that (…) I am looking for 5% or a small part"
		1	"we were asking what kind of service that could provide us? could they do all four things? (…) how about tracking? Can we make sure that this is staying in EU"
	Concept of procurement	5	"their idea was why don't you make this into a service contract (…) so we are responsible for managing your furniture."
		10	"One supplier really wanted us to make a functional requirement. Where we say we give you 12 million, please just handle this. They wanted us to design it like that."
		9	"I believe everyone agreed you get the best playground if (…) you buy the functionality, not the products in itself."

4 FINDINGS

This section answers RQ1: *How are market consultations conducted in the context of CPP?* Based on the cases analyzed, three main aspects of the process conducting market consultations: the staging of the negotiation space, the themes of discussion during the consultation, and the broader organizational context influencing the event and the project.

4.1 STAGING THE NEGOTIATION SPACE

A negotiation space is an arena (physical or virtual) that allows for interaction between social actors. A negotiation space can be emergent or specifically designed and staged by an interested party (Pedersen, 2020). In the case of market consultations, the negotiation space is generally staged by the purchaser or manager of the project, except in the case of supplier-driven

market consultations. In the cases analyzed in this study, all interactions were staged by the procuring organization.

Several salient aspects were identified in the process of staging the negotiation space. The first was defining the setup, which involves selecting the venue, length, methodology, and content of the discussion for the market consultation. As elaborated on in Section 2 above, market consultations can be conducted in a variety of formats, and the cases analyzed reflect this variety. For example, in case 3, the market consultation phase consisted mainly of an online workshop. In contrast, the project manager from case 1 described the process in that case by saying: *"Last year when we invited everybody, we said we want to do the circular procurement... But then [this year] we did this one-on-one [consultation] because we had to have some feedback."*

The project manager of case 1 refers here to two different events organized as part of the market consultation and the unique characteristics of each: firstly, a meet-the-buyers session helped raise awareness in the market of the upcoming CPP project; second, one-on-one technical dialogues with selected suppliers allowed the manager to receive detailed feedback on the capabilities and value propositions of each proposal. The contrast between these approaches and their outcomes emphasizes how the characteristics of the setup influence the amount and type of communication and feedback between the actors involved and its eventual role in influencing the outcome of the procurement.

The number of consultations conducted is to a great extent a function of time constraints, i.e., the pre-defined deadlines of the project, such as when a call for tenders must be released. In turn, the methodology followed during these consultations is a function of the experience and expertise of the personnel in charge of the project. In situations where additional know-how is required, external consultants and other participants can be involved. For example, in case 4, the municipality hired an external project manager to plan, conduct, and manage the pre-competitive phase of the procurement. The consultant brought additional resources including time to plan and conduct the consultations, as well as experience in the topic, however, still required support from the project manager due to a lack of familiarly with the organizational context of the municipality.

Determining which participants (suppliers and otherwise) are expected to be present in the market consultation is also a key task in staging the negotiation space. The project manager has a number of options in defining the "outreach strategy", that is, the strategy followed in the selection and invitation of potential participants. Moreover, it includes determining whether other external actors should be present, such as end-users, legal or environmental experts or any other specialist or employee from the purchasing organization. A common approach identified in the analyzed cases was to invite suppliers already known to the municipality (i.e. those which had previously supplied them with similar goods or services). Project managers also tried to identify industry leaders in the provision of circularity-related goods and services and invite them to participate in order to attract suppliers with experience in delivering circular solutions.

Regardless of the specifics of the outreach strategy, all managers emphasized the importance of making the invitation public in order to give any market participant the opportunity to participate and to respect the Procurement Directive's principles of non-discrimination. This can be done in several ways, such as posting the invitation in the official EU journal of tenders or through a direct post on the municipality portal. Managers also explained the importance of selecting the right keywords and terms to use in these public communications, including "circular" and related terms like "reused" or "non-new", to clarify their intention to conduct a CPP project and create a form of pre-screening of participants.

The last element in staging the market consultation concerns the information provided to the potential participants. This information acts as a form of briefing to potential participants, which they can use to assess the relevance of the market consultation and decide if they are willing to devote the necessary resources to participating. In the best-case scenario, project managers provide as many details of the project as possible, allowing potential suppliers to prepare accordingly. For example, in case 1, the project manager used a list of potential circularity aspects that could be included in the project as a way of guiding the conversation, hearing the opinions of suppliers on the matter, and testing the capabilities present in the market. If the briefing is too broad or unclear, suppliers may be unable to prepare properly. For example, in case 2, the representative of the supplier who

participated in the market consultation was unable to provide significant input regarding downstream relationships with recyclers. It is not clear whether this situation arose because of a lack of preparation by the supplier or a lack of clear information provided by the project manager; regardless, it underscores the importance of the content of the information sent to potential participants when setting up the market consultation.

4.2 ISSUES DISCUSSED DURING THE CONSULTATION

The specific content of market consultations depends on a variety of factors, such as the subject matter of the procurement, the experience of the buyer, the relative progress of the project, etc. However, some overall themes can be identified in the content of the discussions involved in market consultations; these include supplier capabilities, buyer priorities, data gaps, product characteristics, and contract terms.

From the buyer's perspective, one goal of the consultation is to obtain an in-depth understanding of the circularity possibilities of the market. This understanding is incorporated into the process of designing a call for tenders, which sets circularity requirements at a level that achieves the highest potential for circularity while still creating a framework where multiple competitive offers can be obtained. In this process, the hierarchy of priorities for the project managers is clear: the organizational need that must be met takes first priority, and the level of circularity included in the contract is secondary, and thus cannot become a factor that makes the call for tenders fail, for example, due to a lack of sufficient and relevant responses from the market.

The interaction between buyer and potential supplier(s) can also shed light on potential data gaps that need to be closed (by the buyer) prior to the design of the tender being finalized. This additional information must be collected within the purchasing organization and incorporated into the call for tenders in order for suppliers to be able to assess the scope of the contract and provide a well-founded estimation of the cost and capabilities. Such information can refer, for example, to the amount and state of the IT equipment expected to be collected (case 1) or the number of sites and their average waste production (case 4). This information may not be readily available, and the project manager must take on the task of gathering such data. However, in some instances, the data does not exist, prompting some suppliers to suggest an

initial testing phase (pilot project) to allow suppliers to gather this relevant data and use it to shape the full contract. This resembles the concept of an early design contest (introduced in section 2) as a specific form of market consultation.

For potential suppliers, the discussion provides an opportunity to acquire insights that can be translated into a competitive advantage in the eventual call for tenders. This can be achieved by trying to identify and understand the buyer's priorities, particularly when there are multiple circularity aspects that can be potentially included in the project. For example, if both repairability of products and recycling content are discussed, suppliers will try to identify which could hold more weight if both are included as award criteria in the tender. This last element is explained by the supplier in case 4, who said, when discussing the importance of understanding how highly the buyer is going to prioritize recycled content: "*we can inform them about it, but if they do not care at all about recycled material, then, of course, we can just write 'it is made of recycled material' but not spend more time on it.*"

During consultations, potential supplier(s) attempt to not only understand the buyer's priorities but also reframe them to steer the project towards what they believe is the competitive advantage of their value proposition. This can be achieved, amongst other ways, by trying to get the buyer to prioritize concerns that make the supplier's value proposition unique or discouraging the buyer from incorporating specific elements that would make the contract unattractive to their company. For example, in case 3, the supplier identified their value proposition as being unique in terms of quality and sustainability, and hence tried to emphasize these aspects in the consultations: *"we always try to get our customers to focus on evaluating us on this sustainability agenda (…) if they are able to evaluate us in what we do and how we do it (…) we get points for working in that direction."* (Supplier, case 3)

Suppliers participating in the consultation might also attempt to limit the scope of the contract so that it becomes possible for them to compete. This is particularly relevant in CPP as small enterprises are considered the ones with the higher potential for developing radically improved circular solutions but lack the operational capability to deliver goods and services at the level necessary to become a supplier of a large municipality (Crafoord et al., 2018). This highlights the importance for buyers to consider splitting tenders into

lots to avoid excluding the actual leaders of the market in terms of circularity capabilities.

Depending on the extent to which project characteristics are set before market consultations begin, the discussions can have a marginal or radical effect on the project. The impact of market consultations can range from assessing the potential for specific product criteria or making minor adjustments to the scope of the contract to transforming the subject matter of the contract from product to function. By refocusing from product to functionality, the contract opens up the possibility of including a variety of services that are crucial to delivering higher levels of circularity. For example, in case 4, the difference between purchasing individual playground equipment compared to purchasing "learning environments" opened the possibility for suppliers to leverage their design and post-sale service capabilities with the aim of increasing the circularity of the project. When responding to a functional contract, suppliers can go beyond supplying equipment and guarantee durability of their equipment through scheduled maintenance services and eventual take-back and refurbishment, enabling a second life of the equipment.

4.3 ORGANIZATIONAL CONTEXT

A project manager in charge of planning and conducting market consultations is working within a broader organizational framework that influences both the way market consultations are conducted and the potential for introducing circularity aspects into the contract. This organizational framework goes beyond the specific characteristics of the procurement at hand, such as the organizational need or budget, and encompasses broader elements such as policies, guidelines, and existing contracts. For example, an environmental policy that is focused on promoting the purchase of sustainably harvested can generally be considered a positive sourcing policy, as it has the aim of improving the environmental performance of an organization. However, when considered in the context of CPP, such a policy can create a barrier for the purchase of refurbished furniture as these types of reused goods are impossible to certify as sustainably harvested due to uncertainties involving their components. Complex interactions like this mean that existing policies, even if oriented towards environmental improvement, can become a barrier to CPP even when oriented towards environmental improvements.

Similarly, existing practices can also become a barrier to achieving higher levels of circularity in a new contract. For example, in case 1, an existing agreement regarding the purchasing of IT equipment inhibited the potential for including the purchasing of refurbished equipment in the scope of the contract. Instead, the contract was limited to take-back services of used IT equipment. This service is a valuable addition for increasing circularity of IT equipment; however, take-back contracts are attractive for suppliers if their business model is set up to supply refurbished equipment as well as take back used equipment. Overall, disconnecting supply services from take-back services creates a less-than-ideal context for attractive supplier offerings and in general fails to establish the appropriate incentives either for the supply of long-lasting or repairable equipment of for the efficient use of equipment on the part of the end-users.

On the other hand, internal policies can also act as drivers of circularity. As seen in case 4, the internal target of achieving 25% of elementary education in an outdoor learning environment became the main driver for exploring the potential of functional procurement of a learning environment in place of the direct purchase of playground equipment. This form of functional procurement opened the door for suppliers to present solutions which are superior in terms of material efficiency (i.e., repairable, long-lasting, modular equipment) compared to a tender focused exclusively on specific pieces of playground equipment, in which suppliers would compete solely in terms of price per unit.

5 DISCUSSION

Market consultations are more than a simple exercise of data collection in which the buyer, who lacks specific information, consults suppliers, who possess this missing information. Rather, these are complex social interactions, comprising and preceded by a variety of sub-processes, influenced by multiple variables. To unpack some of this complexity, some of the main challenges identified in the process are discussed in-more depth below.

The literature review indicates that market consultations have the potential to act as co-creation arenas where the circularity of the project can be embedded in the core of the contract (Witjes and Lozano 2018). However, the cases analyzed in this study shed light on the significant limitations on this potential

for co-creation. On the one hand, innovative forms of conducting procurement and meeting the organizational needs of the buyers were indeed part of the discussions during the market consultations. For example, as discussed in Section 4, suppliers suggested pilot projects that could create key insights for developing a more comprehensive call for tenders (i.e. similar to design contests) and encouraged buyers to consider the use of functional contracts, which the CPP literature identifies as a key driver of circularity (Thiebault and Tonda, 2018). However, these innovative suggestions were not taken forward by the project managers. This obstacle to the innovation promoted by suppliers can be explained in part as the result of the late timing of the consultations; in other words, some of the market consultations were not conducted early enough in the overall procurement process to allow the outcomes of the meetings to significantly influence the call for tenders and eventual contracts.

This observation is consistent with Wondimu et al.'s (2016) argument that it is vital to involve suppliers in the project as early as possible in order to increase the value added by the consultation process. Since market consultations are conducted in the pre-competitive phase of the procurement project, i.e., before the call for tenders is released, this could be considered an "early" stage. However, taking account of the actual development of CPP projects, it would be relevant to distinguish between the early and late stages of the pre-competitive phase of a procurement project. In the early stage of pre-competitive procurement, the organizational need is identified but the solutions that can meet such a need have not yet been defined. In the late stage of the pre-competitive phase, solutions have been identified, but there are still uncertainties regarding specific aspects of these solutions. Overall, depending on the stage of procurement (early or late pre-competitive), interaction with suppliers can bring different benefits and has different limitations. This needs to be taken into account when determining the most efficient and effective approach to conducting market consultations.

The analyzed cases also shed light on the active role of suppliers in shaping the way market consultations unfold. While buyers may manage the process of staging the negotiation space and provide an initial framing of the procurement project, suppliers display significant agency once the negotiation has begun, working to influence the buyer's priorities and the

direction taken by the discussions. Overall, the supplier's participation in the interaction is not merely as information providers; instead, they are actively engaged in steering the project in specific directions, particularly those which highlight their competitive advantages. Recognizing the influence and agency of participating suppliers emphasizes the importance of project manager's role in determining the participants (a part of the broader tasks of staging the negotiation space). However, the procurement literature offers no guidance on how to define an effective outreach strategy in the preparation stages of a market consultation. Such a strategy would not only be required to meet the legal requirements of market consultations but should also take into consideration the stage of the project and the objective of the meeting, be it to explore innovative solutions, re-define organizational needs, or clarify specific aspects of an already defined solution to a well-understood need.

The agency displayed by suppliers and their potential influence may create a perception that a "negotiation" has taken place during a market consultation. However, under the definition of the EU Procurement Directive, this would result in a breach of the principles of transparency and non-discrimination in procurement, and hence deem the procurement project illegal (Voda and Jobse, 2016). While the interpretation of the legality of the procedural aspects of market consultations is beyond the scope of this study, it is important to express that suppliers may in fact steer the eventual procurement project in their desired direction or obtain a potential advantage by participating in these meetings. The extent to which this influence can be assessed is unknown; however, its existence underscores the responsibility of project managers to make a conscious effort to avoid discriminating against or favoring any participating potential supplier, as well as the importance of documenting such efforts in case this is needed in the event of a potential complaint.

One way in which market consultations could be fully documented, and thus one way to facilitate transparency and reduce the risk of complaints, is by virtual meetings. Virtual interactions have been an innovative trend in terms of market consultations as a way to facilitate co-creation (Alhola et al., 2017); however, their benefits have yet to studied in relation to resource efficiency (such as saving time and money spent on traveling, etc.) inclusiveness (allowing more suppliers to participate) and transparency (recording the

event and making it public). Moreover, virtual setups may provide a variety of possibilities to introduce virtual site visits and product demonstrations that could otherwise be unfeasible in a traditional meeting. In CPP projects these may be useful for showing products and processes that are unknown to the buyer (such as computer refurbishment) and help reduce the negative preconceptions that refurbished or reused products still carry.

6 CONCLUSIONS

This study provides an in-depth view of how market consultations are conducted in CPP projects and the tensions that emerge in the process. The analysis of four CPP cases provides a detailed window into some of the most influential elements in the process of market consultation, including the staging of the negotiation space, the themes of discussion, and the organizational context influencing the consultation. This kind of empirical work on this topic fills in a gap identified in the literature as only a limited set of studies were found to focus specifically on the topic of market consultations.

The findings of the study can provide a basis for managerial recommendations, particularly for project managers (or procurers) responsible for planning, executing, and utilizing the feedback obtained from market consultations. For these interactions to be most effective in driving circularity in public contracts and to ensure the efficient use of the resources available for projects, managers can take the following considerations into account:

1. Sufficient time and resources should be allocated to plan, execute, and utilize supplier feedback when setting the budget and deadlines of a CPP project.
2. A strategy for conducting consultations should be determined at the earliest possible stage, and should include at least these five aspects: a) the goal of the consultation; b) the set-up (type of market consultation, venue, and methodology); c) the outreach strategy (how potential participants will be identified and invited); d) how to ensure transparency and non-discrimination during the consultations; and e) the relevant data that must be collected and shared with participants beforehand.

3. Managers should be aware of the timing of consultations in relation to the overall project (i.e., whether they will take place in the early or late stage of the pre-competitive phase) and recognize the different benefits of conducting a consultation in each phase. In short, market consultations in the early stage of the project are useful for exploring innovative forms of procurement (e.g., setting up a design contest) or innovative solutions (e.g., developing a functional contract). On the other hand, market consultations conducted at a late stage are more relevant spaces for discussion of the specific characteristics of a well-identified organizational need and solution.
4. Managers should consider the use of online consultations to reduce the burden on resources for both the purchaser and the potential suppliers participating in the consultation. Online interactions are also easier to document and make available to the public, which is one way of meeting the non-discrimination requirements of the EU Procurement Directive. Lastly, online consultations create the possibility of more innovative interactions, like virtual visits and product demonstrations.

The methodology followed in this study presents some limitations which must be acknowledged and can provide useful directions for further research. Firstly, in this study, empirical data was generated exclusively from four cases and focused on the overall execution of the market consultation in each case. While this is acceptable for an exploratory study, further research may benefit from a larger sample and a focus on a specific aspect of market consultations. For example, it would be useful for future studies to examine, across a larger set of cases, how managers determine the strategy for contacting and inviting potential suppliers, or how transparency and non-discrimination are ensured. A more detailed analysis can be used to provide richer and more specific recommendations. Secondly, considering the limitations of the study discussed in section 3.2.1. further studies can analyze events through direct observations as they unfold and complement this with semi-structured interviews with key actors both before and after the fact. In this way, recall bias is significantly reduced, and the effects of the market consultations can be assessed in the later stages of the project, for example, by analyzing the influence which the consultations had on the actual call for tenders or on the bids submitted by suppliers.

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CHAPTER 5. PARADOXICAL TENSIONS IN CIRCULAR BUSINESS MODELS

This chapter includes Paper 1, entitled "Exploring paradoxical tensions in Circular Business Models – Cases from Northern Europe" which is published in the international peer-reviewed journal Sustainability. *Before presenting the published version of the paper, an introduction is provided and interconnection with the other chapters in the dissertation is explained.*

CBMs are fundamental building blocks for creating a circular economy. These business models have the potential to generate commercial benefits for firms as well as broader social and environmental benefits for society; however, their implementation is not widespread. As suggested by (RED) CBM are characterized by inherent tensions that emerge from the duality of creating commercial value and increasing circularity. This chapter contributes to the field by providing an overview of the different paradoxical tensions and their corresponding management strategies that can emerge in the context of CBM.

Overall, understanding paradoxical tensions in CBM is relevant not only for managers of the private sector but also for public organizations since a successful CPP project requires establishing a functional CBM, either one that is already being performed or through the development of one through a collaborative innovation process. Therefore, it is important for both actors (public and private) to understand the complexities and tensions derived from CBM as well as the potential strategies that can be useful for managing such tensions.

sustainability

MDPI

Article

Exploring Paradoxical Tensions in Circular Business Models—Cases from North Europe

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Abstract: Circular Business Models (CBMs) are a tool that allows private sector organizations to reconcile circularity (i.e., narrowing, slowing and closing resource flows) and commercial value creation. However, these two elements are not always aligned; they can be contradictory. This makes the relationship between circularity and commercial value creation, in the context of CBMs, a paradoxical tension. These types of tensions are particularly challenging since the elements that create the tension cannot be removed, instead, both elements must remain in place and the tension between them must be continuously managed. This article explores the main paradoxical tensions and management strategies in the context of CBMs through an integrative literature review as well as an empirical study. The integrative review helped identify three literature streams that provide key insights regarding paradoxical tensions of CBMs, namely corporate sustainability, servitization and circular economy. The empirical study suggested six paradoxical tensions inherent to CBMs: (1) using waste as a resource; (2) design of circular products; (3) improving aesthetics of used products; (4) matching supply and demand; (5) Balancing costs in circular activities; and (6) managing resistance from the value chain. The findings from the literature review as well as the empirical study are compared and discussed. Overall, this article sheds light on the paradoxical tension between circularity and commercial value creation that sits at the core of CBMs as well as the potential managerial strategies suitable for dealing with this tension.

Keywords: circular economy; business models; paradoxical tensions

1. Introduction

The constant extraction of raw materials used for producing low-quality products that are quickly turned into waste jeopardizes the ecological boundaries of the planet by exacerbating natural resource exploitation and environmental degradation [1]. In light of these ecological crises, policymakers and industry organizations have promoted the Circular Economy (CE) as a path towards sustainable development [2]. Geissdoerfer et al. [3] define the CE as a regenerative system that minimizes resource inputs, waste, emissions and energy leakage by slowing, closing and narrowing material flows. This definition was chosen as a starting point for the study since it is brief, operational and emphasizes the benefits of a CE (i.e., minimizes resource inputs, waste, emissions and energy leakage), while at the same time pointing towards the mechanisms in which it can be achieved (i.e., slowing, closing and narrowing). More specifically, closing material flows involves transforming outputs into inputs (i.e., from waste into secondary raw materials) [4]. Slowing material flows refers to reducing the time that it takes products, materials and components to exit the economic system and become waste, which can be achieved by maximizing and preserving their value [5]. Lastly, narrowing material flows can be interpreted in two ways: from the production side, it refers to increasing material efficiency of products and services [6]. From the consumer side, it involves an absolute reduction in consumption [4].

A transition towards a CE requires systemic changes in the systems of production and consumption, including social practices such as regulations, norms and consumption patterns [7]. Circular Business

Models (CBMs) are considered a tool for planning, organizing and implementing circularity at the firm level [5]. This makes them particularly appealing to the private sector due to their potential for reconciling circularity (i.e., narrowing, slowing and closing resource flows) and commercial value creation [8]. This implies not only that economic sustainability is a necessary condition for CBMs, as Guldmann and Huulgaard [9] emphasize, but that circularity and commercial value creation are intrinsically connected since it is through increasing circularity that commercial value is created.

Creating commercial value through increasing circularity can be achieved in a variety of ways, which leads to a multitude of potential CBMs [10]. For example, firms that collect and transform waste into secondary raw materials align circularity (i.e., closing material flows) with commercial value creation (i.e., selling secondary raw materials in the market). However, these two elements are not always aligned (reconciled); instead, their relationship can be considered, at times, contradictory. Daddi et al. (2019) shed light to this tension by analyzing firms that utilize waste as a resource in the textile sector in Italy. In their study, they found that the strategy of relying on secondary raw materials (which is positive for circularity since it helps closing material flows) also brought a limitation for the commercial value creation of the company, since it restricts access to specific markets [11]. This suggest that the relationship between circularity and commercial value is not always in synergy (win-win), but can be found in tension or contradiction (win-lose). Following the organizational theory of Smith and Lewis (2011), this tension should be considered as paradoxical, since circularity and commercial value are not only interconnected but also at times contradictory.

Paradoxical tensions represent a unique challenge for organizations. Compared to static barriers that can be eliminated with the right intervention, a paradoxical tension cannot be suppressed, since the elements that create the tension cannot be removed, instead, these must be continuously managed [12]. The approach towards managing paradoxical tensions has proven to have a significant effect in regards to their effects on day-to-day operations as well as long-term survival of commercial firms [13]. For example, in a recent study of sustainable business models, Bommel [14] found that managers who exclusively understood the three pillars of sustainability (i.e., environmental, social and economic) as synergetic, experienced tensions as constraining and complex to manage. In turn, managers that acknowledged the interconnection and at times contradiction between theseelements of sustainability (i.e., paradoxical), experiencied tensions as sources of innovation that promoted the long-term survival of the business model. Translating these findings into the CBM context, it can be argued that acknowledging the paradoxical relationship between circularity and commercial value creation is a necessary step for transforming this tension into a source of innovation and promote the long-term sustainability of CBMs. It is in this context, the paradox perspective becomes a relevant approach for analyzing CBMs.

Byl and Slawinski [15] summarize the paradox perspective as an approach that embraces organizational tensions with the aim of understanding how firms can pursue A and B simultaneously, even when A and B appear contradictory. Several studies analyze (in different degrees) CBMs from a paradox perspective, including Daddi et al. [11]; Franco [16]; Vildåsen [17]; Tong et al. [18] and Prendeville et al. [19]. Overall, the brief literature available confirms that CBMs are subject to multiple tensions emerging from the paradoxical relationship between circularity and commercial value creation. A critical reading of these studies shows that they do not provide an overview of paradoxical tensions, nor the management strategies that are suitable for dealing with them. These studies also focus on a single type of CBM (i.e., manufacturing companies using secondary raw materials), missing a wide variety of other CBM such as those focusing on extending the value of existing products. Moreover, they fail to incorporate knowledge from related research streams to CBMs that might be useful in providing insights in regard to paradoxical tensions such as Product-Service Systems [20], business models for sustainability [14] or sharing-economy platforms [21].

Aim of the Study

Upon this background, this study aims to explore paradoxical tensions and management strategies in the context of CBMs. In order to drive this investigation, two main research questions (RQ) were formulated:

- RQ1: What are the main paradoxical tensions and management strategies addressed in CBM literature and related fields?
- RQ2: What paradoxical tensions and management strategies emerge in the practice of CBMs?

RQ1 is answered through an integrative literature review, which is presented in Section 2. As Snyder [22] explains, integrative literature reviews are recommended when addressing emerging topics scattered across disciplines, such as the case of CBMs. These types of reviews are not intended to provide an exhaustive and systematic overview of a well-defined topic, instead, they are used to create an initial and preliminary theoretical model upon which research can be built.

RQ2 is answered based on data collected through an empirical study of CBMs, specifically from eight commercial firms from North Europe operating in different industries (e.g., food-based industries, construction, furniture, etc.) and occupying different positions in the supply chain (e.g., manufacturer, service provider, remanufacturer, etc.). Details of the empirical study are described in Section 3. The overall conceptual framework of the paper is depicted in Figure 1 emphasizing the integration of knowledge derived from literature and practice in order to provide a comprehensive initial perspective of paradoxical tensions in CBMs.

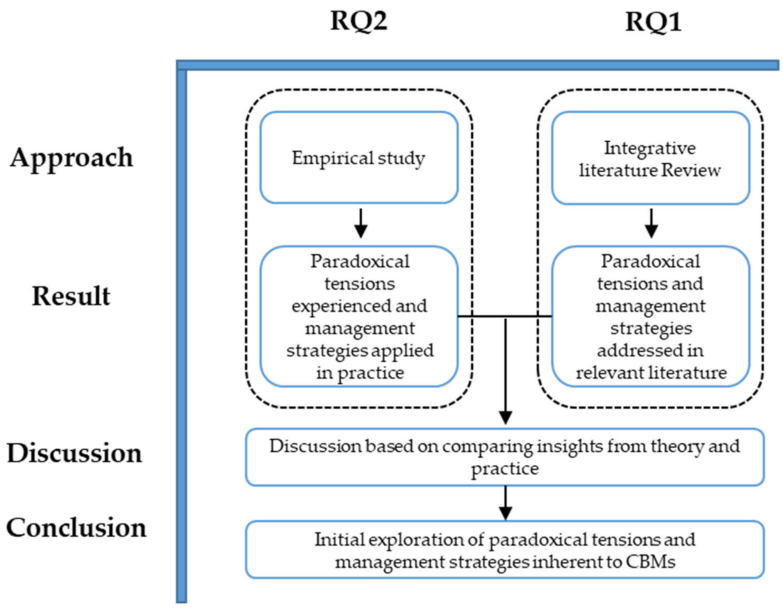

Figure 1. Conceptual framework of the investigation.

The main contribution of this investigation is twofold. Firstly, it presents novel empirical evidence of paradoxical tensions inherent to CBMs. Secondly, it offers a literature-derived overview of the paradoxes and management strategies relevant in the context of CBMs. The literature review also helps consolidate a diffused stream of academic work and set a baseline for further studies. Overall, this study sheds light on the complex relationship between circularity and commercial value in the

context of CBMs, the tensions that these two elements generate and the management strategies used to cope with this tension.

2. Literature Review

In order to locate and analyze studies that focus on paradoxical tensions in the context of CBMs, a systematic approach for reviewing the literature was required. The review protocol was designed following methodological recommendations from Tranfield, Denyer and Smart [23]. Itstarts with the following guiding question *What are the main paradoxical tensions and management strategies discussed in the context of CBMs and related business models?* With that question in mind, an appropriate literature review strategy—which is depicted in Figure 2—was defined. The search was last revised in May 2020.

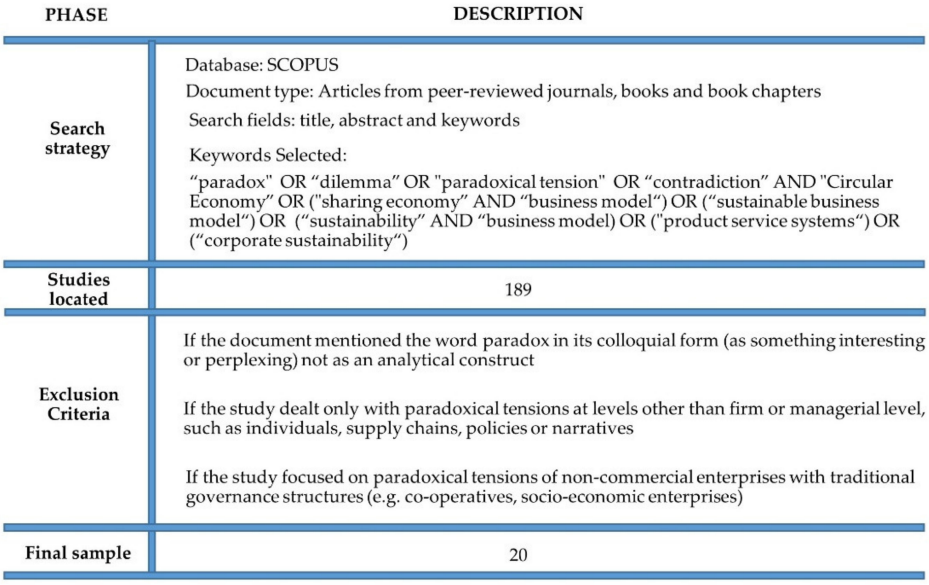

Figure 2. Literature review strategy.

The keywords selected for the search include "paradoxical tension" OR "tension" since this is the main theoretical concept being sought. Moreover, "contradiction" OR "dilemma" were introduced as these are some of the colloquial synonyms of paradoxical tensions. These were incorporated in order to capture studies that may not be aligned specifically with paradox theory, yet they have analyzed "paradoxes" nevertheless. Using different terms is important since, as found by Luisa and Gold [24], the concept of paradoxical tension is not always used consistently across studies.

These four keywords were matched with the AND function of the search query to determine the context of the study, that is, Circular Economy. Additionally, sustainable business models were incorporated since CBMs are often conceptualized as one type of sustainable business model [10]. Moreover, the keyword "Product Service System" (PSS) was added since, as Rosa, Sassanelli and Terzi [25] identified, PSSs are the most common manifestations of CBMs in practice. Based on the keywords selected, 189 potential studies were identified.

The titles and abstracts of each of these 189 studies were screened in order to determine if the study fulfilled one of the exclusion criteria. This process led to the final sample of the articles included in the review. These studies were analyzed by framework analysis, a technique that is focused on

systematically extracting specific data from a text in order to answer the guiding question of the review [26]. The main elements extracted were paradoxical tension and management strategies.

2.1. Paradoxical Tensions and Management Strategies in the Context of CBMs

After analyzing the final sample of studies located through the review protocol, the studies were arranged in three main groups: Sustainability, Servitization and Circular Economy. Table 1 displays the composition of each group, including a brief description of the main paradox and the studies included. The main paradoxes and strategies included in each group are described below. Each section includes a summarizing table that aligns paradoxes, sub-tensions, strategies and references.

Table 1. Final sample of studies selected for analysis.

Literature Group	Main Paradox	References
Corporate sustainability	Simultaneously address multiple desirable but conflicting economic, environmental and social outcomes in different temporal (e.g., short and long term) and spatial arenas (e.g., firm level and societal level)	[13,14,27–35]
Servitization	Increasing revenues from services fail to deliver greater profits because of spiraling costs or overestimation of revenues	[20,36–40]
Circular Economy	Waste valorization and application of an eco-design methodology	[11,17–19]

2.1.1. Corporate Sustainability

The corporate sustainability group is comprised of studies addressing a variety of tensions that emerge when traditional enterprises or sustainable business models aim to create environmental, social and commercial value simultaneously [28]. Bommel (2018) identified that the main paradox is experienced as a conflict between expectations from shareholders (commercial objectives) and demands from stakeholders (social/environmental objectives). Examples of strategies for managing these tensions include creating governance structure, such as socio-commercial enterprises, in which multiple objectives are equally desirable [27]. Similarly, Riel, Mcginnis and Phillips (2019) frame the main sustainability tension in the form of incompatible strategies related to exploitation vs. conservation of resources. Exploitation leading to maximizing shareholder value in the short term, while conservation leading to maximizing stakeholder value in the long term. Haffar and Searcy (2019) concluded that reflexivity, structured decision making and target settings were some of the main actions that could be used to successfully cope with the sustainability paradox.

Hahn et al. (2015) elaborated further on the sustainability paradox and identified sub-tensions, for example, the requirement of fundamentally changing business practices (e.g., new business models) while at the same time retaining legitimacy (e.g., isomorphic pressures) with regard to other value chain members. In regard to this sub-tension, Schneider and Clauß (2019) found that firms managed this tension by accepting the limitations they have self-imposed by pursuing a socio-ecological goal and creating an identity that is consistent with their mission, which provides them with legitimacy amongst other like-minded external actors. Another sub-tension derived from this context refers exclusively to the goal of promoting sustainability in "controversial industries" whose main economic activity is considered detrimental in social or environmental terms, for example, fossil fuel or soft-drink industries. In this context, two studies analyzed defensive strategies aimed at avoiding or externalizing this tension, Iivonen (2018) focused on projection strategies whilst Ferns, Amaeshi and Lambert (2019) explored mythmaking. The different sub-tensions derived from the broader sustainability paradox are listed in Table 2.

Table 2. Overview of paradoxes and management strategies derived from the corporate sustainability literature.

Paradoxical Tensions	Management Strategies	Reference
Simultaneously address multiple desirable but conflicting economic, environmental and social outcomes in different temporal (e.g., short and long term) and spatial arenas (e.g., firm level and societal level)		[13]
		[28]
		[14]
	Strategic sensitivity, collective commitment and resource fluidity	[29]
	Ambidexterity: exploitation and exploration in different markets	[31]
Creation of value for some stakeholders and destruction for others	Stakeholder management	[40]
Financial vs. non-financial performance	Reflexivity, structured decision-making and target setting	[33]
	New governance structures	[27]
Isomorphism (legitimacy) vs. innovation (new business models required)	Engage simultaneously in multiple markets	[27]
	Embrace multiple objectives, accept limitations, transparency and consistency and interaction with like-minded actors	[26]
Sustainability at controversial industries (where main economic activity is perceived as unsustainable)	Projection	[30]
	Mythmaking	[32]

2.1.2. Servitization

Servitization can be understood as a business strategy in which a manufacturer expands its main value proposition from tangible products to intangible services [38]. From this broad business strategy, a unique niche of studies has emerged focused specifically on understanding and devising strategies for dealing with the so-called *servitization paradox*. The earliest study found was by Visnjic and Looy (2013), which explored the disconnection between expected and actual economic benefits for firms following a servitization strategy. More recently, the servitization paradox is described by Kohtam (2020) as the tension between effective customization of the value proposition vs. efficiency in the production process. Sjödin et al. (2020) explain that firms cannot focus only on increasing their value proposition (by adding services) they need to also lower their costs by simultaneously increasing their efficiency in production, which essentially requires them to follow two separate and often times contradictory) logics.

In order to overcome this paradox, literature offers several management strategies. Kuijken, Gemser, and Wijnberg (2017) suggest three characteristics for designing an effective PSS. Firstly, combine products and services that, at least in theory, have autonomous value on the market. Secondly, emphasize both the degree of the tangibility of the product element and the level of interaction in the service element. Thirdly, the value of the product and service should be synergetic (larger than each element separately). For their part, Li et al. (2018) emphasized that a modular portfolio of the service layer in the PSS allows manufacturers to achieve both objectives simultaneously; therefore, they propose a methodology for developing and evaluating modular services in PSSs. Lastly, Sjödin et al. (2020) elaborated upon a methodology for agile co-innovation as a potential pathway for developing effective PSS solutions.

Kohtam (2020) elaborated further on this topic and identified that the main servitization paradox (customization vs. efficiency) spurs more paradoxes (referred in this study as sub-tensions), namely: customer orientation vs. engineering mindset; integration vs. separation of products and services;

exploratory innovation in solutions vs. exploitative innovation in product manufacturing. Kohtam (2020) also outlines unique management strategies for each of the sub-tensions. These are described in Table 3.

Table 3. Overview of paradoxes and management strategies derived from the servitization literature.

Paradoxical Tensions	Management Strategies	Reference
Increasing revenues from services fails to deliver greater profits because of spiraling costs or overestimation of revenues	Specific characteristics of the PSS design (e.g., promoting customer interaction, modularity in service offerings, independent and synergetic value of products and services, etc.)	[34]
		[35]
		[36]
	Co-creation and agile innovation methodology for PSS development	[37]
Customization of services vs. efficiency in manufacturing	Management systems that facilitate production and service performance	[20]
Customer orientation vs. engineering mindset	Strategy for facilitating shared understanding between departments	
Integration vs. separation of services and products	Cross-boundary routines and personnel	
Exploratory innovation vs. exploitative innovation	Training and information sharing routines	

2.1.3. Circular Economy

The last group of studies addresses several tensions that emerge in the context of value allocation between different actors involved in recycling systems, using waste raw material as the secondary raw material and designing products following eco-design. Related to product design in the context of CBMs, is the work of Prendeville et al. (2017) which studied four product-development processes in which eco-design practices were involved. Prendeville et al. (2017) identified several challenges that they categorized as tensions (i.e., two incompatible design strategies), hierarchies (i.e., preclusions and synergies between different eco-design strategies) contradictions (i.e., paradoxical outcomes of a design strategy) and oversights (i.e., emphasis on one eco-design strategy disavows other potential synergetic strategies). As mentioned before, Daddi et al. (2019) explored the tension of transforming waste into raw materials in the context of Italian textile companies. This tension was also explored by Vildåsen (2018) although this longitudinal study did not take place in the practice of CBMs, but rather in the process of developing one. Lastly, Tong et al. (2018) highlight the dilemma between excluding the informal sector vs. integrating informal collection channels in the process of developing recycling business models in China.

These studies not only identified tensions, but also management strategies, as outlined in Table 4. Particularly, the companies analyzed by Daddi et al. (2019), relied on strategies used to reduce the economic impact of circularity by improving the quality of the secondary raw materials or enhancing their selection and sorting procedures. For their part, the main strategy suggested by Prendeville et al. (2017) for systematically managing the eco-design challenges was increasing the scope of focus from product characteristics to business models in order to contextualize the decision-making process and overcome the various dilemmas identified.

Table 4. Overview of paradoxes and management strategies derived from the circular economy literature.

Paradoxical Tensions	Management Strategies	Reference
Applying eco-design	Unified approach including operational, tactical and strategic actions	[19]
Value allocation between stakeholders		[18]
Use of secondary raw materials vs. quality of the final product		[17]
	Investments in sourcing technologies (separation and improvement of waste)	[11]
	Highlight circularity profile and obtain environmental certifications	

3. Methodology

RQ2 is answered by drawing from an empirical study based on semi-structured interviews with key informants from firms operating a CBM. The author conducted the study as part of an EU funded project (The acronym of the project is CircularPP, more information can be found in the project website http://circularpp.eu/). The original goal of the study was exploring a wide variety of CBMs, with a particular focus on understanding the advantages and disadvantages of CBMs vis-à-vis linear business models. This section describes the methodology followed in the empirical investigation, for (1) identification of firms (sampling); (2) accessing experiences and interpretations of key informants (data collection); and (3) analysis of the data collected (data analysis).

3.1. Sampling

The empirical study followed a purposeful sampling approach. This method increases the certainty that cases selected are capable of providing relevant data to answer the research question [41]. The sampling began with a wide screening of potential cases of CBMs originating from countries in the Baltic Sea Region and the Netherlands. The cases suggested varied in terms of value chain positions (e.g., manufacturer, service provider, retail, etc.) and products and services, as well as core circularity approaches (e.g., closing, slowing or narrowing resource flows). The variation in cases addresses one of the main limitations of a similar study [11], where the phenomenon of paradoxical tensions is exclusively explored in the context of manufacturing companies that rely on secondary raw materials.

The author screened the website and other publicly available sources from the cases in order to determine which firms could be considered as rich-data. Afterwards, an interview with a key informant who was knowledgeable on the firm's business model, with a particular focus on circularity aspects, was requested. In total, nine cases were incorporated into the analysis of this article. Table 5 provides a summary and relevant information on the cases.

3.2. Data Collection

Data collection took place through semi-structured interviews with relevant actors inside the organization. King [42] explains that semi-structured interviews are useful for accessing subjective and contextualized interpretations of complex phenomena. Considering that organizational tensions can be understood as socially constructed phenomena which depend on subjective interpretation of the actors involved in the organization [43], then, semi-structured interviews are an adequate tool to access them.

The interviews were conducted from April 2019 to February 2020, in the English language, either face-to-face or through an audio-visual medium. All interviews were conducted by the author, recorded with permission and transcribed for further analysis. The length of the interviews varied between 45 min and 1.5 h. The established methodologies for semi-structured interviews as described by King [42] were followed, including a pre-assessment of the company in order to be familiarized with the business model and the specific circularity elements that are in place. The preparation of an

interview guide containing broad themes which can be found in Table 6, that were explored through specific questions, took place. During the interviews, follow-up questions were asked in order to prompt participants to elaborate on specific topics. These follow-up questions differed in each interview depending on the answers given.

Table 5. Overview of cases included in the study.

Code	Size *	Main Activity	Industry	Business Model Summary	Circularity Effect	Interviewee	Country **
SK	S	Service provider	Hospitality services	Restaurant and catering services based on second-hand ingredients	Closing	Founder/manager	S
FL	S	Re manufacturer	Construction	Retrofit luminaries with LED technology	Slowing	Founder/manager	D
SU	Me	Service provider	Construction	Architecture and design consultancy focused on using existing flows in the region, including construction waste	Closing	Founder/senior partner	N
AC	S	Manufacturer	Construction	Manufacture signage that can be disassembled and re-used	Slowing	Co-owners and manager	S
TU	Mi	Retail	Household products	Grocery store of products in bulk (package free)	Narrowing	Founder/Manager	L
AG	Mi	Manufacturer	Textiles	Manufacture bio-based textiles similar to leather based on food surplus (apple pressings)	Closing	Founder/Manager	D
SA	S	Service/Retail	Furniture	Facilitate interaction between supply and demand of refurbished furniture and related services	Slowing	Two Co-owners and managers	S
HB	Me	Manufacturer	Furniture	Purchase/collection of used furniture and sale (or donation) of refurbished furniture	Slowing	Industrial PhD	D
RF	S	Re-manufacturer	ICT equipment	Refurbish and re-sale of ICT equipment	Slowing	Co-Founder	D

* estimated based on staff headcount Mi = micro less than 10; S = small 10–49; Me = medium 50–249; ** S = Sweden, D = Denmark, N = Netherlands, L = Latvia.

Table 6. The initial design of the interview guide.

Theme	Examples of Guiding Questions
Business Model	Q: How would you describe your business model? Q: How does it differ from "linear" business models? Q: What are the main advantages of operating your business model compared to linear alternatives? Q: What are the main disadvantages of operating your business model compared to linear alternatives?
Circularity Activities	Q: Does your business model reduce the use of materials compared to linear alternatives? Q: Does your business model reuse products or materials considered waste? Q: Does your business model prolong the useful life of products? Q: Does your business model create a market for secondary products or materials?
Value Chain Interactions	Q: How does your collaboration with suppliers differ from linear business models? Q: How does your collaboration with customers differ from linear business models? Q: Does the circularity of your business model provide an advantage or a disadvantage when dealing with the public sector?

3.3. Data Analysis

The interview transcripts contained a detailed account of the CBMs, including main activities, interactions with consumers and suppliers and in particular, benefits and barriers related to the specific circular aspects of their business model. This thick description was used to determine if and how

tensions were experienced in the practice of CBMs. The transcripts were analyzed following an inductive approach to content analysis. Elo and Kyngas [44] describe this method as allowing theories or models to emerge from the empirical data.

In practice, this implied coding the transcripts of the interviews in order to identify any tensions that might be experienced in that specific CBM. The coding exercise followed the suggestions of Bommel (2018) for analyzing organizational tensions, and particular focus was placed whenever the interviewees used terms such as "complex", "problems", "challenging", "frustrating" as these can be indicators of a paradox or tension. Furthermore, special focus was placed on elements that were identified both in the form of benefits and barriers, for example, using waste as a raw material would, on one hand, produce savings in terms of material costs but also increase costs in terms of the additional labor required.

4. Results

The tensions experienced in the practice of CBMs are analyzed in this section. Table 7 provides an overview of the main tensions experienced and the management strategies used to cope with these tensions. Each theme is presented in detail below.

Table 7. Tensions and management strategies arranged by theme.

Tension	Description	Management Strategies Identified	Cases
Using waste as a resource	Negative impacts on operational efficiency or difficulty to meet industry standards due to the use of secondary raw material	Investments in research for product development	SK, AG
		Increase the labor force	
		Change the target market	
Design of circular products	Continuously develop new products suitable for standardization and customization	Modular design	SA, AC
		Role overlap between product designer and refurbishing technician	
Improving the aesthetics of used products	Upgrade functionality and aesthetics without the ability to apply traditional design methodologies of product development	Upgrade of individual components	FL, SA, AC, HB
		Change the context of use	
Matching supply and demand	Logistics of used products are less efficient due to the volume occupied (e.g., assembled furniture) or almost impossible to store (e.g., construction waste). Furthermore, some products may be easily transported yet they suffer from accelerated loss of value (e.g., computers)	Digital tracking and display of flows	SU, SA, RF, HB
		Developing pre-sorting skills for personnel	
Balancing costs in labor-intensive activities	Sourcing, pre-treatment and value extension (e.g., repair and refurbishment) can be labor-intensive activities where salary and management costs can easily overcome potential value created	Alternative governance structure	SK, SA, AC, RF, HB
		Homogenous sourcing	
		Establish long-term collaborations	
		Expand value proposition from product to system	
Managing resistance from supply chain actors	Rejection from suppliers or customers due to the novelty of practices involved in CBMs needs to be continuously managed	Contracts for liability transfer	SK, FL, TU

4.1. Using Waste as a Resource

Using waste as a resource represents a positive element in terms of increasing circularity; however, it can generate tensions for commercial value creation due to difficulty achieving industrial standards related to product characteristics. This is the case of AG, which is focused on creating bio-based textiles

as an alternative for high-end leather in the fashion industry. The main tension experienced in this case is due to product requirements from the fashion industry, particularly an expectation that the material does not have a "plastic feeling":

> (...) it's hard to be at the market, especially when you want to work on these constraints—which is using food waste to make a valuable product (...) coming from this angle, everything that we are doing is circular but we give ourselves several constraints in production where we won't use any fossil fuel derived ingredients, and we won't produce outside of Europe.

In order to manage this tension, two strategies were followed; on one hand, they continue improving the functional characteristics of their product to meet industry standards, and on the other hand, they also remain open for finding more suitable markets for their product. These management strategies of AG involve displays a both/and approach, aiming to continuously develop the technical characteristics of their product and the non-technical elements of their business model.

Moreover, secondary raw materials can also generate unstable supply chains that make it difficult to achieve high efficiency levels in production and logistics, which increases the overall costs of manufacturing. Such tension was experienced in case SK, which is focused on making meals based on recovered or donated food. As such, their sourcing is not homogenous; which has two major implications in relation to operational efficiency. Firstly, it is not possible to have standardized menus and preparation practices, instead new meals are continuously designed to match their incoming raw materials. Secondly, recovered food requires increased pre-treatment before preparation. These two conditions imply that any cost advantage obtained due to savings in materials is countered by the requirement of additional employees, compared to traditional restaurants/catering service providers, where raw materials are bought directly from wholesalers which have already passed a pre-sorting process and have homogenous characteristics (variety, quality, size, etc.).

4.2. Designing Circular Products

Even if waste is not the main raw material, designing products for CBMs can create tensions, particularly, whenever a product requires to be designed to meet specific aesthetic considerations while at the same time remaining standardized so it can be circulated after its initial use. This tension emerged from the case of AC, which is focused on producing signage that can be reused and upgraded. Designers from AC require to simultaneously design for standardization and customization, two apparent contradictory strategies. In order to manage this tension, they followed a modularity strategy, in which some parts of their products where standardized whilst others allowed for customization. This allowed them to apply their aesthetic design competences while at the same time manufacture products with the potential for further circulation after their first use. As explained by the owner from AC:

> That's also very important thing for us. The components that we are updating, those components we want to make in the same size. Very low grade of variables. But the signs that would be a part of the building (...) those could be more unique if we need to. And that's important for us, not to lose our design competence and making signs that are attractive because we don't want all signs to look alike. We also want harmony with architecture.

Designing products for a circular economy is an ongoing challenge, as designers must find ways to continuously develop new products that are suitable for circulating. In order to deal with this tension, designers require unique skills that can be acquired through formal education; however, based on case SA, which is a firm focused on facilitating the refurbishment of furniture, a different strategy focused on learning by doing was identified.

This strategy consisted of overlapping the roles between designer and refurbisher, as elaborated in the following quote:

> (. . .) when they are taking old furniture and making them look like new, they are also learning how to construct new furniture proofed for recycling. So the same crafts, the same people who are making new furniture, they are also making this recycling.

SA acts as a type of supply chain coordinator, connecting potential refurbishment customers with companies capable of performing this service, they are not always exclusively remanufacturers, but they also produce and manufacture new furniture. This facilitates the overlap of roles between designer and refurbisher, however, based on the experiences of SA, there is no evidence that suggests that this strategy of role overlap cannot be translated into the context of a single firm and represent a useful management strategy for developing useful skills in the design of circular furniture.

Overall, product design presents different tensions including traditional design challenges (modular design for standardization and uniqueness) or due to specific constraints imposed by the firm due to the nature of the business model, for example, relying on waste as a raw material. Coping with these tensions requires skilled designers that are able to apply their aesthetic capabilities while still developing products suitable for circulation.

4.3. Improving the Aesthetics of Used Products

Multiple firms emphasized that extending the value of products, involved not only restoring or increasing their functional capacity, but also upgrading their aesthetics since product obsolescence, or a perceived loss of value from products, is not only related to functional, but also to aesthetic elements. This was identified across product groups, including furniture, lighting fixtures and signage. As the manager from SA explains:

> (. . .) is very conceptual. I think that is why we are throwing all that furniture away, is conceptual and it becomes garbage because of how they look.

For traditional manufacturing companies, aesthetic improvement can be resolved through specialized design methodologies applicable in the early stages of the product design; however, not all CBMs are involved in design and manufacturing, instead some are constrained to working with existing (obsolete) products. In such cases, where the company that is operating the CBM is not directly involved in the design and manufacture of new products, a unique tension emerges in the quest to simultaneously upgrade functionality and aesthetics without relying on traditional product design methodologies.

As the interviewee from FL, which are focused on upgrading lighting fixtures with energy-efficient technology, expresses:

> We mostly do technology upgrade but what we also want to be able to do is upgrade the design (. . .) lot of customers, we found out, they want something new to look at also, they don't want to look at the same fixtures that they've looked at the last 20 years, they want to see something happening with the lighting as well, that is why we want to be able to upgrade the design also but still reuse as much of the materials as we can.

One strategy found from the furniture industry sector (in both the cases of SA and HB) is focused on simply exchanging some components of the product, this can be related to paint, textiles and even the size of the furniture, so it is no longer considered old, but classic yet with a contemporary aesthetic. However, not all product groups are suitable for this strategy, for example, if a product is not modular, it would be impossible to exchange some of its components.

In some cases where the potential for an aesthetic upgrade is limited, changing the context of use represents a useful alternative. This strategy consists of taking an old product from one context and placing it in a different context in order to provide new aesthetics with non-new products. For example, in the case of FL, they take lighting fixtures from demolishing buildings, retrofit them with energy-efficient technology and place them at another building, in order to provide the sense of new aesthetics (with old fixtures).

Changing one product into another context might solve the aesthetics tension. However, this spurs an additional tension of efficiently matching supply and demand, as expressed by the informant from case FL:

> (. . .) demolishing companies (. . .) have actually already started to provide us with decent fixtures. The difficult part is to match the supply and demand to make sure that the fixtures that we get are actually the fixtures the customer wants to buy.

This reinforces the paradoxical nature of tensions in CBMs, which cannot be overcome or circumvented but continuously managed, not only because they are re-emergent in time, but also because the management strategies used to cope with one tension are the seeds for additional emergent tensions.

4.4. Matching Supply and Demand

Some CBMs are focused on matching the supply and demand for used products or secondary raw materials. This process requires to be carried out as fast as possible due to two main factors: (a) difficulty or impossibility of storage and transportation; or (b) residual value drainage.

The first factor was identified in cases related to furniture refurbishment (HB and SA), where the capacity for storing and transporting used furniture decreases significantly since the volume occupied by used furniture is much larger compared to new un-assembled furniture. In order to deal with this tension, these two cases both emphasized the importance of pre-sorting or accepting donations of furniture that they believe can have enough residual value. Each of the cases can help illustrate different approaches for this pre-sorting process, HB focused on "on-site" pre-sorting, which took place in the facility of their customers. In the case of SA, this pre-sorting was remote, since customers followed a specific process of furniture identification and uploaded pictures onto their website.

While this first tension was identified in the furniture industry, the construction sector epitomizes this tension where the volume of the waste construction materials makes it almost economically unfeasible to transport and store waste materials, even if their functionality or aesthetics remain intact. This creates a need for a virtually simultaneous match of supply and demand, as explained by the senior partner of SU, which is an architecture and design firm specializing in circular economy projects:

> The good thing about building materials is that they are already relatively known to the market and if you don't change that much to them, they can easily be re-adopted, but the problem is that they have a certain time-limit because the building has to be demolished within a certain time frame. So, it's quite difficult to find the application within that time restriction.

In the case of SU, part of the value proposition (and value creation tool) is a digital platform where the material flows in a region are displayed. This tracking of regional flows through the use of digital technologies is aimed to reduce transaction costs and promote the close of loops between waste and raw materials.

The second factor that creates a tension in matching supply and demand is related to the fast decline in the potential value of certain products, such as used ICT equipment (e.g., computers, mobile phones, etc.) This tension was explored in the case of RF, which is focused on acquiring used ICT equipment, refurbishing it and selling it. In a few words, due to the market dynamics of new ICT equipment, characterized by low prices and exponential increases in computing capacity, even accepting a donation of a five-year-old computer (still with significant functional value) represents a cost for refurbishing companies, since it will not sell. Instead, it is only suitable for recycling. This tension sheds light on the importance of acquiring recent products for refurbishing companies, not just functional, and that product obsolescence is related to social perceptions and not just the physical properties of a product.

4.5. Balancing Costs in Circular Activities

CBMs focused on restoring the value of used products are characterized by constant tensions of keeping management costs below the level of the residual product value. This is particularly challenging in North European economies, where salary costs are relatively high since value extension activities such as refurbishment and use of secondary raw materials can be labor-intensive activities. The following quote from the case HB, which collects and refurbishes furniture, summarizes this tension:

> The biggest balance is that we don't spend too much labor cost on refurbishing or replacing, there is a tipping point of course when it won't be feasible to put up a tabletop and sell it because we have spent too many hours on doing it (. . .) we have to very aware. That is also, why these single furniture pieces are very hard to manage because it does not take a lot to reach that tipping point.

The quote not only points towards the tension of keeping management costs down but also towards a management strategy—that is increasing the homogeneity of the products refurbished. This can be achieved, as in the case of SA, by focusing on specific sectors for sourcing such as hospitals, schools, public offices, etc., which are characterized by larger volumes of homogenous products that help with keeping product management costs down.

Another management strategy for dealing with this tension was displayed in the case of HB. This strategy consisted of reducing salary costs and creating additional revenues by operating as a socio-economic enterprise that provided educational and training services to their employees through furniture refurbishment activities. However, as time passed and the structure of the firm change, and the socio-economic enterprise was transformed into a traditional commercial company, which resulted in anan increase in salary costs and loss of revenue from the educational services. This increased the pressure related to keeping operational costs at a minimum. However, since employees have acquired skills during their time in the training program, it allowed them to be more efficient in their tasks, particularly of pre-sorting and identifying which furniture should be destined for recycling, donation or refurbishment. These developed skills allowed HB to balance operational costs with increased efficiency.

The case of SK also displayed this tension as well as reported a different management strategy. In order to reduce time and costs, both for SK and their partners, they establish long-term collaborations with supermarkets which allowed SK to standardize logistics procedures and, at the same time, secure a steady intake of raw materials. Developing partnerships for business models that rely on periodic donations or sales of used products was also identified as a strategy in RF. The disposal cycles from food may be weekly, whilst ICT equipment may take 2–3 years. Nevertheless, ICT refurbishment companies also aim to establish long-term collaborations, which would help guarantee a steady (and homogenous) inflow of used equipment.

Some services offered by CBMs can create value for customers and increase circularity; however, they are unable to generate sufficient commercial value to be maintained. Such was the case of AC, which explored the implementation of a take-back service in order to collect signage from their customers to use in other locations. They quickly realized that the costs of the service overtook the potential value captured. As explained by the owner:

> (. . .) We have looked into that *[take-back system]*, and we were first looking for a model where we wanted to say that without any charge we would take the sign, dismount the sign. Unfortunately, there are too high costs in these actions, many times you have to go with a sky lift, permissions to the municipality and so on, so there is a gap between the value of the sign compared to the actions required.

The manager of AC considered that a take-back service of signage was not economically viable due to increased management costs. Therefore, the take-back service was suspended; instead, they changed target customers, from individual users to facility owners. Essentially, increasing their scope from

selling single signs to selling signage systems for infrastructures. This way, AC could reduce the movement of the signs from one location to another, and instead provide upgrade services at a facility level and keep logistics costs down.

4.6. Managing Resistance from the Value Chain

One tension that was brought up in several cases was related to resistance from suppliers and customers to the novelty of the practices involved in CBMs. This resistance was attributed by the informants, not to the inferior quality or performance of the value proposition, but to the fact that CBMs represented unfamiliar practices to their customers and other actors across the value chain. For example, the value proposition of FL, refurbishment of lighting fixtures, clashed with dominant practices of engineers in charge of infrastructure lighting:

> This is a totally new way of doing lighting and especially it's engineers that are quite skeptical when we introduce our solutions (. . .) because they are just used to buying new fixtures all the time, so that is often a huge barrier for us (. . .) for them it is something new that they have to find out how to handle, of course, is also some extra work for them, and that is why often we struggle.

In terms of management strategies, evidence from case SK suggests two approaches for dealing with the initial resistance to innovative practices. On one hand, SK has found that organizations that share a similar ideology (e.g., stores focused on organic food) are somewhat "natural allies" and collaborations are easier to set up. Furthermore, they have focused on establishing formal collaborations mediated through legal contracts that transfer all liability from the supermarket to SK in case there would exist some health impact to one of the customers of the market.

5. Discussion

In this section, paradoxical tensions and management strategies are discussed. The discussion is structured as follows: Section 4.1 addresses paradoxes and management strategies that overlapped, both in the literature review and in the empirical study. Section 4.2 focuses on tensions and strategies found only in the empirical study, which can be considered as novel theoretical constructs in the field of CBMs. Lastly, Section 4.3 focuses on tensions and management strategies found only in the literature review but empirical evidence was not available for their comparison.

5.1. Tensions and Strategies Found in the Literature and Empirical Study

Using waste as a resource was the main paradoxical tension explored by Daddi et al. (2019). This tension was confirmed in the empirical study, since product competitiveness was found to be in partial contradiction with using secondary raw materials, or in other words, in contradiction with circularity. However, this finding was not only confirmed but also expanded, since product characteristics were not the only element that created tension when using waste as a raw material. Based on the cases reviewed, it was found that secondary raw materials also put pressure on management and production processes, even if equal product characteristics can be achieved compared to "non-circular" products. Particularly, operational inefficiency can result from a non-homogenous source of raw material, which can create complex logistics or additional sorting and pre-treatment requirements.

By expanding the scope of the tension, contradictions between circularity and commercial value creation become salient in other elements of the business model, such as value creation mechanisms (i.e., production processes). This creates a bridge with the literature stream of product–service systems studies where Kohtam (2020) concluded that managers should avoid either/or mentalities when thinking about customization and efficiency of product operations, but instead should accept the tension between them and embrace both the need to increase customization as well as creating unique solutions. Translating this into the context of CBMs can be interpreted has exhorting managers to

expect and embrace the tension that using waste as a raw material would inherently generate. This also opens the opportunity, for managers to find ways to achieve both objectives simultaneously, that is, continue using secondary raw materials yet, at the same time, find mechanisms for improving the efficiency in production, including end-product characteristics and efficient logistics.

The empirical study also pointed out management strategies used for coping with the various tensions arising from using waste as a raw material. Some of them were already found in the literature reviewed, for example, investments on improved sourcing and homogeneity of raw material [11]. Moreover, flexibility in terms of market segments and manufacturing processes proved crucial for managing this tension. These strategies were already suggested in the study of Birrell et al. (2018) which poses that resource fluidity, which is defined as the capacity for swift reconfiguration of business systems, is a key characteristic for coping with paradoxical tensions in organizations that require them to simultaneously pursue efficiency and customization.

As argued by Prendeville et al. (2017), some of the main tensions experienced in applying an eco-design methodology cannot be resolved unless the scope of analysis is expanded from single product characteristics to business models. This same approach was observed in the case of AC, where the company transitioned from selling single signs to individual consumers, to selling signage systems to building managers. This change was instrumental in balancing economic value creation with circularity and confirms the management strategy suggested by Prendeville et al. (2017), where a change in value proposition can become a tool for coping with a paradoxical tension. The change not only allowed the company to deliver circularity (i.e., upgradable signs) but it also reduced costs in the process of delivering the value proposition (i.e., avoiding the moving costs of signs from customer to customer).

As elaborated in Section 2 of this study, supply chain resistance has been identified by Hahn et al. (2015) as one of the sub-tensions that emerge whenever a company aims to create environmental, social, and commercial value simultaneously, in other words, as part of the sustainability paradox. The cases analyzed in this study confirm that CBMs indeed face resistance from the value chain due to what appears to be the innovativeness of their practices, not a reduction in quality and functionality. By itself, this finding is far from surprising, however, by doing a cross-case analysis, it was possible to identify patterns behind this resistance. In particular, the evidence suggests that resistance displayed towards the different CBMs is derived from different factors, including formal, informal and underlying assumptions. For example, case SK reported that "the biggest challenge is the health regulations on the governmental level in Sweden, which are really high, too high". The informant from case SU stated, "the problem with many materials is they have not been researched for the specific purpose that we want to apply them to (. . .) if a certain material does not have fireproof regulations it needs to be tested first". In turn, case TU, which is a traditional convenience store offering everyday household products in bulk and free of packaging, expressed the following:

> The main difficulty is to educate people and encourage them that this is not difficult. Also, of course, there are a lot of people who would never be satisfied with this kind of shop (. . .) they find that products in bulk are not hygienic. They need everything to be sealed, wrapped, closed in their own package. Only then do they feel safe.

This type of resistance appears to be derived not from authority guidelines, but from taken-for-granted assumptions and cognitive frames of reference. This differentiation between the sources of resistance has significant implications regarding how to manage and promote the acceptance of CBMs.

5.2. Tensions and Strategies Found Only in Empirical Study

Firms focused on extending the value of products through repair, refurbishment and resell face a constant tension between balancing the value that can be created based on used products and the potential costs involved in creating this value. Managing this tension requires firms to focus on

multiple aspects simultaneously including (a) assessing how much residual value is left in products they acquire or accept as donations; (b) estimating the potential value that can be re-loaded into these products through repair and refurbishment activities; and (c) reducing product handling costs in order to avoid overtaking the potential value of the product.

In order to manage this tension, firms can apply management strategies specifically addressed to each element. For example, lowering product-handling costs by improving their used product valuation mechanisms. This can improve the accuracy of calculating the residual value of used products. These types of practices can already be seen in mature circular markets, such as the automobile industry and in ICT equipment, however, they need to be improved and expanded for other industries such as furniture. Furthermore, increasing the homogeneity of the incoming used products can also reduce management costs since it allows standardization in repair processes. This can be achieved by focusing on product groups that are homogenous and come in large volumes such as furniture or ICT equipment from large corporations or public sector organizations.

Moreover, alternative governance structures such as the socio-economic enterprise model were also identified as a potential strategy that can reduce costs, particularly for CBMs with labor-intensive activities such as furniture refurbishment. This strategy of alternative governance structures has already been mentioned by Hahn et al. (2015) as a potential strategy for dealing with performance tensions in the context of corporate sustainability; however, it has not yet been translated in the context of CBMs, nor has its potential been highlighted as a strategy for cost reduction and simultaneously creating social value.

Firms can also focus on developing medium and long-term partnerships. This strategy is similar to the findings of Schneider and Clauß (2019), which found that sustainable business models rely on a network of stakeholders that share their beliefs and facilitate the value creation process. The cases analyzed in this study suggest that partnerships provide stability to CBMs since they guarantee that eventually or periodically, they would have access to a certain amount of (valuable) products or secondary raw materials. These types of partnerships are common in periodic collaborations, for example, in the form of weakly donation of food waste from supermarkets or restaurants to CBMs focused on using waste food as raw material. However, this approach also shows the potential to be applied to waste streams whose expiration data can be calculated in the mid- to long-term future, such as server farms, windmill blades or materials from building demolitions. If the timeframe for the end-life of these waste streams can be calculated, then they can provide a significant opportunity to firms since it would guarantee a pre-defined income of valuable products around which a CBM can be modeled.

5.3. Tensions and Strategies Found Only in the Literature

Based on the literature review it was possible to identify two main groups of research that addressed paradoxical tensions and management strategies relevant to CBMs. Firstly, corporate sustainability literature represents the largest academic field related to CBMs that has embraced the notion of paradoxical tensions. It analyzes both sustainability initiatives from firms, as well as full business models focused on the triple bottom line (environmental, social and commercial value creation) [14]. It is relevant for CBMs since these are aimed to create commercial value and promote circularity, which in some conditions, can be equated to creating environmental value. Moreover, if the social element of sustainability is incorporated into CBMs, then additional tensions related to the social effects of CBMs would gain importance, such as governance structures of CBMs (e.g., cooperatives, social enterprises, etc.), worker–employee relationships and distribution of benefits.

For its part, servitization literature provides relevant insights regarding tensions experienced in the process of adding intangible services to tangible product offerings. While the discussion of these tensions is limited to the economic aspect of the business model, it remains relevant in the context of CBMs since commercial value creation is intrinsically connected to circularity. As the empirical data suggest, CBMs struggle to balance increasing costs with circularity, which resembles the servitization

paradox. CBM research could take inspiration from this literature and focus on an in-depth exploration of a paradox which, in turn, would allow to break it down into sub-tensions, just as Kohtam (2020) did in their study. Moreover, CBM research would also benefit from a combination of research methods (i.e., qualitative and quantitative) similar to how the servitization literature has done. Particularly qualitative methods, such as in the case of Sjödin et al. (2020), help in the conceptualization and building of models for understanding the paradox, whilst quantitative methods, such as in the cases of Kuijken, Gemser and Wijnberg (2017) or Li et al. (2018), offer a suitable approach for the evaluation of management strategies.

6. Conclusions

The point of departure of this study was that CBMs experienced paradoxical tensions, either in the process of designing circular products [19] or when manufacturing products using secondary raw materials [11]. By incorporating literature and practice insights, it was possible to not only explore and further detail these paradoxes but also identify additional paradoxical tensions (and management strategies) relevant in the context of CBMs.

From the literature review, it was possible to identify two academic fields that can help understand paradoxical tensions in the context of CBMs. Firstly, the corporate sustainability literature explores the sustainability paradox, which emerges when firms aim to generate social, economic and environmental value simultaneously. Secondly, a niche in the literature of product–service systems explores the servitization paradox that focuses on the disconnect between expected and actual revenues of firms transitioning from product-based to service-based value propositions. This well-defined niche in the literature is past the stage of conceptualizing and, instead, is focused on the evaluation of potential management strategies.

Through the empirical study of nine firms operating a wide variety of CBMs, it was possible to identify novel paradoxical tensions relevant to CBMs, namely, improving the aesthetics of used products, matching supply and demand and balancing costs of circularity activities. These three tensions were mostly relevant in the context of CBMs that extend the value of used products (i.e., slowing resource flows), which in the past have been overlooked compared to recycling business models. The cases analyzed suggest that, depending on the circularity approach followed by the CBM, different tensions will be experienced, and a variety of management strategies will gain importance. Some of these strategies are technology-focused (i.e., using digital technologies to reduce transaction costs), others, related to innovation in "softer" elements of the business models such as changing target customers or expanding the scope of the value proposition from product to service offerings. However, none of the management strategies identified in this study eliminate the tensions, but instead help managers cope with the continuous effects these create. This initial exploration of tensions and strategies offers but a superficial glimpse into the journey of each individual CBM.

One of the main limitations of the study is that empirical data collection relied purposely on an interview-based study whose main goal was not specifically designed to analyze and explore paradoxical tensions and management strategies, but rather to understand the advantages and disadvantages of CBMs in comparison to linear models. Considering this limitation, future research could rely on in-depth longitudinal studies to analyze the identification, management and re-emergence of specific tensions in a single case. This would allow deeper engagement with the causes and variety of management strategies related to a specific paradox.

Another limitation is related to the sampling approach in which product-groups and types of CBMs were pre-defined. This means that the paradoxes and management strategies identified are not applicable to all types of CBMs, nor all industries or product groups. However, since the objective of the study was to conduct an initial exploration, this sampling bias is considered acceptable. Future research could follow different sampling approaches, such as cluster sampling, in order to analyze in depth one type of paradox relevant to unique value chains or industries. This could obtain different

perspectives from the same phenomenon and provide a more comprehensive analysis of a single tension or strategy.

Overall, by analyzing CBMs from a paradox perspective, it was possible to shed light on the challenge (and the ways firms cope with this challenge) of reconciling two interconnected, yet at times contradictory, objectives in a single business model: increasing circularity and creating commercial value. This study advances the theoretical understanding of CBMs by offering a nuanced understanding of the relationship between circularity and commercial value creation, a perspective that is necessary for the successful management of CBMs.

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SECTION III:

INTEGRATING INSIGHTS

CHAPTER 6. DISCUSSION

In this section, the insights from Chapters 3, 4 and 5 are integrated into a cross-cutting discussion that explores the interconnection between CBM and CPP particularly from a perspective of innovation dynamics and the potential for bridging paradox theory into the field of CPP.

6.1. INNOVATION DYNAMICS RELATED TO CPP

The novelty of CPP, both from a procurement process perspective as well as in terms of the market solutions being purchased, leads to a need of closer interaction between the purchasing organization and potential suppliers. Market dialogues provide an arena for interaction, where solutions and even organizational needs of the buyer, are co-constructed. As elaborated in Chapter 4 it is during market dialogues where purchasers gain insights into the circularity potentials of the market and suppliers develop a more detailed understanding of the organizational needs of the buyer. Besides facilitating such in-depth information sharing, which can help improve the CPP project at hand, market dialogues can trigger broader innovation dynamics, both within the buyer and the purchasing organization. In the following sections, the innovation dynamics in and around CPP projects are discussed.

6.1.1. CPP DRIVING INNOVATION IN CBM

The potential of demand-side innovation, or the premise that public purchasing power can be used to drive innovation for private sector organizations, has been recognized for more than 30 years (Hommen and Rolfstam, 2009). Inspired from theory on demand-side innovation (Obwegeser and Müller, 2018), the following paragraphs discuss four mechanisms in which CPP can lead, facilitate and steer innovation of CBM are presented.

Firstly, procurers can trigger innovation by requesting products and services that do not yet exist "off-the-shelf," and hence new business models are required to deliver such solutions (Georghiou *et al.*, 2014). This can be achieved by procuring services, also known as "pre-commercial procurement" (Iossa, Biagi and Valbonesi, 2018), or by bundling together R&D and commercialization in a single procurement procedure through the use of IP. Applied in the context of CPP, both pre-commercial procurement and IP can be translated into the development of "new" circular products and services (Alhola *et al.*, 2019). However, after reviewing the literature, it was

not possible to find specific cases where this particular procurement procedure was followed. Regardless of the apparent lack of empirical evidence connecting IP and CPP, innovation procurement recognizes the potential for addressing sustainability, which includes implementing circularity. From this perspective, as elaborated in Section 4.5, innovation procurement and R&D are part of the palette of tools for implementing CPP that have a direct connection with developing innovative business models.

Secondly, CPP can promote innovation by purchasing innovative circular products and services that have not been diffused or experienced widespread adoption in the market. For example, CPP can provide a platform for testing emerging CBM through pilot projects or demonstrations that provide protected arenas for innovative solutions wherein a supplier is capable of testing CBM free from the external pressures of the market, facilitating the development of niche innovations (Trindade, Antunes and Partidário, 2017). One example from the literature is provided by Ceschin and Vezzoli (2010), who discuss the potential of procurement in facilitating the experimentation of PSS business models in mobility services.

Thirdly, CPP can involve adaptive innovation, whereby the procured product or system is not new to the market but rather new to the context of procurement; therefore, innovation capabilities on the part of the supplier (and the purchaser) are required to adapt the solution to the specific local conditions (Iossa, Biagi and Valbonesi, 2018). For example, Aalborg municipality created a take-back agreement for ICT equipment, which substituted current practices related to the end-of-life management of ICT equipment across the municipality (Report II). For relatively large municipalities such as Aalborg, suppliers require the development of unique procedures that allow them to efficiently monitor, collect and refurbish the vast and wide variety of ICT equipment being continuously disposed of. In other words, even if the CBM of refurbishing ICT is not novel to the world, its application in the context of Aalborg municipality was innovative.

Fourthly, CPP can influence not only the rate of innovation but also the direction in which it takes place (Hommen and Rolfstam, 2009). Exemplifying this effect, in the case of Lohse and Riel (2017), CPP drove an incremental development in the business model of regional ESCOs. As a result of the continuous and strategic demand from the public sector, these firms progressively expanded their services and competences, from the renovation

of single elements of a building to the ability to deliver a deep-energy renovation of the entire structure.

Overall, CPP can act as a direct driver of innovation for CBM, whether through developing new products and services, testing emerging technologies, helping diffuse CBM or steering the direction in which business models innovate Besides driving innovation in business models, CPP can be a catalyst for innovation in the organization conducting the procurement.

6.1.2. CPP AS A CATALYST FOR INNOVATION AT THE PURCHASING ORGANIZATION

After discussing the potential of CPP driving innovation in CBM (inside the supplier organization), this section turns towards exploring the potential of CPP sparking innovation inside the purchasing organization. This is approached from a procurement process perspective, as well as a broader organizational practice perspective.

From a procedural perspective, CPP can be considered in itself a form of innovative procurement as it involves the use of novel forms, techniques and tools, in the execution of procurement projects (Obwegeser and Müller, 2018). Examples of such novel procedural aspects include the extended use, frequency and form of market dialogues, the design of minimum requirements or award criteria used to promote circularity, the contractual clauses established to facilitate product circularity beyond the lifetime of the contract, amongst others. Regarding this form of innovative procurement, the pilot projects presented in Report II shed light on different aspects of procurement processes that can be considered innovative, such as using framework agreements to promote the participation of SMEs, developing and implementing a market-engagement strategy (the 5-step plan for market engagement), or carrying out market dialogues in the form of webinars and seminars. The fact that these processes are not considered innovative does not stem from the fact that they have never been implemented before (new to the market). Instead, their innovative element lies in the fact that they are not widespread applied, considering that most procurement is off-the-shelf and awarded to the lowest bidder (European Comission, 2019); hence, market dialogues generally lack a established framework for implementation

CPP can also be analyzed from its potential to drive broader organizational innovation. In other words, sparking innovation beyond the scope of procurement practices. As elaborated by (Yeow, Uyarra and Gee, 2015), when

CPP involves a novel solution, it has the potential to create changes in multiple areas of the organization. The CPP cases analyzed can be helpful to shed light to some of the ways this organizational innovation dynamic can unfold. For example, in the CPP project of reused furniture from Malmö municipality (Report II), representatives from Malmö municipality, in collaboration with potential suppliers, jointly determined the bundle of services related to furniture refurbishment that would be the most relevant and achievable considering the context of the municipality, including the internal practices related to furniture reuse. The CPP project resulted in the creation of new decision tree guidelines for the purchase of reused furniture, which was rolled out to all employees of the municipality. However, not only changes in terms of procurement where derived. The municipality also re-organized its internal processes in terms of refurbishment and re-use of furniture internally, without involvement of external suppliers. In other words, sparking changes that transcend the scope of the contract. From this perspective, the Malmö case is more than then development of a framework contract for purchasing refurbished furniture, but a re-organization (innovation) of the internal processes regarding the use, purchase, re-use and disposal of furniture in the municipality.

Another concrete example in which CPP ignited changes in broader organizational practices at the purchasing organization is the case of ICT procurement in Aalborg municipality (Report II). Here, the procurement project helped the municipality identify wasteful practices which are beyond the scope of the procurement project. This took place during the pre-tendering phase of the project where a specific organizational practices of labeling municipality ICT equipment was identified to prevent and hindered the reuse of ICT products. Based on this knowledge, a so call "spin-off project" started, which consisted in a process of changing the organizational policy and practice of equipment labelling, which required the involvement of several actors inside the municipality, located at different departments. This case, emphasizes the potential of CPP to spark innovation inside the public organization, as well as the importance of understanding (and analyzing) CPP as an organizational-wide project, and not an operational tasks exclusive of procurement departments.

6.1.3. THE POTENTIAL OF SYSTEMIC INNOVATION

The last perspective of innovation dynamics, which bridges the role of CBM and CPP, is related to systemic innovations. System innovations are large-scale transformations in the way societal functions are fulfilled, involving not

only technological artifacts but also new markets, social practices, regulations and cultural meanings (Köhler *et al.*, 2019). Although it is rare for a single CPP project and its interconnected CBM to be capable of generating a system transformation, the literature suggests that they can be used to spark such systemic change.

The case presented by Gee et al. (2013) serves as a paradigmatic example, where a procurement project provided the cornerstone in the transformation of waste management practices at a regional scale. Evidently, this was achieved not only through procurement but through a series of interrelated interventions orchestrated by the public sector, including changes in land-use regulations, de-funding landfill activities, helping develop waste sorting practices amongst citizens, etc. However, this case exemplifies the potential influence that single CPP projects can have in broader transformations, such as in this case of the waste management system.

Overall, as the practice of CPP becomes more prevalent and diffused across PSOs, their cumulative effect may be able to help shape a broader socio-technical transformation towards circularity. Therefore, policies and strategies from governmental institutions aimed at promoting the development of CPP projects should are crucial for maintaining the momentum of a CE transition at public sector organizations and potentially reach levels of socio-technical system transformation.

6.2. BRINDGING PARADOX THEORY AND CPP

As presented in Chapter 5, the concept of paradoxical tensions is valuable for exploring the contradictory pressures that characterize the ongoing activities in CBM. Once these tensions are made explicit, it is possible to develop management strategies to deal with such tensions. Bridging the concept of paradoxical tensions into the realm of CPP can be expected to shed similar results, particularly helping identify tensions that emerge in the ongoing execution of CPP projects, deriving from interrelated-yet contradictory elements. paradoxical tensions characterize CPP projects. For example, the project managers from the Latvian CPP projects (Case III) identified a paradox in their CPP project. In their experience, a tension emerged in the process of obtaining support from the market in the participation of market dialogues. Their assessment was that the CPP project required to be developed as a pilot (small scale) in order to be considered safe and receive support from political and higher management levels. However, due to this small scale of the project, suppliers where not interested or did not allocate the necessary resources for

participating in the market dialogues. This hindered the overall performance of the project, particularly regarding the level of circularity embedded within the contract.

Having identified this paradox related to the size of the pilot project it is possible to device management strategies. In this case, it is evident that the project required to be small enough to receive political support and large enough to attract the attention of potential suppliers and grant their use of resources in the market dialogues. Finding this "right size" may be possible however, drawing from paradox theory, an alternative solution can be found. Specifically addressing each of the poles of the paradox at different time scales.

For example, making the pilot project small enough (to create political support) and at the same time sending a signal to the market of a larger contract which would be developed based on the findings of the pilot. In this way, the current size of the pilot may not be attractive enough, but the attention (and resources) of suppliers may be available based on the expectation of a future larger contract.

This example is only a glimpse of the explanatory and managerial power that paradoxical tensions can bring to the CPP literature. In the future, this theoretical concept can be applied to analyze such projects from a perspective that emphasizes the tensions experienced in the process, which are dynamic, complex and interrelated rather than static barriers to CPP, such as limited resources or knowledge from purchasers. Overall, taking a paradox perspective for the analysis of CPP projects could help develop further insights that studies on barriers and drivers may not be able to generate.

Another way in which paradox theory can be bridged into CPP is by exploring how CPP projects can help in the management of paradoxical tensions in CBM. One of the main paradoxical tensions identified in CBM was related to the continuous pressure to improve logistics and operational efficiency in re-use business models. In such busines models, firms face continuous pressure for sourcing suitable used products which can be repaired and re-sold. To manage such tension, firms establish long-term collaborations that can provide stability to their incoming stream of inputs for production. Such collaborations can take the form of donations, however, CPP can offer an alternative partnership model in the form of a commercial contract. Such contract, advantages compared to a traditional non-commercial partnership

since it is possible to stipulate clear expectations from both actors and contemplate mechanisms for compliance to guarantee a smooth interaction.

For example, the case of ICT procurement in Aalborg (Case I from Report II) exemplifies how a commercial contract may be a more adequate form of partnership between a PSO and a firm operating a CBM compared to non-commercial arrangements. Overall, a contract that establishes the responsibility for collecting used products from the municipality provides a stable source of raw materials for the CBM, which can then be used to improve their logistics, reduce operational costs and overall strengthen their position on the market. Since this is a commercial transaction, the conditions of collection, such as frequency and the expected physical state of the products, are stipulated in the contract. Compared to simple donations that are made in an ad-hoc manner, this form of commercial arrangement provides more valuable inputs to the firm. Furthermore, from the perspective of the buyer, a collection contract eliminates linear waste management practices related to product disposal or recycling and instead incorporates a more circular practice to managing products at their end of life. This can help improve their reporting and environmental performance, providing the public organization with additional value compared to ad-hoc donations.

CHAPTER 7. CONCLUSIONS

A summary of the content and structure of the dissertation is in the beginning of this chapter. Afterwards an overview of the main theoretical contributions is provided as well as managerial and research recommendations. The conclusion also gives a critical assessment of the main concepts analyzed and a statement related to the expected impact of the study

The goal of the dissertation was to theoretical insights that advance the academic field of CBM and CPP and operationalize those insights into relevant recommendations that can facilitate their implementation in practice. Therefore, this chapter presents and overview of the research process, the main theoretical contributions and practice recommendations.

Chapter 3 included a systematic literature review on CPP. As a result of the review, a state of the art on the field was developed as well as a novel conceptual framework proposed. Lastly, literature gaps in the field of CPP where identified and research paths were proposed to close these gaps and advance the field.

The key theoretical contribution of Chapter 3 is the new conceptual framework of CPP (displayed in section 3.4) which is constructed based on the state of the art of the field. The framework systematizes knowledge on CPP derived from a variety of research streams into a coherent structure comprised of main elements, sub-elements, and the relationships amongst them. This structuration of the state of the art of CPP provides conceptual clarity by dividing CPP into key components that so far have received attention in literature and hence they can be further explored based on an existing baseline. Furthermore, it can be used to identify what so far has not been addressed (literature gaps) which is also useful for advancing the field.

Chapter 4 presented an empirical analysis of four CPP cases, particularly focused in a tool applied in the pre-competitive stage of procurement, namely market consultations. The study resulted in the description and discussion of processes and tensions related to market consultations, and the elaboration of practice recommendations aimed at improving their implementation.

From a theoretical perspective, the key contribution from Chapter 4 is that it helps close a significant gap in literature related to market consultations, it

provides an overview of the existing literature on the field and identifies key processes within the broad topic of market consultations. By identifying tensions in market consultations, it was possible to develop practice recommendations which can address such tensions and improve the effectiveness of market consultations. One key insight/recommendation is related to the importance of aligning the timing of the consultations with the overall timing of the project to obtain useful feedback. Early consultations are better suited for exploring the potential for functional procurement and the use of product-service systems, while late consultations are better suited to discuss specific characteristics of a well-defined solution.

Chapter 5 presents an empirical study focused on CBM, in which drawing form paradox theory, the main paradoxical tensions that characterize CBM are explored. The study resulted in providing an overview of the main tensions identified in literature and practice, as well as their corresponding management strategies.

The main contribution of Chapter 5 is outlining a series of paradoxical tensions that emerge from a variety of CBM related to key activities including: access to secondary raw materials, design of new circular products, balancing the costs of labor intensive activities that facilitate circularity, improvement of aesthetics for second life of products, matching supply and demand in a timely manner to avoid costs overtaking the value of circular products and institutional resistance from the supply chain. These paradoxical tensions offer a novel view on the challenges faced by CBM and the management strategies used to deal with such tensions. In the context of CPP, insights regarding CBM are crucial to conduct procurement in such a way that takes these challenges into consideration.

Chapter 6 gathers insights derived in previous chapters to fuel a cross-cutting discussion focused on innovation dynamics in CPP projects and the potential for bridging paradox theory into the field of CPP. The concept of innovation dynamics offered a suitable context for addressing the interconnection between CPP and CBM. Overall, the discussion introduces the complex innovation dynamics that are sparked in CPP related to innovation in processes of the public sector as well as in innovative CBM.

Additional managerial recommendations specifically aimed at improving the execution of CPP are made in the reports included in the Appendix. Report I and Report II (Appendix A) cover broader organizational practices

specifically directed towards procurers (Report I) in the form of considerations that can be taken during and (previous) to the procurement process to develop a procurement project in which CBM can have a chance of becoming a supplier. In turn, Report II provides recommendations that go beyond a procurement process, instead are addressed towards procurement department managers and policy makers. Overall, through these two sets of recommendations it is emphasized the need to address changes both at the micro (procurement project) and the macro (procurement policies) level.

A key limitation of the dissertation is that CBM and CPP were unevenly analyzed, and most of the dissertation (except Chapter 5) focused primarily on CPP. One way in which such limitation can be addressed (in further research) and advance current knowledge regarding CPP, from a CBM perspective, is exploring how can CBM become more competitive as suppliers in the public sector. Such study would require understanding which limitations and advantages characterize circular suppliers vis-à-vis traditional linear suppliers and translate this knowledge into procurement recommendations.

Lastly, it is important to emphasize that most of the empirical data was generated procurement project that had additional resources in place due to their involvement in CircularPP. Hence, they can be considered as critical cases and do not reflect the everyday activities of procurement departments. With CPP continuing to diffuse across public sector organizations, it would be relevant to make a broader analysis (for example drawing from procurement databases at an EU level) to explore if and how are circularity elements implemented in non-CPP projects which would help understand if CE is being embedded in day-to-day procurement practices, or is it still conditioned to external resource support.

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APPENDIX A

This appendix includes the summary versions of Report I and Report II. Both outputs were developed for the CircularPP project.

Report 1 introduces the concept of circular business models (CBM) through the presentation of 10 cases from different countries in the Baltic Sea Region. Each case is described in terms of the circularity strategies that the business model applies as well as the main benefits and barriers.

Report II introduces the concept of circular public procurement (CPP), the CPP cases analyzed, and a series of recommendations aimed at municipalities to advance CPP.

REPORT I

Interreg Baltic Sea Region

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

Circular PP

Summary report work package 2.2
Alternative business models available for circular procurement

October 2019

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October 2019

This summary report has been made as a result of the INTERREG Baltic Sea Region project Circular Public Procurement. It reflects what has been done in the state of the art workshops under work package 2.2 of the CPP project.

Preface

The following report presents the findings of work package 2.2, of the CircularPP project. The focus of this work package is to analyze and provide an overview of best practices within business model innovation for a circular economy and provide recommendations for business models and partnerships approaches suitable for circular public procurement.

In this study, circular public procurement is considered as "the process by which public authorities purchase works, goods or services that seek to contribute to closed energy whilst and material loops within supply chains, minimising, and in the best case avoiding, negative environmental impacts and waste creation across their whole life-cycle" (European Commission 2017b, 5)

The methodology is based on analysing innovative business models suitable for a circular economy. The scope of the business models analysed is limited to small and medium enterprises, operating the partner countries of the project (i.e. Denmark, Finland, Netherlands, Latvia, Poland, Sweden and Russia) and specialized on the following product groups, which were selected as relevant amongst the partners of the project (i.e. food and food-based products, furniture, built environment, ICT equipment, textiles and miscellaneous).

The report is divided in four sections:

- Section I introduces the topic of Circular Economy in general, and in particular the context of small and medium enterprises is addressed through the concept of Circular Business Models. This serves as the theoretical foundation for the study.
- In Section II is described the methodology followed during the research.
- Section III presents the overview of 50 cases of Circular Business Models, arranged by product group Furthermore, 10 of these 50 cases are analysed in depth and presented separately in the form of "cases".
- Section IV concludes with the overview of CBM for each category group and recommendations related to public procurement and how it can promote and obtained the most benefits out of the out of the identified business models.

Contents

I. Introduction

1) Linear and circular flows in the economy.

Since the 1950s, industrialized economies have followed a model for incentivizing the economy based on accelerating production and consumption of short-life and disposable products (Stahel and Clift 2015). This approach, known as the "linear economy" relies on the constant extraction of materials from nature and an uninterrupted flow of these materials through the economy in the form of products. (Ellen MacArthur Foundation 2015). The linear economy model jeopardizes the stock and recovery rates of both renewable (e.g. forest, fisheries) and non-renewable resources (e.g. minerals, oil). In addition, it generates a constant flow of waste into the environment (including greenhouse gas emissions and other chemicals), which results in environmental degradation and climate change. Overall, the linear economy is part of the reason why the life-sustaining natural systems of the planet are currently at risk (O'Neill et al. 2018).

A Circular Economy (CE) is characterized by resource flows that are narrowed, slowed and closed (Bocken *et al.*, 2016). Flows are narrowed either by decreasing the total extraction of materials, or by relying on secondary (non-virgin) materials (Zink and Geyer 2017). This narrow flow is also slowed down as it passes through the economy by different product-life extension activities such as repair, refurbishment or remanufacturing (Stahel and Clift 2015). At the end of the use-life of products, resource flows are closed by recovering the products and materials before they end up in landfill, the ocean or simply being burned. This recovery provides the opportunity to give the right treatment to the different materials either re-incorporating them into the economy or returning them safely to

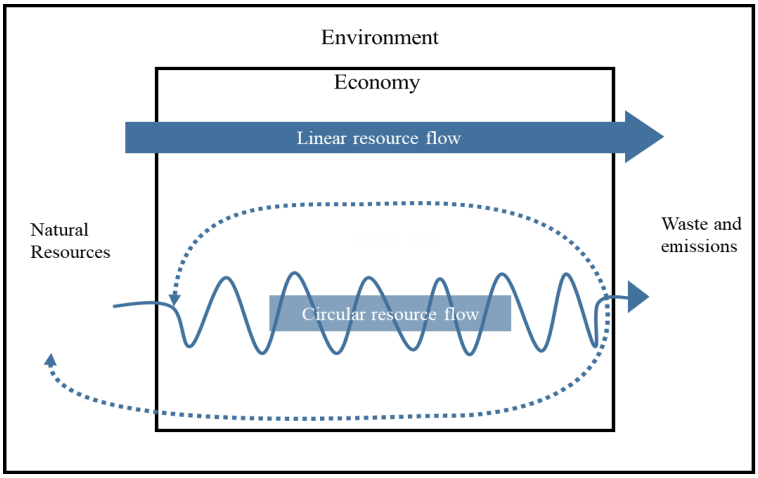

Figure 1: Resource flows in linear and a circular economy. Source: Own elaboration

nature (Braungart, McDonough, and Bollinger 2007).

An economy could never become fully circular, however, "circularity" as a characteristic of the economy, is desirable (Zotti and Bigano 2019), especially since it holds the potential for reducing the demand for natural resources and waste generation (Prieto-Sandoval, Jaca, and Ormazabal 2018). In addition to environmental benefits, increased circularity has the potential for generation of employment by substituting energy intensive activities (e.g. mining), with labor intensive activities

(e.g. repair shops or waste recovery and sorting) (Stahel and Clift 2015). Furthermore, it can promote economic stability, particularly for economies dependent on materials import, since it decreases the dependency on imports of critical materials (Ellen MacArthur Foundation 2015).

Most agree that circularity can only be achieved by a systemic redesign of systems of production and consumption (Kirchherr, Reike, and Hekkert 2017). From the private sector perspective, this includes rethinking products (Bocken *et al.*, 2016) services (Tukker 2004) the and business models that allow for the production and consumption (Urbinati, Chiaroni, and Chiesa 2017). In parallel, social aspects such as consumer practices (Camacho-Otero, Boks, and Pettersen 2018) and regulatory frameworks (Milios 2017) also require a reconfiguration aligned with circularity flows. This kind of multi-level redesign of the economy is based on partnerships across multiple stakeholders such as enterprises, governments and communities, where each of these actors have different roles to play (BSI 2016).

2) The "how-to" for circularity at enterprises

For more than 50 years, the CE has been associated with the "3R" framework, which stands for reuse, remanufacture and recycle (Stahel and Clift 2015). This framework represents the result of interactions between multiple supply chain actors such as customers, manufacturers and recyclers which circulate materials creating "loops". Nowadays, a greater variety of loops, including more stakeholders, have been explored and put into practice (Ghisellini, Cialani, and Ulgiati 2016). This is due in part because several schools of thoughts and disciplinary approaches have influenced the current understanding of the CE, including eco-design, performance economy, cleaner production, etc. (Homrich et al. 2017).

In other words, the original "3R" framework has been greatly expanded with additional product-life extension actions which include sharing, repurposing and cascading (Reike, Vermeulen, and Witjes 2017). Nevertheless, the approach towards circularity remains the same: interactions between multiple supply chain actors allowing for the formation of "loops" which can promote the preservation of value from materials in the economy. Collectively, all these potential loops can be considered as '*circularity strategies'* (Zotti and Bigano 2019).

Table 1 contains a list of strategies relevant for promoting circularity at an enterprise level. The list is inspired by the 10R typology[1] introduced by Reike, Vermeulen, and Witjes (2017) and modified based on contributions from additional frameworks (The Ellen MacArthur Foundation 2015; Kalmykova, Sadagopan, and Rosado 2017; Lüdeke-Freund, Gold, and Bocken 2018). The list of strategies presented below are framed from the perspective of a focal enterprise, or as individual actions from a single perspective. However, they should not be confused with isolated tasks, since these often involve actions both inside and outside of the walls of the focal enterprise. The table provides names and brief description of 12 strategies that enterprises can follow in order to close, narrow and slow material loops. These are categorized based on which product life-cycle phase they are most relevant. In addition, the table indicates what type of object (physical or otherwise) the strategy pertains, example of literature that deals with the topic as well as the potential material effect these strategies may lead

[1] This specific framework, which is published in a peer-reviewed journal, was chosen as a baseline since it was developed based on a systematic literature review and it is focused on strategies for implementation of CE at an enterprise level.

Product-life cycle phase	Circularity Strategy	Description	Object	Material Effect	Example reference
Design	**Circular Product Design**	Design strategies for durable products including **long life** (i.e. emotional, physical durability); **life extension** (i.e. repairable, remanufacturable); **flexibility** (i.e. upgradable, modular); **recyclability** (i.e. reduced hazardous materials, recovery/recyclability rate).	Design of products, consumer practices or interactions amongst various social actors	Narrow, Slow and close	(den Hollander, Bakker, and Hultink 2017) (Braungart, McDonough, and Bollinger 2007).
	Eco-sufficiency	A strategy in which the enterprise, through multiple aspects such as their product design, sales strategies, services or governance structure, aims to mitigating a consumerism behaviour of their customers and hence, reduce the absolute demand for resources			(N. M. P. Bocken and Short 2016)
	Market creation	Creates a market (digital or physical) which allows for interactions between consumers, enterprises or a combination of these actors. This markets can be of secondary raw materials or second-hand products.			(Kortmann and Piller 2016)
Production	**Industrial symbiosis**	Directs a waste stream from the production process into another companies production process	manufacturing process of products, either consumable (e.g. food based products) or durable (e.g. furniture)	Narrow	(Patricio et al. 2018)
	Secondary raw materials	Incorporates wasted products, components or non-virgin materials into its production			(Gaustad et al. 2018)
Use	**Product-as-a-service**	Provides access to products by leasing, renting or result oriented schemes. Ownership of the products remains with enterprise and customers become users.	Products that retain their integrity (i.e. used for the intended purposes they were manufactured.	Slow	(Tukker 2015)
	Product Life Extension	Service interventions that can extend the useful life of a product. For example, repair, replacing components, refurbishing, reconditioning and remanufacturing. Ownership remains with customer and the enterprise simply provides the life-extension service			(Moreno et al. 2016)
	Take-back	Collects or buy-back products with the aim to be sold to another costumer. Some			(Renswoude, Wolde, and

		service intervention might be required (e.g. repair). Ownership change, from costumer to enterprise.			Joustra 2015)
	Cascade	Sell products to a category of consumer requiring lower standards of quality. Change of ownership from enterprise to costumer.			(The Ellen MacArthur Foundation 2015)
Recovery	**Part harvesting**	Takes valuable components from wasted products (for example from recycling stations, demolition sites etc.)	Components and materials (once product reached obsolesce and will not be used as originally intended.	Close	(Reike, Vermeulen, and Witjes 2017)
	Biological recovery	Returns biological nutrients to nature (e.g. composting), creates bio-gas, or extracts their nutrients (e.g. biological extraction)			(Braungart, McDonough, and Bollinger 2007)
	Recycling	Recycles materials so they can be reintroduced in production processes.			(Moreno et al. 2016)

Table 1: Circularity Strategies

The circularity strategies presented in Figure 1 are combinations of design and business strategies; which, by definition, represent abstract plans and not "turn-key solutions" ready to be applied in any given context (Mintzberg 1987). In practice they need to be adjusted due to significant differences between trades and economic sectors and aligned with the conditions in which the enterprise operates (Lüdeke-Freund, Gold, and Bocken 2018). In other to understand the context in which these instruments of implementation of a CE unfold, the following section reviews the concept of Circular Business Models.

3) Circular Business Models: value creation through circularity

The concept of Circular Business Models can be used understand how do circular strategies unfold in practice. In other words, to shed light to the context in which enterprises can narrow, slow or close resource loops as part of their commercially oriented activities. While the concept of Business Model (BM) has multiple definitions, it can be considered as an aggregated and simplified representation of the general activities of an enterprise related to two major components: value creation activities towards generating products and services and the customer and market considerations (e.g. distribution channels, revenue structures etc.) that are relevant for obtaining or sustaining a competitive advantage (Wirtz et al. 2016). In other words, it describes the logic of how an enterprise creates value, capture value from customers in the form of revenue and sustains this position in the market.

Building upon that definition of business models several authors have provided definitions for a Circular Business Model (CBM) with no clear established consensus apparent (Lüdeke-Freund, Gold, and Bocken 2018; N. M. P. Bocken et al. 2014). The most specific definition of CBM is that of a business model that creates 'commercial' value by prolonging use-life of products, closing material loops (Nußholz 2018). Overall, the understanding of a CBM in this research is the following:

"A circular business model describes most important components related to the sustained process of creating and capturing value from by narrowing, closing or slowing material flows.

In other words, a CBM describes how a firm creates value to customers through circularity. This definition differences between sustained interactions involving consumers and limited time initiatives that may be aimed towards circularity. These sustained interactions can potentially generate environmental and social benefits and their scope is bounded (limited and promoted) by an institutional context". The remaining of the sections discusses some theoretical aspects of this definition of CBM.

An inter-organizational perspective

One of the core elements of CBM is that in order to create a CBM, it requires the sustained interaction of suppliers and customers (Rohrbeck, Konnertz, and Knab 2013). These characteristics can help differentiate between CBM and isolated or in-house initiatives aimed at environmental improvement such as efficient production processes s these, by themselves, do not represent a value proposition from the firm to their customers or involve their suppliers in their actions.

Urbinati, Chiaroni, and Chiesa (2017) developed a taxonomy that categorizes CBM based on whether the main interactions happen between the firm or its supply chain and/or customers. Specifically, a circular business model based on relationships between firm and customers is considered as *downstream* circularity. In turn, *upstream* circularity involves the firm and its supply chain and "full" circularity involves incorporating downstream and upstream circularity. Geissdoerfer *et al.* (2018) argued that incorporating both supply chain and customer allows for an optimal performance of a CBM, however collaboration across the entire supply chain is complicated considering that most enterprises have a limited influence in the full value chain (Ranta et al. 2018).

Institutional context

It is argued that most business models are inherently trapped in an institutional logic (rules, norms an regulations) aligned with the principles of a linear economy (Fischer and Pascucci 2017). In that same way, CBM are still bounded within this institutional context and it is a crucial element to understand which CBM are able to be developed and which are not.

This institutional context includes inter-dependence with other business models. For example, CBM based on collecting, repairing and re-selling mobile phones is dependent on the manufacturing of these devices, this is referred to as the business model ecology (Nancy Bocken, Boons, and Baldassarre 2019). In other words, some CBM may only be able to exist because there are non-circular BM in place.

Furthermore, from a regulatory perspective, CBM are subject supra-national national and even regional specific standards. This official rules may legally prohibit the development of a specific CBM such as trade bans of used clothing or waste exports. This formal rules also interact with unofficial local cultures and industry-specific practices which can become relevant elements that enable or hinder the development of specific CBM (Tura et al. 2018). Customer acceptance is also a crucial component on CBM as this are commonly regarded as practices that differ from the dominant market practices in the sector (Camacho-Otero, Boks, and Pettersen 2018).

Environmental and social benefits

One main discrepancy in the different understandings of CBM is regarding their potential for environmental and social value creation. Some have placed these two elements as inherent to a CBM, while others as potential consequences (Pieroni, McAloone, and Pigosso 2019). While it is undeniable that part of the attractiveness of the concept of a CBM is precisely in the fact that they hold the potential of creating social and environmental value while creating economic value, in this investigation, social and environmental value creation is treated as potential consequences, which require further analysis (outside of the scope of this project) to fully measure and confirm.

This consideration is taken because social value creation is dependent on the decisions taken by the firm in regards to how to conduct their operations what to do with the economic value created (Khmara and Kronenberg 2018). This will determine, if a CBM has positive effects on job creation or additional consumer value for example. Nevertheless, these are a function to the specific context of implementation. Furthermore, research is clear that environmental benefits are dependent on life-cycle analysis, the specific boundaries defined for their analysis, in addition to larger economic consideration related to what is commonly known as “rebound effects” which describe potential negative consequences of actions that initially can be perceived as beneficial from an environmental perspective (Zink and Geyer 2017).

II. Methodology

The research approach for this investigation was to identify and analyze – based on the analytical framework presented in the previous section - different SMEs from the Baltic sea region in order to present an empirically derived overview of the CBM currently available in distinct trades and sectors of the economy.

1) Search for cases

The approach for selecting cases followed a purposeful sampling approach (Emmel 2014) in which pragmatism and in consideration of the interests from the involved group are the main driver for selecting cases. This approach guarantees that the cases selected are able to provide relevant data for the research purpose, compared to for example random sampling.

During the process, all partners from CircularPP provided at least five examples of what they considered as best practices of circular SMEs from their corresponding countries focusing on the pre-selected categories: Information and Communication technologies (ICT), Furniture, Office or indoor equipment, Textiles/clothing, Playground infrastructure, Catering services, Lighting. The categories were determined in order to be relevant for the pilot projects developed during the CircularPP and to based on general interests from the municipalities' participating in the project. The suggestions included name of the company, country of operations/origin, brief description and product group.

2) Case selection

Following the partner's suggestions, each case was analyzed in order to determine if they could be considered as a circular business model. This identification was done by answering the question: "is the firm following one or more of the different circularity strategies discussed in the previous section (table 1)?" The question was answered based reviewing the information available on the firms' website, and if available CSR reports and other relevant documents, such as news or scientific articles addressing the company. This type of qualitative proxy indicators are useful for simple categorizations, and in this case are necessary, since there are no available indicators for circularity of business models (Simone and Alberg 2020)

Some suggested cases were dismissed due to the company was no longer in operation, there was not sufficient information available on their website to determine if they were following a circular strategy, or they were *clearly* considered as trans-national corporations that did not meet the "Small and Medium Enterprise" criteria[2].

3) Case analysis

In addition to the secondary sources (e.g. website, CSR reports and other documents), primary data collection was also conducted following two approaches, semi-structured interviews (face-to-face) and structured (written) interviews. The structured interviews were direct questionnaires sent to the representatives of the firms through email. In total, 50 websites were analyzed, 14 semi-structured interviews were conducted, 9 structured questionnaires were sent and responded and eight external documents were reviewed. The details for each case data collection are provide in the Annex.

Semi-structured interviews were conducted with representatives of the firms that could explain elements related to the circularity aspects of the business model. This type of interview is an

[2] The process of determining what accounts as an SME in Europe is complicated and requires sensitive information (e.g. turnover, employee count, balance) that is hardly available on websites. Therefore, the authors criteria was used to determine which cases were clearly out of the SME scope.

adequate research tool to explore experiences such as complex social interactions (King 2004). These interviews followed an interview guide, available in the Annex, which contained broad themes in order to allow space for the interviewer to make follow-up questions and allows interviewees to potentially bring forth critical aspects that might not have been considered when designing the interview guide, another strength of semi-structured interview method (King 2004). Overall, these interviews were used to construct ten individual cases with additional relevant information. The selection of these cases was based on a balance between geographical scope, product groups, uniqueness of their business model and willingness to be interviewed.

III. Results

In this section, 50 different cases of SMEs operating a circular business model are introduced. The cases are arranged in sub-sections for each category group. Each subsection contains an introduction to the category group and a table that includes relevant information of the cases analysed for that category. The information includes value chain position or main activities, a brief description and the main circularity strategies associated with that case. The cases are not mentioned by name; instead, a code is used in both the table and the text. The code contains a letter, representing the country from which the case was obtained and a numeric indicator.

Code	Value Chain position/ Main activities	Brief description	Circularity Strategy											
			Design			Production		Use				Recovery		
			Circular Product Design	Eco-sufficiency	Market creation	Industrial symbiosis	Secondary Raw materials	PSS	Product-life extension	Take back	Cascading	Parts Harvesting	Biological Recovery	Recycling

Table 2: Heading of the summary table included in each category group

From the 50 cases analysed, 10 cases are presented separately with further information, namely a main barriers and benefits of the CBM. Each section with an empirically derived overview of the CBM available for that category.

1) Food and food-based products

The category of food and food based products is mostly represented by the food value chain, which includes several industries and sectors aimed at producing unprocessed, partially or fully processed food intended for human consumption (Stenmarck et al. 2016). However, other supply chains such as the biomaterials industry are also included. The traditional flow in the supply chain begins with food producers (farmers, fisheries, etc.) in charge of supplying produce (fruits, vegetables, diary, meat etc.) to enterprises downstream in the supply chain such as the food and beverage industry, wholesalers, retailers and food service organizations (e.g. restaurants/catering) (DG Agriculture and Rural Development 2017).

Code	Value Chain position	Brief description	Circularity Strategy											
			Design			Production		Use				Recovery		
			Circular Product Design	Eco-sufficiency	Market creation	Industrial symbiosis	Secondary Raw materials	PSS	Product-life extension	Take back	Cascading	Parts Harvesting	Biological Recovery	Recycling
Food and food-based products														
R1	Food Producer	Certified organic farm	X											
P1	Processing	Production of biodegradable dishes and cutlery from natural wheat bran	X				X							
D11	Processing	Use food surplus (apples) to produce a natural, biodegradable leather	X				X						X	
S6	Processing	Juice production enterprise based on "wasted" fruits and vegetables from supermarkets					X					X		
P4														
S8	Food services	Restaurant and catering services based on second/hand ingredients					X					X		
S9														
N13	Secondary Market/Food services	Restaurant and catering services based on second/hand ingredients. Retailer of second hand ingredients		X			X				X			
F9	Secondary Market	Connects suppliers (café, restaurants, grocery shops) that have "leftover" food products, with potential customers offering an interface system for interaction			X									
S4					X									
L5	Retail	Zero-waste (bulk) retail shop		X										

D7	Waste management/Processing*	Recovery of spent coffee grounds and processing in bio-refinery to produce coffee oil and coffee flour.										X	X	

Table 3: cases analysed in the category group of food and food based products:

The foundation of a circular food industry

Based on the cases reviewed, a case of CBM for food production enterprises is focused on organic production in order to provide safe inputs that can be used downstream in the supply chain (**R1**). This production technique avoids chemicals and pesticides which creates the foundations for a circular system in which products and materials can be circulated and reincorporated safely into the ecological system (Braungart, McDonough, and Bollinger 2007).

CBM based on secondary flows

All across the supply chain, secondary flows and waste is generated. These flows can be used as secondary raw materials in order to develop a CBM.. Three main secondary flows are distinguished:

1. By-products: unintended produce generated during the production of a main product, mostly generated by food producers and the food and beverage industry.
2. Class II products: edible and commercially valuable produce (e.g. fruits and vegetables) that are considered of lower quality due to size, maturity and esthetic reasons.
3. Donations: Produce or processed food products that were destined for waste but instead were donated, or allowed to be collected by different organizations. There are multiple situations in which edible products would be destined for waste, such as: products reaching "best-before-date", over-stocking by supermarkets, re-branding of products and need to take out old products from market, products packaged in pre-set quantities in which one of the products is damaged but the rest are not or produce that farmers cannot sell due to aesthetic reasons

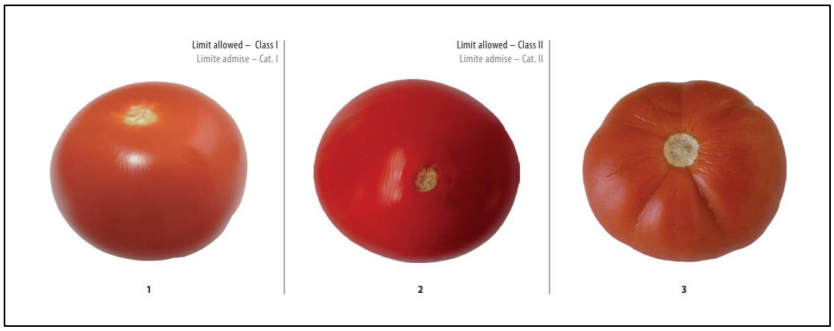

Figure 2: Three tomatoes differentiated in Class I, Class II and Class III based on the characteristic "fresh in appearance". Image taken from the OECD International Standard for fruit and vegetables (OECD 2019)

Some CBM based on secondary flows are for example **P1**, which provides a substitute for single use plastic cutlery by using a by-product from wheat bran producers and manufacturing with it biodegradable single use cutlery and dishes.. Similarly, **D11** uses apple pressings, a by-product of from cider industry, to produce leather-like textiles, which can be used as a viable bio-based

material. In terms of donations, some processing enterprises such **S6** and **P4** collect fruits and vegetables destined to waste from supermarkets and restaurants, which then are used as ingredients in the production of juices. In turn, class II products are slightly different as they still hold a commercial value (although slightly lower that class I products) and cases like **S8** and **S9** are examples of food service enterprises (e.g. restaurants and catering services) that prepare meals mainly based on class II and donated products.

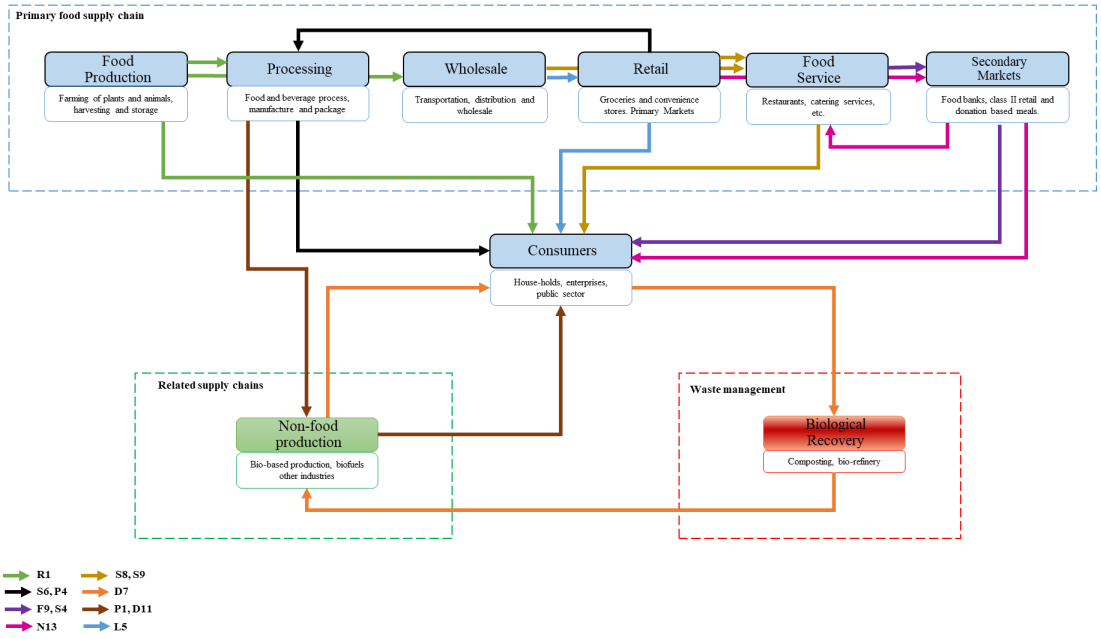

Figure 3: Supply chain map in which different actors are connected by material flows. Each colour arrowed represent one CBM and it displays the material interactions and actors involved in that particular CBM. Source: own elaboration

Creating markets

Class II and donated produce tend to have a less reliable supply compared to virgin raw materials and Class I products. Therefore, enterprises that rely on them have to manage the uncertainty of the distribution channels and the variable availability of any given time. Due to this situation, another form of CBM is creating a secondary markets for Class II and donation flows which can facilitate their retail and distribution. Such is the case of **N13** that collects secondary raw materials through their established partnerships and makes them available as wholesale distributor to other enterprises, essentially creating a secondary market. This type of actor in the food supply chain is known as back-line organization (European Commission 2017a) .

A similar secondary market is also created by **F9** and **S4,** however this one is at the level of food service. These two firms create digital markets for meals that are unsold at the end of the day in restaurants or cafes. This newly created market allows food service providers and consumers to interact and get mutual benefits. Suppliers of meals can potentially obtain additional revenues for

previously unsold meals that would have been discarded as waste and consumers get access to discount meals through a user-friendly interface.

Engaging consumers

It is estimated that 20% of the food produced is wasted in the EU (Stenmarck et al. 2016). The retail sector is considered the lowest contributor with an estimated of 150 and 200 million tons per year- around 5% of the total food waste (Stenmarck et al. 2016). However, while food waste may not be critical at the retail sector, there are retail practices that can help reduce food waste further down the supply chain, namely at the consumer level. Such is the case of **L5**, whose zero packaging and bulk offering of products allows consumers to purchase more accurately to their needs, which can help reduce food waste at the household level. Similarly, **N13** is directly involved in educating consumers in conservation techniques in the kitchen, which is another initiative that can help reduce household food waste.

Valuable waste

Following the CE principle, products components and materials should remain in the economy at its highest value (Geissdoerfer et al. 2017), in the case of food, this translates in a priority of rescuing edible food for human consumption, or if not possible, recovered for animal feed. However, sometimes these options are not possible (e.g. inedible parts of animals, rotten fruits and vegetables etc.) and waste management becomes necessary (Commission for Environmental Cooperation 2017).

Food waste can be treated in several ways such as composting and biogas generation, incineration or landfill (Stenmarck et al. 2016). A preferable option is to recover some of the valuable nutrients in the waste fraction. Such is the case of **D7** who collects wasted coffee grounds from hotels and restaurants and through a process of biological recovery; they obtain raw materials for producing coffee-based products.

Case: Sopköket

Country: Sweden

Description: Sopköket is a restaurant and catering business that prepares meals based on partly rescued and surplus ingredients from supermarkets and wholesalers.

Figure 4: Sopköket staff at the restaurant premises. Image provided by Sopköket

Main Strategy: Secondary Raw materials

Circularity of business model:

Sopköket circularity is based on narrowing food flows by incorporating ingredients that were destined to be waste but remain in suitable conditions for human consumption. They are also focus on eliminating their own waste, by redistributing leftover meals to people in need or amongst their employees and their relatives. Lastly, they operate their own compost to minimize waste generation and just recently began producing a fertilizer for their rooftop garden.

Other benefits:

Running this type of CBM provides several advantages. Firstly, their approach has a clear focus on sustainability (in particular eliminating food waste), which allows them to find partnerships with like-minded enterprises, such as organic or local food retailers, in order to get access to donated or class II produce. In addition to attract a growing niche of sustainability-sensitive consumers.

Another benefit is that they have lower raw materials costs since some of the ingredients used are donated or purchased at a discount price. However, this business model also requires a larger work-force compared to traditional restaurants and Sopköket focuses on providing opportunities for immigrants in Stockholm to enter the job market. Lastly, they communicate the story of the rescued ingredients, for example the place where they were collected. This action not only raises awareness and promote a stronger connection between their customers and their food but also provides their customers reassurance that their food was not taken from a garbage bin.

> "We have a lot higher salary costs because it takes much longer time to deal with ingredients at our disposal due to sorting, going and picking up the ingredients at the store, then sorting it and cleaning and creating new recipies every day…Then of course we buy other things in a normal way to complement the things we rescue and be able to prepare the meal…" Fillip, Founder of Sopköket

Main Barriers:

Their main challenges are related to higher salary costs, since it takes longer time to deal with ingredients at their disposal for sorting and cleaning and creating new recipies every day. In addition, even though they have stablished partnerships with supermarkets with specific dates and times for pick-up, they have more complicated logistics than traditional restaurants. In particular, health regulations that require detailed registration of every item donated represent a barrier for establishing collaboration with some members of the retail sector because, this in turn, requires supermarkets to allocate more resources on additional work-force to deal with the established requirements.

Case: Turza

Country: Latvia

Description: Turza is zero-waste, package free, self-service shop, where it is possible to buy everyday products in bulk. Product selection includes oils, teas, plastic-free body care, household products, and a selection of daily life food products.

Main Strategy: Eco-efficiency

Figure 5: Inside one of Turza locations. Image provided by Turza

Circularity of business model:

Turza narrows material flows in two different ways. First, it gives customers a chance to buy the specific desired quantities which helps reduce the potential of overstocking and eventual food waste at the household level. Secondly, it promotes a "slow" shopping culture by having consumers taking time to measure and pack products inside the store in the containers that they brought, which creates the conditions for a more conscious decision-making while buying.

Furthermore, it reduces demand for plastic and generation of plastic waste by offering package free solution. This includes both for their customers but also for their suppliers, whom have responded positively to Turza's requests for bulk delivery or taking back the containers in which they supply their products.

Other benefits:

Turza can get access to lower prices from suppliers when buying large quantities of products that are traditionally sold in small packages (e.g. nuts, oil, coffee, etc.) and potentially even lower prices when some suppliers recognize that is cheaper for them to deliver in bulk and without packaging. This savings translate into lower prices for Turza's customer on most products that usually come in package.

Furthermore, Madara, the founder of Turza says she has observed increase interest into bulk retail. Not only from customer interested in zero-waste philosophy but also customers that have recognized that bulk shopping allows them to save money.

"Offering products on bulk you give a chance to people to buy the product as much as they need, even if it's just a few grams…shopping is becoming a midnfull process for a lot of people." Madara, Founder of Turza

Main Barriers:

The main barrier for further development of this business model is mainly related to cultural barriers from consumers. These include misconceptions regarding bulk products lacking hygiene, lack of variety of brands and consumers wishing to spend as little time possible doing their shopping.

Furthermore, market conditions for vegetables and fruits make it impossible for Turza to compete in terms of prices with super-markets buying large quantities of fruit and vegetables every day, therefore these products can be more expensive.

ii. Built Environment

The “Built environment” is a category that includes a broad range of activities related to designing, constructing, operating and potentially demolishing infrastructures (e.g. houses, offices, and other type of facilities). In the context of CE, the construction sector has crucial economic and material implications. It represents approximately 8% of the EUs GDP and provides 10% of all employment (Reinstaller 2016). Furthermore, it consumes around 40% of materials and it generates between 25-30% of all waste (Thelen et al. 2018). This economic sector is more similar to a project-based activity than a routine manufacturing task. Its complexity results partly from the variety of actors and sub-economic activities involved and the inherent characteristics of the main “product” (i.e. infrastructures).

A complex economic sector

Buildings (and other facilities) are complex structures which can be considered as an assembly of multiple “layers”, each comprised of unique materials and components (Brand 1994). This is significant to circularity, since these “layers” have diverse lifetime spans. For example internal layers in a building such as carpeting or furniture might last between 5-10 years, while the plan layout and façade may be changed after 15 years, roofing renovation at 20 years and the structure of the building can be made to hold for more than 70 years (Thelen et al. 2018). Furthermore, in the built environment, multiple actors coalesce at different points in time (Pomponi and Moncaster 2017).

It has been highlighted that the challenges and opportunities for circularity in the built environment depend on whether one is dealing with an existing facility (which may not have been originally designed following circularity principles) or a potential facility, which can be design with the state-of-the-art knowledge, however it would require a large amount of materials (Thelen et al. 2018).

Figure 3 depicts the main sub-economic activities of the construction value chain in relation to the three main life-cycle phases of infrastructures, includin beginning of life (i.e. construction of the infrastructure), middle of life (i.e. use and operation of the infrastructure) and end-of-life (i.e. both demolition or renovation and repurposing activities) (Reinstaller 2016). The main sub-economic activities considered are:

1. Construction: includes all type of on-site works, from site preparation and building of the infrastructure.
2. Construction services: includes architecture, design, and other parallel services.
3. Construction supply: includes suppliers of raw materials (e.g. gravel, sand, bricks) and specialized components for construction (e.g. insulation panels, illumination systems, etc.).
4. Operation of facilities: includes management and maintenance of facilities thorough the time they are used.
5. Renovation or repurposing: includes works conducted to the infrastructure that prolong its “use life”, either for its original purpose (renovation) or for a different function (repurposing).
6. Demolition and recovery: includes all activities at the end of life of the infrastructure, including (selective) demolition, decommissioning and site remediation

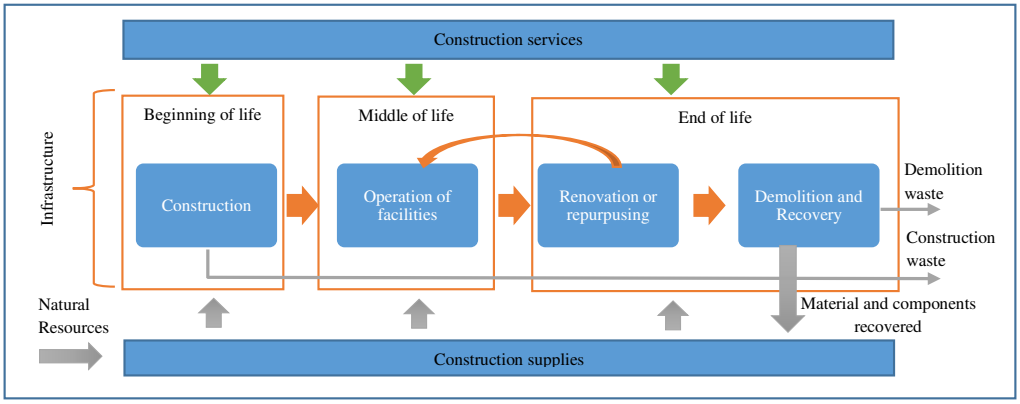

Figure 6: Main economic activities (blue rectangles) divided by life cycle stages (orange rectangle) of the infrastructure. The orange arrows represent a transition in life cycle phase. The green arrow signals a supply of services. Grey arrows signal material and waste flows. Source: Own elaboration

The cases considered in this section are diverse, as they pertain to almost all the different sub-economic activities related to construction, as well as the different life-cycle stages of infrastructure. Seen in isolation, they might be difficult to relate to each other, however, the model is expected to help position and contextualize these different CBM considered in the analysis for this category group.

Code	Value Chain position	Brief description	Circularity Strategy												
			Design			Production		Use				Recovery			
			Circular Product Design	Eco-sufficiency	Market creation	Industrial symbiosis	Secondary Raw materials	PSS	Product-life extension	Take back	Cascading	Parts Harvesting	Biological Recovery	Recycling
Built Environment															
N12	Construction Services	Consultancy/design firm focused on sustainable (circular flows)	X		X		X							
D12	Construction Supply	Insulation panels with a C2C silver level certification	X						X	X				
D3	Construction Supply	C2C certified carpet tiles	X				X							
N4	Construction Supply	C2C certified carpet tiles and take back system	X			X				X		X		
S10	Operation of facilities	Company specialized in modular luminaries and lighting-as-a-service programs	X				X	X				X		
S1	Operation of facilities	Signs (electronic) that are designed to be disassembled, re-	X					X	X					

		used and re-cycled												
D4	Renovation or repurposing	Retrofitting current luminaries with LED technology	X				X		X			X		
D5	Demolition and recovery	Upcycling of recovered bricks from construction					X					X		
D10	Demolition and recovery	Artificial turf recycling company												X

Table 4: cases analysed in the category group of built environment

Construction and Demolition: a market for materials

Waste-valorization is one of the cornerstones of the CE and different category groups are faced with unique challenges in their quest for tapping into the value of waste streams. Particularly in the construction sector, **N12** address this challenge by facilitating and enhancing the market for secondary construction materials. They do so with the help of an online platform that maps the different resource flows available in the region, which facilitates interactions between supply and demand of construction waste and construction materials.

Construction supply: circularity of individual components

Insulation panels, luminaries, electronic signs and carpeting tiles. These are all specialized components that are relevant to the inner layers of building. As such, their circularity (at a product level) is important to the total building circularity. At the product level, modularity and ability to incorporate non-virgin materials are the keys for circularity.

Being able to dis-assemble their own products incentivizes companies to recover them after their customers no longer are using them. Then, these products become valuable resources which companies can incorporate into their production process reducing the demand for virgin materials. Such is the case of **D12**, which takes back old insulation panels from their customer when they purchase new panels from them. Furthermore, through the Cradle-to-Cradle certification, D12 keeps track, communicates and set a paths for improved circularity in some of their specific products.

Similarly, **D3** and **N4**, both add on to the building circularity by means of their own carpets and rugs. Both companies also offer some of their products with a Cradle-to-Cradle certification. Particularly, D3 specializes in incorporating recycled materials (such as fishing nets, plastic bottles or recycled yarn) into their products. For their part, N4 has established a system in which they collect old carpets (their own and from competitors), separate them into two streams of resources (yarn and bitumen). The yarn is reintroduced as feedstock into their suppliers' production process and the bitumen is used by the road and roofing industry, generating an industrial symbiosis.

Operation of facilities: Product service systems for circularity

A circular product design based on modularity and high quality materials, results in long lasting products. This provides an incentive for companies to switch from selling their products into offering them as a service. Particularly **S1** with electronic signs, and **S10** with luminaries and lighting, have adopted a product-service-system model in which their customer no longer purchase their products but in turn, pay for the result desired. In these cases, the results provided are related to keeping a specific level of illumination (S10) and the management of signs inside a facility (S1).

Renovation and repurposing: life extension of inner layers

Firms like **D4** focus their circularity in renovation, in other words, extending the use-life of products and preventing them from going to waste. Specifically, retrofit old luminaries with energy efficient LED technology. This way, resources are saved by not having to purchase new luminaries and the aesthetics of the building are preserved. D4 also *harvest parts* and components from old or wasted (third-party) products like old luminaries or television screens and incorporate them into their own production line.

Demolition and recovery: resources at the end-of-life of buildings

Construction and demolition waste flows includes concrete, bricks, metals, tiles ceramics, plastics and excavated soil, all of which have the potential to be recycled, but often end up simply being used as material filling on other construction projects (Thelen et al. 2018). This is down-cycling, an activity of low-added value, both in economic and environmental terms. A circular solution can be distinguished in the cases of **D5** and **D10**, two companies which undertake on-site decommissioning of buildings and houses (D5); and artificial turf facilities (D10) respectively. Both of these cases make use of their own technology which allows them to conduct a recycling processes in which they are able to recover high value components (e.g. bricks) or pure raw materials (e.g. high-quality turf yarns).

Case: Superuse Studios

Country: Netherlands

Description: Superuse Studios started as an architectural firm in 1994, since then, they have focused on incorporating available regional flows (e.g. existing materials, water, energy, data) into their designs. Today, one of their main business models is related to facilitating, through a digital platform, the exchange of resource flows (particularly focusing on construction materials and industry flows) in specific regions or industrial zones.

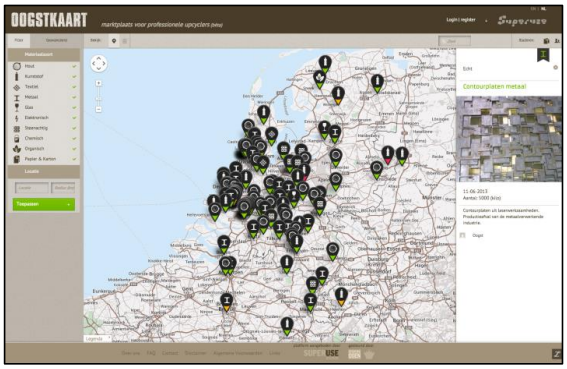

Figure 8: Screenshot from digital platform mapping regional resource availability. Image provided by Superuse

Main Strategy: Market creation and secondary raw materials

Circularity of business model:

Super-use closes construction material flows through the creation of a market for secondary materials that facilitates the interaction between construction waste suppliers and potential customers. This is achieved by mapping, visualizing and sometimes brokering the exchange of resource flows, within a limited spatial dimension (e.g. region or economic area) for the organizations that sign up to their platform. Additionally, in the projects that they develop, they narrow multiple waste flows by designing their own projects focusing on the available resources (and waste) that are available. For example, using wasted parts from wind turbines to create the main structures of a playground project.

"*Our creativity comes from a clever combination of the demands, requierements, available materials and obstacles on the site. It is a different starting point.* Jan Jongert, Founder of Superuse Studios"

Other benefits: Reclaiming building materials is a relatively known practice. These particular waste streams comes in large quantifiable flows, which facilitates the planning accordingly to their use. For example, based on the installed capacity of energy generation windmills, it is possible to anticipate for a steady income of "wasted" blades in the upcoming years. Furthermore, at a material level, they do not differ greatly between virgin and secondary resources; therefore, they can easily be re-adopted.

Main Barriers:

Utilizing "wasted" construction materials presents a series of inherent barriers. From a logistics perspective, construction materials are constrained by tight schedules. In other words, building have to be demolished whitin a certain time. Due to the volume of this resource flows, the costs associated with potentially storing or warehousing is too high, therefore, it is crucial to find potential application for this materials whitin that time restriction.

Furthermore, unlike other commodities, secondary construction materials cannot be based on business models in which a company retains ownership of these materials. This is because, they usually have a long use-life, therefore, it is very difficult to predict the value the material will have in the future, in fact, this value is almost entirely dependent on finding demand for the material within the timeframe that it becomes available.

Other barriers highlighted are related to the additional labor required to incorporate reclaimed materials into a design. This situation, coupled with the imbalanced tax burden on labor compared to tax on new raw materials, makes it very difficult to compete with designs entirely focused on cheap materials. Lastly, related to participating in governmental projects, the use of reclaimed regional construction materials requires flexibility in the initial phases, particularly in the design proposal, which often times, public procurement process do not support.

Case: Accus

Country: Sweden

Description: Accus is a company specialized in providing signage (with or without illumination) for branding, way-finding and overall visual communication in buildings and facilities. Their business model include selling or renting of individual signage. Recently, they have begun collaborating with facility owners and operators in order to supply signage "as a service" providing continuous maintenance and adjustment of all signage requirements in the facility.

Figure 9: Sign from Accus which highlights the modular design. The frames, components and circuits are displayed separately as they are all interchangeable. Image provided by Accus

Main strategy: Product design, product-service system and product-life extension

***Circularity of business model*:**

Accus slows down resource flows used in the manufacturing of signage including plastics and electrical components, firstly by designing products in a modular way so these can be maintained and adjusted to changing environments. In addition they take back signage from their customers and reuse them in other projects. Furthermore, they can keep ownership of their products essentially providing signage as a service. In this arrangement, facility owners are their customers and tenants of buildings become users of the signs. Lastly, they also narrow material flows by incorporating recycled materials in the manufacturing process of their products.

"We are hoping that there would be better criteria in the future, that municipalities would have a more life-cycle thinking and value competences that you need to provide a sustainable service" André Zandelin - Accus CEO

***Other benefits*:** The CBM of Accus allows their customers to meet their needs of signage and visual communication with a reduced environmental impact compared to conventional disposable products. To Accus, their circular product design allows them to use their products for several cycles, not only with one customer and eventually recycle their products once they cannot be re-used. Signs, particularly those used on the outside of buildings, have a fixed position and are relatively on inaccessible locations, therefore, this facilitates Accus keeping track of their own products and potentially recovering them when their users no longer need them.

Main Barriers:

Signs, specifically the branding ones, require a relatively high degree of aesthetics and uniqueness in their design. Sometimes this can be at odds with circular design, modularity and re-usability. Furthermore, implementing innovative designs that include re-used materials, in addition, to providing a constant maintenance service and adjustment, involves higher costs. Therefore, it is difficult to compete in bidding processes against suppliers who focus on cheap disposable materials, when price is the only criteria for selection.

iii. Furniture

The furniture sector involves a supply chain where several actors interact. From producers of wood, and metal, to component manufacturers (e.g. textiles, plastic components); designers and furniture manufacturers; distributors and retailers. Together, they produce different types of furniture, including wood-based, kitchen, mattresses, metal furniture, non-upholstered and upholstered seats (Forrest et al. 2017; White 2018). The main environmental concerns related to the furniture industry are waste generation, reliance on virgin raw materials (wood, metal and plastics), and the use of chemical, dyes, adhesives and coatings in the production process (Barbaritano, Bravi, and Savelli 2019).

In the EU, it is estimated that 80% to 90% of furniture waste is incinerated or sent to landfill, with less than 10% being recycled and re-manufacturing activities currently representing 0.1% of the industry (Forrest et al. 2017). This indicates the opportunity to develop CBM in this sector, particularly related to product life extension. There are various barriers faced in regards to remanufacturing including changing consumer preferences in regards to design and materials, unreliability of product supply and high labor costs of manual disassembly (Grösser 2017).

Code	Value Chain position	Brief description	Circularity Strategy											
			Design			Production		Use				Recovery		
			Circular Product Design	Eco-sufficiency	Market creation	Industrial symbiosis	Secondary Raw materials	PSS	Product-life extension	Take back	Cascading	Parts Harvesting	Biological Recovery	Recycling
¨Furniture														
D13	Design/Manufacturer	Furniture that is bamboo-based and painted with natural methods	X											
P5	Design/Remanufacturer	Collect non-recyclable spare parts from wasted automobiles to create various types of indoor equipment	X				X					X		
D8	Remanufacturer	Social enterprise focused on handcraft workshop based on recycled materials.					X					X		
D15	Design/manufacturer	Furniture design based on recycled or sustainable sourced materials (ocean plastic waste and recycled steel).	X				X			X		X		
S7	Distributor/retail	Market creation for remanufactured furniture		X	X					X				
D6	Design/(re) manufacturer / Retail	High quality furniture with a take-back system	X						X	X	X			
F8	Design/Remanufacture/Retail	Furniture services (new, remanufacture, renting, collection)	X					X		X	X			

N8	Design/Manufacturer/Remanufacturer	Workspace facility management	X				X	X	X	X				

Table 5: cases analysed in the category group of furniture

Material choices in furniture design

These environmental issues are more efficiently adressed when considered from the stage of product desig, particularly in the choice of materials. Such is the case of **D13**, a company that designs furniture based on FSC certified bamboo-wood which natural renovation cycle (and carbon footprint) is lower than alternative wood sources such as pine or cedar. Additionally, they limit the use of hazardous chemicals by using natural painting methods, water based dyes and adhesives. This strategy towards circularity is important since it sets the foundation for safe circulation of products and materials.

Waste as raw materials

Collecting "wasted" wood, plastics and metals is an approach to close material flows in the furniture industry. Relevant examples of this practice are **P5**, **D8** and **D15**. These three organizations collect parts from waste streams and incorporate them into their production as secondary raw materials. Each enterprise focuses on a distinct market segment and a unique waste stream:

- In particular, **P5** focuses on high-end handcrafted metal furniture. They try to give metal waste a conscious, modern and aesthetic design by using old automobile parts, which unique shape provides the foundation for unique furniture designs. The use of these pre-fabricated metal pieces substitutes the intensive energy process of metal folding.
- **D8** mainly works with wooden furniture for specific commissioned projects; they rely on collecting "waste" wood, furniture and various other components and incorporating them in their projects.
- Lastly, **D15** focuses on using recycled materials, particularly ocean plastic waste in the design and production of their furniture products.

Furthermore, each of these cases display relevant aspects of circularity that go beyond material aspects. **P5** incorporates a form of information transparency in which their products have a "material passport" that can help trace down to their origin. **D8,** as a social enterprise, provides labor opportunities for young people in risk of social exclusion thanks in part to the labor-intensive nature of furniture remanufacturing.

Facilitating Interactions

Circularity in the furniture sector can also be promoted by facilitating interactions. Such is the case of **S7**, which part of its business model is based on creating a market that facilitates the interaction between supply and demand of refurbished furniture. They do so, in two main ways. Firstly, they have a web-based marketplace where one can purchase remanufactured furniture; secondly, they can facilitate the interactions between organizations interested in refurbishing their own furniture.

Extending the life of furniture

One way to slow down the flow of furniture into landfill or incineration facilities is by collecting furniture at the end of their use life and perform different service interventions which prolong their useful life. This type of activities are normally performed by re-manufacturing and repair shops (Krystofik et al. 2018). Two cases, **D6** and **F8**, specialized in take-back of their own furniture and

collection of other company's furniture. This services are offered in addition to designing and manufacturing their own furniture following circular design principles.

Once they take back the furniture, they can refurbish it (e.g. replace worn-out parts, upholster, aesthetic changes etc.) and re-sell it. Refurbishment can also be done for the same customer; in this case, the furniture remains with its original user. Additional components to the CBM are related to donations of re-manufactured furniture that cannot be sold (D6) and short-term rental of furniture (F8).

Holistic approach: office furniture management

N8 business model has a more holistic perspective of circularity in which several phases of the supply chain are involved, including design, (re)manufacturing practices but also use-phase services and recovery. In summary, N8 provides a full workspace management service that includes, design, provision of furniture, maintenance services and eventual take-back. The modular design of their furniture facilitates disassembly and re-introducing collected parts in their own production process. Service contract creates an incentive to N8 to design modular, long lasting furniture that is easily repairable. This type of CBM requires frequent interaction with their customers in order to understand and satisfy their needs more efficiently.

Case: HOLMRIS B8 Circular

Country: Denmark

Description: HOLMRIS B8 is a company specialized in interior design and furniture solutions in four main segments: office, learning, hospitality and care. Part of their business model, operated by HOLMRIS B8 Circular, involves collection and refurbishment of used furniture.

Main Strategy: Product-life extension, Take-back and Cascading

Figure 10: Changing frames is part of the refurbishing process of furniture conducted at HOLMRIS B8 circular. Source: Jan Jul Søndergaard

Circularity of business model:

The circularity of HOLMRIS B8 Circular is based on slowing material flows by prolonging the use-life of furniture. They accomplish this in multiple ways, including: 1) extend the life of the furniture of their own customers through refurbishing services 2) acquire (or even purchase) used furniture, which then is refurbished and re-sold. What cannot be sold, is donated through their own network of charity organizations network and 3) offer a rental option for working stations or temporary office solutions. In addition, they close material flows by sorting and preparing for recycling the furniture that is unable to be sold or donated. This prevents valuable resources, such as metal and wood, from being landfilled or incinerated.

Other benefits:

The CBM operated by HOLMRIS B8 Circular brings about multiple benefits to the different customer than can be engaged through their activities. The main ones are:

1) Customers wishing to purchase refurbished furniture get an opportunity to access high quality furniture at a lower price compared to market standards.
2) Customers wishing to get rid of old furniture save on collection and disposal costs. They can even get some money for their old furniture, if it still has a high residual value. Furthermore, additional costs savings can be achieved when combining logistics of moving in new furniture and moving out old furniture. These customers also get an environmental report that describes the handling process and destination of their disposed furniture i.e. what is resold, what is donated and to whom, as well as how much is send for recycling.
3) Customers who would like to extend the life of their used furniture save costs and resources by changing upholstery or other modifications instead of purchasing new furniture.
4) Social benefits for organizations who are recipients of donated furniture, since they can improve the physical conditions of their working spaces without using their limited financial resources. This also avoids potential landfilling or incineration of furniture.

> "The other part is of course people who buy the used furniture, and I think for a lot of those they are smaller companies who don't have a lot of money so it's cheaper for them to buy used, because is normally half price or less, compared to a new furniture. And the quality is just as nice."
> Heidi Simone Kristensen, Industrial PhD at Holmgris B8 Circular"

Main Barriers:

Collecting furniture presents difficulties, particularly when this is very diverse. The more homogenous the furniture is collected, the

easier it is to manage it. Furthermore, limited warehousing capability presents a barrier, which in addition to their objective of minimize unnecessary transportation of used furniture, pushes HOLMRIS B8 circular to find a suitable purchaser of the refurbished furniture as soon as possible.

In terms of dealing with pre-owned furniture, the lack of information on the components (e.g. wood) of tables makes it difficult to meet strict standards from some markets, for example, public tenders. Since some requirements require a complete disclosure of all elements in the furniture, a task that in some cases is impossible for re-used furniture. Lastly, trends in design also increase difficulty for refurbishment, for example, color of the wood or size of desks has changed considerably in recent years.

Case: Sajkla

Country: Sweden

Description: Sajkla is a company focused in creating a stop-stop shop for reconditioned furniture. They do so by providing multiple services, like consultancy, retail space, education programs, storage and transportation. They also facilitate the interaction between users interested in refurbishing furniture and potential suppliers.

Main strategy: Eco-sufficiency, market creation and take-back.

Figure 11: refurbishing process of a chair. Photo provided by Sajkla

Circularity of business model:

Sajkla slows down material flows by facilitating the life-extension of furniture. They follow various strategies. For example, they encourage their customers to reduced their consumption of new furniture and instead based on inventory analysis, advise them in regards to the potential of their furniture to be refurbished. In some cases, they can acquire furniture directly from users, refurbish it and re-sell it through their website.

Furthermore, through their digital market, they connect users interested in refurbishing their furniture with their network of suppliers capable of conducting high quality renovation works. They allow users to upload pictures and information of their furniture and return them a quote from their network of suppliers. Their website also functions as a retail center for refurbished furniture where customer can purchase from a pre-defined selection.

Other benefits:

Sajkla is located in a small region of Sweden, with a long tradition of furniture handcraft, where multiple furniture suppliers, capable of conducting refurbishing work, are grouped closely. This allows them to draw from different expertise in terms of the type of furniture expected to be refurbished. Furthermore, by developing the remanufacturing market alongside with original producers, it also allows them (the suppliers) to understand how to design new furniture that is easily refurbished in the future.

"When we see an old chair we think: *how can we make this look current, contemporary and nice again*? Because If you can make something look *right* for this time, then you are loading this old material with value again. A value that is even greater than the one from a new new chair. Because everyone wants to do something for the environment". Jenny Ekman, Co-owner of Sajkla

By facilitating and developing the market of refurbished furniture, they benefit both potential buyers of refurbished furniture but also current users of furniture interested in refurbishing and not purchasing new. Furthermore, this incentivizes a segment of the industry (re-manufacturing) which is characterized by labour intensive activities, compared to the production of new furniture.

Main Barriers:

The public sector focuses on specific labels for furniture (e.g. Möbelfakta in Sweden) granted based on quality, environmental and social aspects. However, this standard automatically excludes the potential of purchasing refurbished furniture because of the impossibility to track down all the materials included in the old piece

of furniture. Not only that, it also makes it impossible for the public sector to also refurbish their own furniture.

Besides regulations, there are cultural barriers for the use of refurbished furniture, for example, some people might still associate them with old furniture. Lastly, there is limited information and marketplaces specialized in refurbished furniture

iv. ICT Equipment

Electric and Electronic Equipment (EEE) is a broad category that includes anything with a plug, battery or electronic cord. EEE has multiple subgroups, such as temperature-exchanging machines, lamps, white goods etc. In the context of this report, the focus is on equipment related to information and communication technologies (ICT). Products in this subgroup include most of consumer ICT equipment that can be found in average offices and households, including mobile phones, desk computers and peripherals (e.g. mouse, keyboard, memory sticks, etc.), laptops, printers, photocopiers, modems, screens, mobile phones amongst others.

Waste derived from Electric and Electronic Equipment (WEEE) is the fastest growing waste stream in the world and only about 20% of it is collected and recycled under appropriate conditions; the remaining 80% is either dumped, landfilled or treated in substandard conditions (Meloni, Souchet, and Sturges 2018). From this waste stream -estimated to have reached 50 million tons in 2018- about half of it are personal devices, such as computers screens, smartphones and tables. This particular kind of waste stream is not voluminous, yet it can be highly toxic due to the multiple hazardous chemicals and metals included in it. At the same time, these same materials, which are often limited in nature, make it one of the most valuable waste streams: it is estimated that 8% of gold, worldwide, is contained in wasted electronics (Bel et al. 2019). Value in the materials and components that make of ICT equipment can, in some cases, be more than €300 (Meloni, Souchet, and Sturges 2018).

A CE perspective highlights that the largest residual value resides not in recovered materials and components (e.g. screens, batteries) but as a full functional product (e.g. mobile phone). This product value is partly determined by the functional state of the product but also on the user's perception of it. This perception of value can be a complex assessment considering there are multiple factors, besides proper functionality, that determine if a user perceives a mobile phone as valuable (Wilson et al. 2017). Another problem with keeping ICT equipment at its highest value is that ICT equipment in particular is susceptible to "hibernation" which describes the state of unused products, stored at households, which have the potential of being refurbished and have a second-life, but remain inaccessible for organizations capable of treating them (Bel et al. 2019).

Therefore, in order to keep the WEEE stream from growing, it is necessary to preserve the value of ICT equipment, in its highest potential (as full products) in the economy. While re-use statics are unclear, some types of products, for example modems and printing cartridges, are successfully collected and re-used based on circular business models in which the manufacturer retains ownership and responsibility for the product (Meloni, Souchet, and Sturges 2018). Yet, for other consumer ICT equipment there is multiple barriers that prevent their widespread re-use; including, unfriendly design towards repair; regulatory barriers; market inefficiencies; unwillingness of consumers to accept 2nd hand products and difficulties to access acquire unused, yet functional, products that could feed into the 2nd hand market (Meloni, Souchet, and Sturges 2018).

In this section, the business models presented deal with prolonging the use of ICT equipment, avoiding its premature disposal and guaranteeing a responsible end-of-life treatment.

Code	Main Activities	Brief description	Circularity Strategy											
			Design			Production		Use				Recovery		
			Circular Product Design	Eco-sufficiency	Market creation	Industrial symbiosis	Secondary Raw materials	PSS	Product-life extension	Take back	Cascading	Parts Harvesting	Biological Recovery	Recycling
ICT Equipment														
F10	Refurbish / Retail	Purchase of used mobile phones, refurbish and retail on their website								X	X			
D9		Purchase of (organizations) used ICT equipment, refurbishment and retail								X	X			
D16		Refurbishment of (coorporate) ICT equipment								X	X			
F3	Service provider / refurbish / retail	ICT equipment rental, leasing or purchasing. Maintenance service provided						X	X	X	X			
N9		Manager of ICT-equipment for organizations. Services focused on leasing equipment through contracts with users.						X	X	X	X			
S3	Financing / Service provider / refurbish /retail	2nd hand ICT purchasing, upgrade and retail						X	X	X	X			
F1		Full ICT asset manager including, financing, service and maintenance, renewal and leasing/retail of used ICT equipment						X	X	X	X			
N3	Recycling	Mobile phone collector in developing markets										X		

Table 6: Cases analysed in the category group of ICT equipment

Purchase, re-sell and more

Purchasing used ICT equipment in order to refurbish and resell it is a common business model in this product category, however there are nuances that differentiate between cases.

- **D9** specializes in purchasing used ICT equipment from organizations, refurbing it and then selling it through their website. They refurbish these products, a process that includes data cleansing, parts replacement and software upgrade –the latter taking place under an official license from the software provider. They rely on their own grading system of re-used products in order to help their customer understand the quality level of the re-used product. Most of the products they sell are laptops and desktops computers; however, they also deal with peripherals (e.g. screens and keyboards) and specialized components (e.g. power supplies, memory cards).
- The business model of **F10** is similar, since they also purchase used ICT equipment, refurbish it, help customers with their own grading system and resell it through their online platform; nevertheless, they deal only with mobile phones and not a broad range of consumer ICT equipment. Secondly, they accept equipment from private users; they do so through a reverse logistics system that facilitates collection and delivery.
- For their part, **D16** displays some unique characteristics**.** Firstly**,** their focus is dealing with professional and not consumers ICT equipment. They specialize in guaranteeing certified data wiping and responsible handling of equipment once it reaches a point beyond recovery. Professional ICT equipment is a different market; for this type of customers, access to spare parts, such as mother board or other specialized components it's important, therefore, they also offer a hardware management agreement with guarantees their customers supply of spare parts. This is particularly useful for products and components that are no longer produced by major manufacturers.

Renting and leasing

Some companies keep a close collaboration with their customers through agreements which allows them to keep track of their customers' needs and provide additional services to them; For example **F3**, not only do they sell products, they offer services such as conducting need's assessments or provide maintenance service. This close interaction also allows companies like F3 to lease or rent their used equipment and collect it after the contract ends. In fact, some companies like **S3** offer flexible rent schemes, in which throughout a contract period, for example, 3 years, the company guarantees to their customers they will have functioning

Renting and leasing can be options that some companies offer, however in some cases; enterprises only operate under this model. This is the operational logic of **N9**, an organization focused on responsible ICT equipment management, particularly computers and laptops.

Value from waste

A different CBM in this category group is related to the capturing of potential value in the form of materials or components from waste streams. This is the bedrock of the model of **N3**, which offers a "material off-setting service" to their customers. This means that, for a small fee, they will collect and guarantee the proper recycling of a second-hand mobile phone in Africa on behalf of their customers

in Europe. In this way, customers in Europe can enhance their environmental performance by supporting circularity actions in developing countries.

Life-cycle-management

F1 offers a holistic approach of ICT equipment management for organizations. Their services allow their customers to acquire, manage and refresh new ICT equipment; in addition to also guarantee that, their used ICT equipment will be refurbished and re-used through leasing contracts. These services are facilitated largely through their multiple digital solutions that allow a close monitoring of all their equipment.

The business model begins with F1 facilitating the financing for acquisition and renewal of ICT for their customers. After their leasing period expiries, F1 collects this equipment, refurbishes it and re-sells it. They also collect used ICT from external users. If used ICT equipment is unable to be given a "next life", it is harvested for valuable spare parts and eventually sent to recycling. Their geographical scope of activities is transnational; consequently, they collaborate with local and national organizations for refurbishing, re-selling, part harvesting and recycling.

Case: Inrego

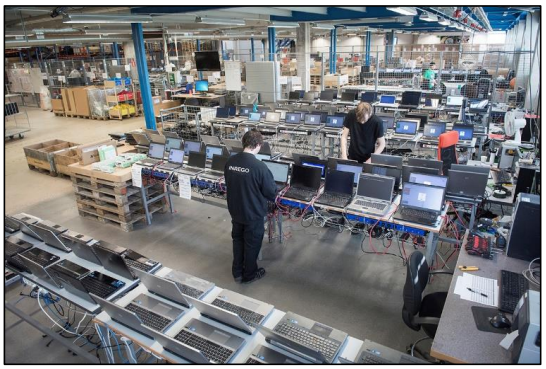

Figure 12: View of the testing and data erasing line at Inrego. Image provided by Inrego

Country: Sweden

Description: The business model of Inrego consists in purchasing used ICT equipment such as laptops, desktops, screens, mobile phones, network equipment, server printers etc. Afterwards, they refurbish it, clearing all the data it contains and re-selling it, leasing it or renting it to new customers.

Main strategy: Product-Service System, Product life extension, Take-back and cascading.

Circularity of business model:

Inrego slows down material flows by purchasing ICT equipment from users that consider them as waste or no longer useful. Once they acquired this equipment, they prevent its disposal by refurbish it and keep it in the economy at a high-value level.

This business model also slows down the flow of ICT equipment through the economy, by leasing and renting equipment to their customers, which allows the company to have control of their equipment and guarantee its proper maintenance. Furthermore, they can target different markets (in level of quality expected) which reduces the chances extracting the most value from products before they are disposed.

Other benefits:

Inrego provides customers that are interested in a non-new ICT equipment an opportunity to acquire this type of products, either as a sale or a rental or leasing agreement. This prevents the demand for new equipment, and hence, extraction of virgin raw materials for their production. Furthermore, by purchasing used equipment, it provides an opportunity for organizations to responsibly disposed their used equipment.

"We have been able to win a few tenders with progressive municipalities that have put in the effort on tender design in order to give refurbished ICT equipment a chance to compete". Erik Pettersson, Environmental Manager/ Circular Innovation on Inrego

They can also collaborate with manufacturers and make synergy contracts in which Inrego can guarantee a buy back of a certain amount of equipment after a period of time. This provides certainty to the manufacturers of an expected return value after three years which they can use to provide a lower price offer to their potential customer.

Main Barriers:

One of the barriers they face is that organizations (which are their suppliers of used ICT equipment) do not have the proper systems or resources in place to collect, store and sell their used ICT equipment to companies like Inrego. Furthermore, some organizations still show a resistance to service (rental/leasing) agreements, based on biased (short term) notion of purchasing being a better option.

Participating in public tenders can also be challenge. Some of the barriers include misconception from municipalities about not being able to purchase non-new ICT equipment; additionally, some

specifications put in the tender can only be met by new equipment, essentially blocking refurbished ICT suppliers. Furthermore, even when re-used framework contracts may be assigned, Inrego has experienced that users inside the municipality might not be aware or them or lack incentives for requesting refurbished ICT equipment.

Case: Recover-E

Country: Netherlands

Description: Recover-E is foundation that offers a program focused on recovering, reusing and recycling old used ICT equipment. They acquire equipment from an organization and guarantee their re-use and eventual recycling, all the while tracking and monitoring their physical and financial value.

Main strategy: Product-Service System, Product life extension, Take-back and cascading.

Figure 13: Official logo of recover-e

Circularity of business model:

The business model of Recover-E is able to slow the flow of ICT equipment, preventing its premature disposal as well as guaranteeing its control (close flow) once it has reached a stage where is no longer valuable and guarantee its recycling. Their operations rests in two pillars:

1) They enter into collaborations with their customers through medium term contracts (4-5 years) in which they guarantees that their used (and depreciated) ICT equipment will be responsibly re-used in the future. The contract collaboration includes labeling and tracking of equipment across their life-cycle; data wipe and refurbishment after collection and preparation for recycling of obsolete equipment.

2) Once the used ICT equipment has been acquired by Recover-E, they offer it through their web shop to other customers through leasing contracts. This 2-year lease includes service and replacement in case of malfunctioning while the contract is valid. After the expiration of the contract, the user is free to send it back and get a refund of €50 or keep it, only without the guarantee service. In this way, they can guarantee that their original consumers ICT equipment is used and kept in best state as possible, and not treated as waste in unknown conditions.

"Our goal is to maximize re-use of ICT equipment, not profit…we guarantee to our partners a responsible destination of their products…We aim for re-use and eventually, recycling with our established partners in Western Europe and do not export products to markets where are unable to monitor our equipment". Jan-Paul Kimmel
/ Team member at Recover-E

Other benefits:

Recover-E can be considered as an ICT-equipment broker and it is from this position that they can carry on their activities without facing some of the largest structural barriers that other actors in the supply chain face. For example, manufacturers may be reluctant to promoting re-use of equipment due to the risk of cannibalizing their own sales. Conversely, waste managers, are not allowed, per regulation, to pursue a second life for any used ICT equipment they acquire.

Main Barriers:

Compared to other ICT brokers constituted as for-profit which are ruled by market dynamics (supply and demand), Recover-E cannot guarantee a maximum commercial value in return to the used-ICT equipment to organizations. Their value offering resides on maximizing re-use, therefore, if cost is the only consideration, they are unable to compete in some cases with traditional ICT equipment brokers.

V. Clothing and Textiles

The textiles industry is involved in the sourcing and production of natural and synthetic fibers, including the various sub processes like spinning, weaving and dying. This industry requires inputs from petroleum and chemical industry, particularly for yarn production and fabric processing and relies on global logistics, since the supply chain of textiles has spread across the globe (Fontell and Heikkilä 2017). The main use of textiles is as raw material in clothing and apparel, which is in charge of the fashion industry (ibid).

Textiles, however, are not only used in clothing, they also make up rugs, covers, curtains and some are considered as "technical textiles" which may include: specialized clothing like health and safety equipment, construction components (i.e. insulation panels); or remediation and pollution control (i.e. chemical spills). These have functionality, and not aesthetic design, as their main feature (Franco 2017).

Worldwide, the textiles and fashion industry are on the rise. In the last 15 years, clothing production has doubled and since 1996 the volume of clothing purchased per capita has increased by 40% (Hemkhaus et al. 2019). This indicates that clothing demand is not only increasing due to population increase, individual consumption has also increased. Consequently, an increase in the significant environmental impacts related to the textiles industry has followed (Fontell and Heikkilä 2017). The industries' main impacts are associated with water use, greenhouse gas emissions and chemical use and discharge (WRAP 2017), and lately, due to an exponential growth of the use of synthetic fibers, release of micro plastics to the environment (ten Wolde and Korneeva 2019).

From a material flow perspective, it is estimated that 80% of clothes end up incinerated or landfilled; 12% is cascaded for other uses and only 2% is recycled and reintroduced into the production process as secondary raw materials; the rest is lost as leakages at multiple stages of the supply chain (Hemkhaus et al. 2019). This highlights the need to increase the circularity of the textiles industry, with multiple areas of improvement including collection, re-use and recycling.

Trending towards circularity?

Despite industry efforts to reduce environmental impact of their activities (e.g. development of sustainable fibers, low-impact technologies used in production of garments), the exponential increase in consumption of textiles offsets these environmental gains (WRAP 2017). In other words, minimizing the environmental impact of the textile industry cannot be a based on a manufacturing process fix, but instead requires the involvement of designers, retailers, customers, and those involved in re-use and recycling activities (WRAP 2017). Recently industry associations have recognized the need for further action closely aligned with circularity principles, including setting targets for product design for cyclability, garment collection and re-sell and use of recycled post-consumer fibers (Global Fashion Agenda 2018).

Code	Value Chain position	Brief description	Circularity Strategy											
			Design			Production		Use				Recovery		
			Circular Product Design	Eco-sufficiency	Market creation	Industrial symbiosis	Secondary Raw materials	PSS	Product-life extension	Take back	Cascading	Parts Harvesting	Biological Recovery	Recycling
Textiles and Fashion														

F7	Design/Retail (clothing fashion)	Artisanal manufacture of bags from leftover materials from various industries. The products transparency DNA code allows tracing materials and labour.	X				X							
F4	Design, Retail (indoor textiles)	Indoors textiles company with organic and fully recycled products made from collected bed-sheets and jeans	X				X			X		X		
R6 L2	Retail (clothing fashion)	Second-hand charity shop								X	X			
S2	Retail/Service provider (corporate textiles)	pay-per-use clothing	X					X						
N10	Manufacture and retail (corporate clothing)	Clothing design and management	X				X			X				X
N6	Manufacturer/Chain Manager (corporate clothing)	Design, manufacture and function as a "chain manager" between stakeholders in the textiles industry by providing a tracking and tracing system for clothing	X				X			X				X
D14	Manufacturer/Retail	Buy-back, rental agreements on leather jackets. Also upcycling of old jackets and parts harvesting	X				X	X	X	X				
F2	Manufacturer/Recycler (technical textiles)	Using a mechanical recycling process, the company transforms the textile materials back into fibres and uses these to manufacture new materials and products for various uses					X							X

Table 7: Cases analysed in the category group of textiles and fashion

Recycling (and its limitations)

The two main fibers used in the industry are polyester and cotton, with the polyester surpassing and almost doubling in use compared to cotton, since 2005. Recycling of textiles can take place in an open or closed loop, depending on where the recycled material is used; namely, inside the fashion

industry or in parallel sectors (Hemkhaus et al. 2019). However, the used of secondary raw materials has some critical limitations.

Recycling of polyester is achieved through chemical processes, however it is mostly limited to mono-fiber garments, which today are not the predominant in the market; consequently, recycled synthetic fibers are mostly originated from other waste streams such as PET bottles. However, this brings its own complications due to content of hazardous chemicals. Additionally, technologies for production of secondary synthetic materials require large capital investment that places recycled fibers and virgin ones at the same price level.

In turn, cotton is mostly recycled through mechanical processing which damages the quality of the material. This leads to most natural fibers (70%) not being recycled for clothing production but rather down-cycled as components in insulation, industrial cleaning cloths etc. (Hemkhaus et al. 2019). Such is the case of **F2** that uses a mechanical process that transforms surplus materials from the Northern European textile industry into fibres that are used then to manufacture, in Finland, new products for various uses related to industrial maintenance, environmental clean-ups amongst others.

Design and material choice

The largest ecological impact of textiles takes place at the sourcing and manufacturing of fabrics (Sandin and Peters 2018). Not surprisingly, several business models emphasize material selection as a way towards reducing their ecological footprint. For example**, F7** circularity is closely related to the design of their products and the choice of materials. They base mostly their manufacturing process on secondary raw materials such as regional recycled leather, salmon skin, cut-offs from the furniture industry, amongst others. Additionally, they manufacture in an artisanal manner at a workshop in Italy. This allows them to track every component of their products, including the person who worked with them, providing what they call a "Transparency DNA".

Similarly**, F4** circularity is also focused on design and material selection. Their design facilitates the recycling stage since 90% of their products are mono-material- made exclusively from cotton. Furthermore, they emphasize using organic, fair-trade cotton and linen or recycled fibers-both natural and synthetic. Besides material selection, they also are involved in take-back of their own products and collection campaigns for jeans, which they are sent for recycling with a partner company and used for producing unique products with almost 100% recycled material.

For a different market -corporate fashion- **N10** uses a similar strategy, focusing on use of recycled fibers (natural and synthetic) in the production of the corporate garments. Furthermore, they collect directly from their customer' old clothing and send them to recycling partners; which then form part of their supply of recycled fabrics to manufacture new clothing.

Local and regional re-use

Overall, across the EU, collection and re-sell of clothing is increasing -which is encouraging since it has the potential to have a positive environmental effect[3]. Regardless, second-hand clothings remains a marginal share of the total purchasing of clothing –around 9%- even in countries like Denmark which have one of the highest collection rates of textiles (44%) and where second-hand shopping is socially accepted (European Environment Agency 2018).

[3] as long as a) it substitutes purchasing of new clothing; b) the use-life is similar to that of new clothing and c) the system is not powered by fossil fuels (Sandin and Peters 2018).

However, cases such as **L2** and **R6** display a strategy aimed precisely addresses this issue. Their operational model is focused on collection of clothing from consumers, once they reach a point where clothes are no longer useful for them. This generates avoids functional clothing to be unnecessarily disposed or incinerated and at the same, once this clothing is collected, these organizations can carry on economic activities like repair and re-sell or direct donation.

These organizations both have an organizational structure as a non-profit. Operationally, both cases display a wide collection network (one across Latvia and the other across St. Petersburg respectively) which facilitates the donation of clothing articles by citizens. Furthermore, they both sort manually the incoming clothing to identify what is suitable for donation, repair or re-sell.

They both have their own selling points, but also part of the stream is directly donated to partner organizations. Furthermore, as non-for profits, the revenue generated from sales, after covering operational costs, is donated to other charity organizations with different goals. Overall, organizations like these to nurture practices like local donation, household repair and maintenance.

It is important to emphasize the importance of local or regional donation schemes compared to transnational export of used textiles. Exporting used textiles into developing markets brings some economic activity to the importing region and deals with the "waste problem" at the exporting countries; however, it also hinders local textile industry in the importing regions and creates environmental problems; especially when the infrastructure is not adequate to manage the clothing that ends up as waste. Due to these conditions, countries in the east African community (traditional recipients of collected textiles from Western Europe) have essentially banned imports of used-textiles starting on 2019 (Fontell and Heikkilä 2017).

Pay-per-use textiles

Product service systems is one of the most closely business models associated with the CE. In the textiles industry, **S2** presents the perfect case of applying this model in a Business-to-Business context. They provide access of work wear clothing for multiple industries (i.e. hospitality, healthcare) through a rental scheme. Additionally, they outsource cleaning and maintenance services for their own clothing and other indoor textiles, such as mats, mops and linens. This operations hold significant environmental value, since cleaning and drying are a stage in which the carbon footprint of textiles can be significantly reduced (WRAP 2017).

Take-back schemes and other incentives

In order to reduce the 80% of clothes that end up incinerated or landfilled, increasing collection capacity is crucial. This involves both infrastructure from waste management sector (i.e. improve collection and sorting) but also new business models from retailers which incentivize take-back of garments (Hemkhaus et al. 2019). For example, **D9** operates a business model of mostly leather jackets in which they offer a buy-back guarantee that is paid as 50% discount in the purchase of a new jacket. In this way, D9 makes sure that they can take advantage of the large residual value that used leather jackets have, since this type of product (and material) can be repaired re-used in new models with ease.

On a different strategy, **N10** performs a function of "chain manager" whose role is to track and trace clothing products across their lifetime. This facilitates their collection and the knowledge of the specific fabrics which they are composed off, both being crucial elements for a more efficient recycling.

Case: Better World Fashion

Figure 14: Recovered leather being re-worked into a new product. Image provided by Better World Fashion

Country: Denmark

Description: Better World Fashion manufactures leather goods such as jackets, bags, oven mittens, computer bags etc. based on recycled leather. All their leather jackets include a buy-back guarantee when purchased. Additionally, they have short-term rental (4 months) and leasing model (24 months) for their jackets.

Main strategy: Product-Service System, Product life extension, Take-back.

Circularity of business model:

Better World Fashion is able to narrow the material flow of by relying almost entirely on pre-owned or recycled leather to produce a broad range of leather-based products. Furthermore, they slow down the flow of leather through the economy keeping ownership of their jackets through their rental and leasing systems, which allows them to retain their products at the maximum potential value in the economy.

They also help closing resource loops by purchasing old leather garments from NGOs and other users. In addition, the buy-back guarantee, that all of their jackets include. Incentivizes their customers to return their products once they are no longer considered useful for them. This allows Better World Fashion to re-use the leather in other products.

Other benefits:

"The world needs something new. Not new things, but new ideas. Better World Fashion is a new idea. We are revolutionizing the way we produce, sell and own clothing." -first paragraph of the Better World Fashion Manifesto available at their website (own translation).

Their business model provides benefits to multiple stakeholders. Firstly, they help satisfy the demand for leather jackets without increasing demand of virgin materials that in itself, brings about an environmental benefit. For their environmentally conscious customers, they are able to access leather jackets that have a significantly lower environmental impact. Additionally, their financial models allow new customers to try a luxurious article such as a leather jacket without the large financial investment required.

Furthermore, they provide an income stream for NGOs that are focused on collecting used garments, similarly to users with un-used leather products at home.

Main Barriers:

The main barriers or disadvantages that Better World Fashion faces is difficulty in competing with the price level that their competitors are able to offer. They understand the traditional modus operandi of the fashion industry is based on environmental and social exploitation that allows bringing down prices. Therefore, the decision to improve their production processes in terms of environmental and social protection makes them more expensive to produce.

vi. Miscellaneous

This section includes business models that were hard to precise to a category group or there were not enough similar cases to provide a general overview of the industry. Nevertheless, they provide an example of the broad scope in which circularity can be used as a business model.

Code	Main activity	Brief description	Circularity Strategy											
			Design			Production		Use				Recovery		
			Circular Product Design	Eco-sufficiency	Market creation	Industrial symbiosis	Secondary Raw materials	PSS	Product-life extension	Take back	Cascading	Parts Harvesting	Biological Recovery	Recycling
Miscellaneous														
R8	Remanufacturer	Extending the life of ships and vessels through a variety of maintenance and service interventions							X	X		X		
L1	Service provider	Company offering a holistic "pay-per-drive" model to users, facilitated by a mobile application which tracks automobile booking, registration and use						X						
R3	Online Market	Online platform for consumer-to-consumer interactions, focused on rental of consumer products			X									
P6	Recycler	Innovative end-of-life treatment of tires which is able to generate three valuable by-products and avoid incineration or landfill												X

Table 8: Cases analysed that were considered as miscellaneous and not fitting in the previous category groups

Starting with **R3**, an online market that facilitates rental transactions amongst citizens in the large cities in Russia (e.g. Moscow, St. Petersburg). They offer a platform that allows users to become renters or to rent various consumer articles such as clothing, sports equipment, power tools etc. The site automatizes the rental process and the management team function as a mediator to help resolve disputes. This type of digital markets make renting easier (improving market efficiency) which can lead to more intensive use of durable products. Intensifying the use of products can bring environmental benefits if the rented products substitute the purchase of new ones, however, if they simply increase consumption which was previously inaccessible, it might be resulting in a rebound effect (Zink and Geyer 2017).

Also related to intensifying the use of a durable product, **L1** offers short-term car-rental service (Business-to-consumer) in Latvia. The company serves both individual and corporate consumers; with the latter being able to enter in a contract agreement. L1 business model is based on providing users to access to drive any of the available automobiles of the company's fleet. Users, after registration, pay a single fee that covers all costs including fuel, insurance, maintenance and parking. L1 facilitates

the rental process through their own mobile application that monitors and tracks the use of their automobiles.

From a CE perspective, recycling is considered, as a last resort option only after prolonging the use of products is no longer possible. However, in some cases, there is no other solution. Therefore, business models like **P6** provide a valuable contribution by handling end-of-life tires through their technology of continuous pyrolysis. This recycling strategy allows them to produce three by-products: gas, oil for rubber production and carbon black. Through this process, P6 is able to recover valuable raw materials which otherwise would be lost through traditional end-of-life treatments such as incineration or landfill.

Case: Ship technical service Ltd., Novorossiysk

Figure 15: Recovered ship being repaired. Image provided by Novorossiysk.

Country: Russia

Description: Novorossiysk is a project-based company specialized on extending the life of ships and vessels through a variety of maintenance and service interventions. They have competences with dry cargo ships, tankers, ferries, tugs, floating cranes, barges, catamarans, yachts, pontoons and passenger ships.

Main strategy: Product-life extension, Take-back, parts harvesting

Circularity of business model:

Novorossiysk slows down the flow of ships and vessels in the economy by means of multiple service interventions such as 1) maintanance and repair of main and auxiliary engines, diesel engines, generators, electrical equipment or 2) refurbishment of ships and vessels by replacing of worn-out components with parts newly purchased or manufactured in-house. Including full restoration of ship hulls.

They also close material loops by purchasing wasted ships and other equipment and restoring them to a functional state. Then, this equipment is either used in-house in the companies' operations or re-sold to customers. Furthermore, they specialized in part harvesting from ships and vessels before being disposed as metal scrap.

"Traditional approaches are used by large enterprises such as car factories, shipbuilding and aircraft factories, the purpose of which is the creation of new machines. Our job is to repair equipment that has been used for a long time, and restore its performance. It happens: some build, others repair." Vladimir Vinogradov / Deputy Director at Novorossiysk

Other benefits:

Their capacities to repair and refurbish old wrecked ships allowed Novorossiysk to build up their own fleet of boats that diversify their potential business activities (i.e. water transport, transport specialists, crewmembers etc.). Overall, their fleet helps their business become more sustainable during periods of decline in ship repair orders.

Furthermore, working with multiple types of wrecked ships, vessels and equipment has developed Novorossiysk into an agile company which is capable to adapt and work with different equipment, even outside of the shipping industry, for example special equipment in the construction of wind farms. Traditional manufacturers are bounded to their specific trade, for example making new ships. This agility has also helped them develop a positive reputation in a context where burocracy and red tape characterizes business transactions.

Main barriers:

As expected for project-based business models, it is a challenge to secure constant orders and contracts. However, this barrier has been partially addressed by expanding their business activities into other economic activities, facilitated by the ship and vessel fleet they have developed.

IV. Conclusions

The objective of the research was to provide an overview of the alternative business models currently available in the Baltic-sea region market suitable for a circular economy and recommend alternative business models and partnerships suitable for public procurement. In the following section, a brief overview of each category group is provided followed by recommendations related to the role of public procurement can have in order to promote the development and make the most of on the strengths from the available CBM.

Food and food-based products

Based on the enterprises analysed in this category group, it was possible to identify multiple CBM that are viable in the current context. These can be arranged in three major groups:

- Circulation of secondary and waste flows amongst different actors in the supply chain. This not only reduces the amount of waste food, but it represents the foundation of CBM which are able to capitalize on the residual value of these flows and use them as secondary raw materials.
- The creation of secondary markets at the retail and food service level. This approach of CBM is based on enhancing (or if necessary, creating) a market place, either digital or physical, in which different actors (suppliers and consumers) can trade on secondary or waste flows since the main distribution channels (wholesalers, retailers, restaurants) deal mostly on class I produce.
- Modifying consumer practices. This last group is important since it bridges supplier's actions with consumer practices. Particularly in the context of the EU, where consumers at the household level are the number one source of food waste, CBM that engage directly with influencing consumer behaviour, for example by allowing consumers to buy in bulk, or providing information on waste-minimization techniques, are greatly required

Based on data collected in this research, the following considerations can be taken by public procurement departments in order to promote and make the most out of the strengths from the available CBM:

- Consider the amount of packaging used in the supply of catering or canteen services and push towards bulk delivery, zero packaging and container take-back from suppliers. Particularly on catering events when single-serving items are mostly used
- Consider the amount of wasted food generated, either from catering events or daily canteen activities and engage with organizations that are willing to rescue and redistribute the leftovers.
- Consider accentuating cooking and conservation techniques that reduce the generation of food waste at the preparation stage
- Consider the separation of organic and inorganic waste.
- Consider treating organic waste in a way in which nutrients are recovered or in case is not possible, energy is recovered.
- Consider allowing internal clients (users of canteen and catering services) to decide on portions and engage them with food-waste prevention campaigns.

Built Environment

Overall, the built environment is a very diverse sector and it would be difficult to provide a full overview of all the circularity activities taken place in it. However, taking the cases analysed and grouping them following the model introduced in figure 6, four main types CBM can be identified:

- Construction services: Focused on connecting construction and demolition through the creation of a market for secondary construction materials, matching demolition waste with construction sites in the same region. Furthermore, actual construction project development with designs based on available materials, including wasted materials available in the region and site.
- Construction supply: enterprises in this sector focused on supplying specialized components including carpeting, luminaries and insulation panels. These CBM highlight that circularity at a facility level is influenced directly by the circularity at each of its components. Furthermore, from an operation management perspective, two product-service systems arrangements were identified, offering lighting and signage as a service.
- Renovation: Two CBM where identified particularly in renovation of lighting fixtures. These highlight, that existing infrastructures can also be suited for circularity interventions.
- Demolition and Recovery: two cases addressed circularity at the end of life of infrastructures. One, recovering bricks from demolition of houses and buildings and the other, recovering raw materials from artificial turf facilities through a specialized recycling technique.

Based on the information obtained, the following considerations can be taken in public procurement in order to promote the development and make the most of on the strengths from the available CBM:

- Consider flexible designs for new infrastructure that are open for changes based on regionally available materials.
- Consider renovation of internal components -for example lighting fixtures- before purchasing new components.
- For internal components with a medium-time life span like carpeting and panels, consider take-back options. This can be in the form of pay-per-service contracts in which the supplier retains ownership, or contract clauses that guarantee collection and re-use.
- Consider selective demolition and components recovery for contracts dealing with end-of-life infrastructure, including innovative recycling techniques that allow recovery of valuable raw materials.

Furniture

The CBM in the furniture group include cases with different scopes and market segments. Some of the cases focus on the so called “contract furniture”, which involves larger volumes in the context of hospitals, education institutions, offices and the public sector in general, whilst other focus on “private” furniture, which is design oriented, handcrafted and unique. The circularity strategies used in each sector differ; specifically contract furniture cannot depend on waste flows (since they do not provide reliability for their volume of production) but instead focus on used-product flows, particularly from organizations.

Some cases focus on single aspects of circularity such as a) material selection and chemical avoidance, b) incorporation of waste as raw materials or c) the development of the re-manufactured furniture market. A more holistic approach was presented with two CBM, both of which in addition to designing and manufacturing long-life and modular products, they collect and take-back furniture, which allows them prolong the use-life of furniture (i.e. refurbishment) and re-sell them after the initial customer no longer desires to use them. Furthermore, one case describes a company where full office furniture management is offered based on service contracts that cover all stages from design, (re)manufacturing, maintenance and take-back.

Based on the information obtained, the following considerations can be taken in public procurement in order to promote the development and make the most of on the strengths from the available CBM in the furniture sector:

- Consider if the needs of furniture can be satisfied by re-furbishing of existing furniture instead of purchasing new.
- Consider using recovered (waste) materials in the manufacturing of furniture, particularly for small-scale projects.
- Consider collaborating with organizations that can facilitate donation of existing furniture in case new furniture is expected to be purchased.
- Consider if it is necessary for the public organization to own the furniture or if the supplier can keep ownership of it and only guarantee functionality.
- When arranging for suppliers to take-back or buy-back furniture after a certain period of time, consider contract clauses that make sure that the furniture is not disposed but instead repaired if possible and given a second-life.
- Consider identifying functional requirement such as “working area for X amount of persons” instead of focusing on requesting specific pieces of furniture (e.g. Y amounts of desks and a Z amount of chairs).
- When purchasing new furniture consider the following:
    - Materials used in its manufacturing process particularly wood, textiles and metals
    - Dyes and adhesives used in its manufacturing
    - A modular design that can allow repair, replacement and dis-assembly of the furniture at the end-of-life period

ICT Equipment

Overall, the CBM analyzed in this category are focused on preventing the premature disposal of ICT equipment. They rely on capturing the residual value of used equipment by acquiring it or purchasing it from organizations and private individuals; then preparing it (i.e. refurbishment and data wiping) for future consumers. The companies whose market are private consumers rely on rating systems which facilitate communication of quality standards and overall increasing the efficiency of the market. Some of the cases display a close collaboration with users that allows them expand their financial schemes, from single purchasing, into rental leasing (and buy-back guarantee) all the way to full ICT equipment management for organizations.

Based on the information obtained, the following considerations can be taken in public procurement in order to promote the development and make the most of on the strengths from the available CBM in the ICT equipment sector:

- Consider an inventory and needs assessment service, this will allow setting a baseline of the current equipment which can be valuable information for upcoming tenders.
- If there is a need for ICT equipment and a tender is expected to be developed, consider functionality and needs, instead of technical specifications. This will allow refurbished equipment suppliers to participate in the process.
- Consider flexible agreements in which the supplier retains ownership of ICT equipment and guarantees their functionality throughout the contract. Consider contract-clauses related to the actions expected to be taken once the equipment is collected after the contract expires.
- Before purchasing new, consider if it is possible to refurbish current equipment.
- If refurbished equipment contracts are available, consider promoting them with the internal clients and emphasize their value, so they are more likely to be used.
- If new equipment is to be purchase, consider a take-back scheme in which the supplier, or other organization, can guarantee that the current ICT equipment will be refurbished collected, refurbished and reused, not simply recycled.
- If take-back arrangements are made, emphasize re-use (and monitoring) instead of commercial value return
- If take-back arrangements are made, consider certifications for data wiping and compliance with data privacy regulations.
- Consider collaborations with organizations that offset the material impact of new ICT equipment purchases by actions in developing markets such as collection and guaranteed recycling.
- Consider including labelling and tracking of current ICT equipment as a requirement in order to facilitate its monitoring thorough its lifetime.

Clothing and textiles

Overall, the CBM analyzed in this category covered three main aspects: design and material choice for new products, collection repair/recycle and re-sell, and clothing management. The types of organizations involved are both commercial enterprises and not-for-profit organizations, particularly involved in the collection, donation and local or regional re-sell of clothes.

For new clothing and textile products, design can be aimed at creating mono-material products. Furthermore, it can be focused on incorporating recycled content (both natural and synthetic fibers) as well as secondary raw materials originated as by-products from other industries (e.g. furniture sector) or directly collected from waste streams (e.g. old jeans).

The different business models analyzed display unique strategies for collection of textiles: from take-back arrangement of their own products, buy-back guarantees, or widespread collection points across a city or a region for consumers to deliver their un-wanted clothes. Collected garments can be donated, re-paired and resoled, re-worked into new garments, or down-cycled to manufacture new products.

One case displayed a business model in which cooperate clothing is offered as a service, as well as the outsourcing of other clothing-related activities such as washing, drying and maintenance. Lastly, one case takes a chain manager position that facilitates tracking and monitor of clothing across their lifetime.

Based on the information obtained, the following considerations can be taken in public procurement in order to promote the development and make the most of on the strengths from the available CBM in the clothing and textiles sector:

- Consider the functionality of clothing as a service instead of the direct purchase of clothing articles.
- If purchasing new clothing, consider establishing contract-clauses for buy-back guarantees or collection.
- Consider end-of-life treatment that prioritizes, repair and re-sell or donation, and leaves recycling as a last option.
- Consider material choices and design (e.g. recycled material, mono-material clothing) when purchasing new clothing
- Consider use-phase (cleaning and drying) educational campaigns or the potential of some suppliers to provide a holistic service covering these aspects.
- Consider collaboration with partners dealing with local and regional collection, repair and donation
- Consider the use of clothing managers that can facilitate keeping track of ensuring the responsible use/re-use of clothing

V. Annex

Detail of data collected from each case

Category	Cases	website	semi-structured interview	structured interview	Other sources
Food and food based products	R1	x			
	P1	x		x	
	D11	x	x		
	S6	x			
	P4	x			
	N13	x			
	F9	x			
	S4	x		x	
	S8	x	x		
	S9	x	x		
	L5	x	x		
	D7	x			
Furniture	S7	x	x		
	D6	x	x		
	N8	x			
	F8	x			
	D8	x			
	D13	x		x	
	P5	x		x	
	D15	x		x	
Built environment	N12	x	x		
	S10	x		x	
	D12	x			
	S1	x	x		
	D4	x	x		
	D5	x		x	
	D3	x			x
	N4	x			
	D10	x		x	
ICT and equipment	S3	x	x		
	F10	x			
	F3	x			
	F1	x			x
	N9	x	x		
	D9	x			
	D16	x			
	N3	x			

Textiles	N6	x		x	
	F4	x			x
	N10	x			x
	F2	x			x
	F7	x			
	D14	x			x
	L2	x			
	R6	x	x		
	S2	x			x
Other	L1	x			
	R8	x	x		
	R3	x			
	P6	x			x
Total	50	50	14	9	8

Interview guide used during the semi-structured interviews

Theme	Guiding questions
Business Model Description	Q: How would you describe your BM? Q: How is your BM different from your "linear" competitors? Q: Is there a difference in the costs you have or in revenue structures? Q: Is there a difference in the way you collaborate with suppliers/customers?
Circularity	Q: How does your BM reduces the use of materials? Q: Do you use non-virgin or wasted materials as raw materials in your production? Q: Do you repair, refurbish or remanufacture products? Q: Do you collect any products considered as waste or unwanted? Q: Do you create (or improve) markets for suppliers and costumers to interact?
Advantages and Barriers	Q: Can you mention some of barriers or disadvantages that you have faced operating this BM compared to a linear model (e.g. regulation, sourcing, market demand, etc.)?
Procurement Experience	Q: Have you participated in public tenders? Q: How can you use circularity as an advantage to win tenders?

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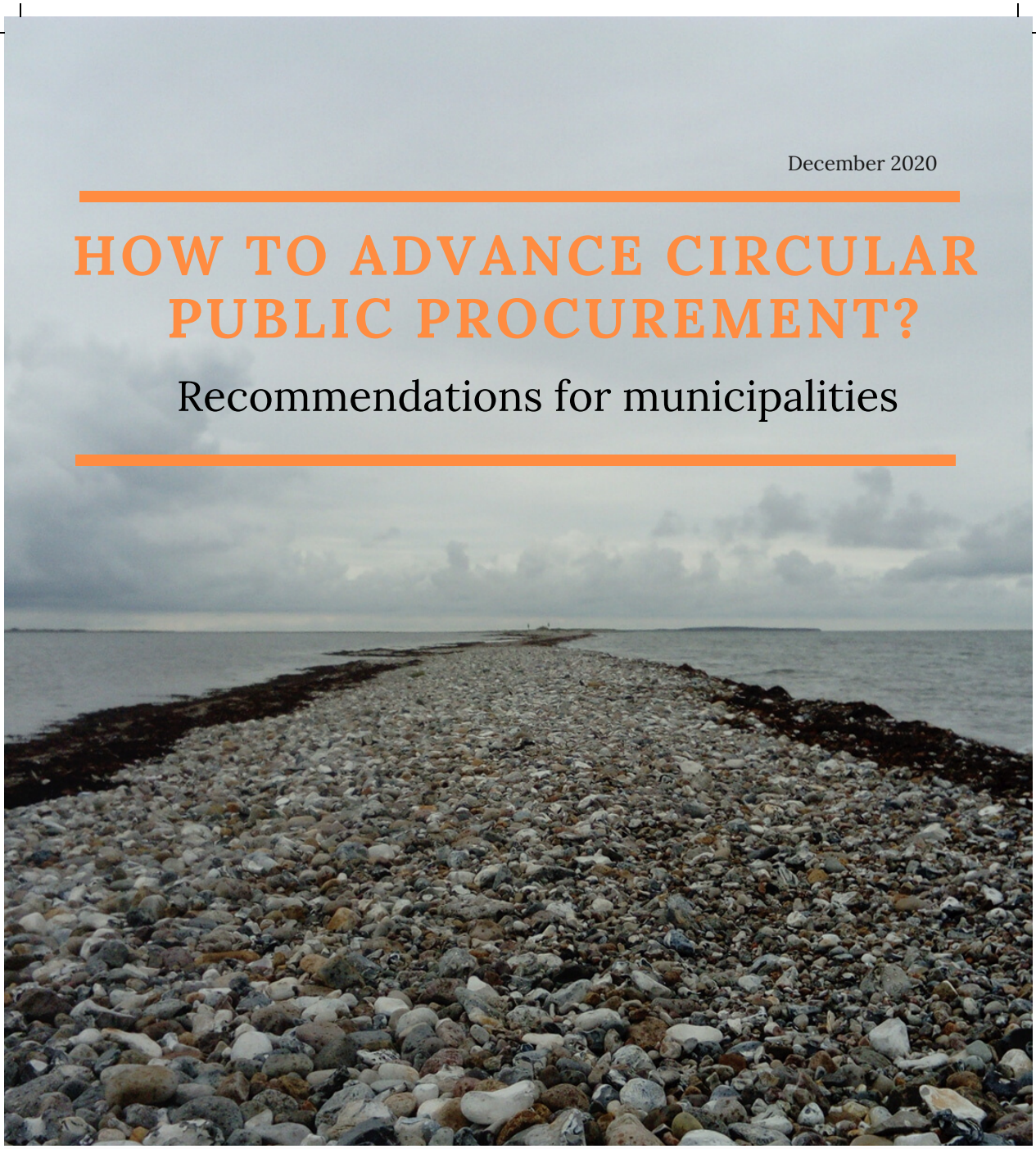
REPORT II

December 2020

HOW TO ADVANCE CIRCULAR PUBLIC PROCUREMENT?

Recommendations for municipalities



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Interreg Baltic Sea Region
EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND
Circular PP

PREFACE

This report is the output of Work Package 2.3 from CircularPP, an Interreg-funded project that is focused on building capacity across the value chain of the Baltic Sea region, for the incorporation of circular economy principles in public procurement.

The goal of the work package is:

"to produce a set of recommendations in regards to organizational structure and intra-department cooperation in order to include relevant circular criteria into public procurement procedures".

The recommendations presented in this report have been developed by the author in close collaboration with parters of the CircularPP project.

More information on CircularPP can be found at circularpp.eu

CONTENT

PUBLIC PROCUREMENT

In the European Union (EU), public procurement (PP) represents the process by which contracting authorities (for example, municipalities) acquire goods and services from the market. The main premise of PP is to promote a fair and transparent competition between potential suppliers, from which one or more would be awarded the public contract. According to Directive 24, which regulates PP in the EU, public contracts shall be awarded to the supplier that submits the Most Economically Advantageous Tender (MEAT). The MEAT can be identified in two ways:

BID WITH THE LOWEST PRICE

BID WITH THE BEST COST-QUALITTY RATIO

COST-QUALITY RATIO: A STRATEGIC CHOICE

Cost can be calculated based on life cycle costing methodologies, which gives the contracting authority **a more accurate approximation of total costs incurred.**

Quality criteria can refer to environmental and social considerations, which allows the contracting authority to **create social and environmental value through procurement.**

Choosing the MEAT based on a cost-quality ratio, rather than the lowest price alone, is the foundation for procuring strategically.

MECHANISMS FOR STRATEGIC PROCUREMENT

Besides awarding contracts based on a cost and quality ratio, the Procurement Directive contemplates additional mechanisms that can promote strategic procurement. Some of them are presented below along with the article in the Directve in which they are adressed.

Take into consideration environmental externalities and other costs such as collection and recycling in the total cost of contract.

Life-cycle costing — Art 68

Define environmental and social considerations as quality criteria that receive a relative weight compared to cost.

Award criteria — Art 67

Conduct pre-competitive market consultations to gain knowledge of market or inform on priorities of procurement

Market dialogues — Art 40

Reserve specific contracts so only social enterprises or sheltered workshops can participate in the competition

Reserved contracts — Art 20

Type of contract that includes R&D of innovative solutions and procurement of the outcome of the innovation process.

Innovation Partnerships — Art 31

Define technical specifications as outcomes or functional requirements providing incentive to innovate to suppliers

Outcome-based specifications — Art 42(3)

Use of third-party awarded eco-labels for reference towards technical specifications, award criteria or contract clauses

Eco-labels — Art 43

Divide large contracts into smaller lots to encourage participation of SMEs and incorporate competences of different suppliers

Division of contracts — Art 46

Establish framework agreements or dynamic purchasing systems that govern individual contracts for a defined period.

Aggregated purchasing — Art 33

CIRCULAR ECONOMY AND PROCUREMENT

WHAT IS A CIRCULAR EOCNOMY?

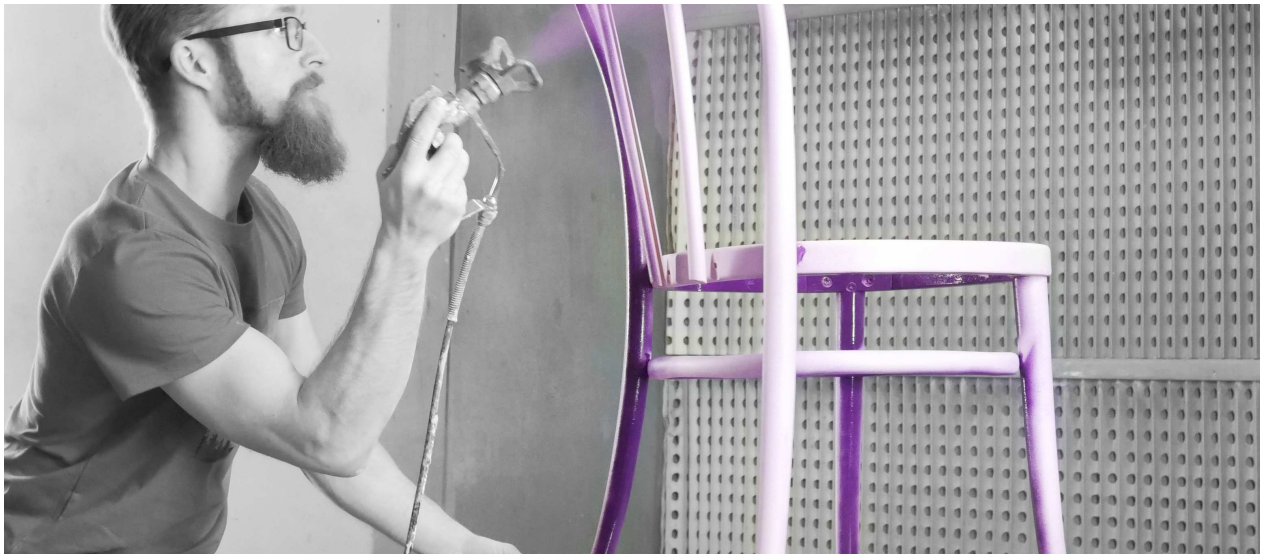
A Circular Economy (CE) is an economic system with the main goal of preserving and maximizing the value of material stocks inside the economy. By focusing on preserving stocks, a CE contributes to reducing the use of natural resources (in flows) and generatio of (out flows). A CE prioritizes economic activities related to resource preservation (such as repair, remanufacturing, etc.) rather than resource extraction and waste treatment. Due to the characteristics of preservation activities, local job opportunities with a lower carbon footprint are promoted.

WHAT IS CIRCULAR PUBLIC PROCUREMENT?

Since 2015, the EU Commission highlighted the role of PP as a strategic tool to support a transition towards a Circular Economy. This has lead to the emergence of Circular Public Procurement (CPP), a strategy towards incorporating circular economy principles in public procurement.

SCOPE OF CIRCULARITY IN PUBLIC CONTRACTS

Alhola et al. (2018) explains the four main levels in which circularity can be incorporated into public contracts: product, business model, innovation and ecosystem.



CIRCULAR PRODUCTS

Purchase of products (or services) that are superior in circular terms (such as recycled content, free of hazardous chemicals, designed to be repaired, etc.

CIRCULAR BUSINESS MODELS

Use leasing, or pay-per-use contracts to incentivize a more efficient material management from both buyers and suppliers.

CIRCULAR INNOVATIONS

Develop innovative products and services currently non-existent in the market thorough innovation partnerships.

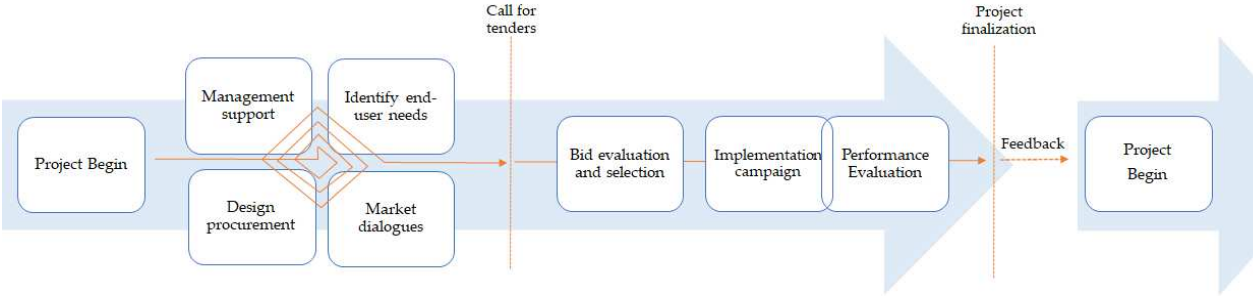
CIRCULAR ECOSYSTEMS

Develop multi-stakeholder networks for circularity in which various actors collaborate to form closed loop systems.

CPP PROJECTS

MAIN PHASES AND KEY INSIGHTS

CPP requires interaction between actors inside and outside the municipality, including end-users, budget managers, legal experts, environmental specialist, suppliers, etc. (United Nations Environment Programme 2018). Due to their complexity, CPP is better suited to be managed in a project-by-project basis, lead by a multi-disciplinary team.



PRE-TENDERING

The pre-tendering phase involves four simultaneous and often iterative tasks, 1) obtaining management support, or at least no active resistance particularly from the departments involved in the procurement. 2) Assessing the needs of end-users and 3) contrasting these needs with market capabilities through market dialogues. In addition to 4) designing the procurement process including procedure, subject matter, requirements, award criteria etc.

TENDERING

The tendering phase includes the publication of call for tenders or competition, the bid valuation and selection of supplier(s) following the requirements prescribed in the relevant regulations. This phase does not differ much from “traditional procurements”.

POST-TENDERING

Due to their novelty, CPP contracts might require an implementation campaign designed to raise awareness of the contract and facilitate behavior change from end-users and buyers. This process of promoting a behavioral change can begin the pre-tendering phase and be carried out as an ongoing activity. Contract clauses might require on-going verification, which makes on going performance evaluation of the project a critical aspect. The feedback generated throughout the lifetime of the project can be used in other projects to promote organizational learning.

METHDOLOGY FOLLOWED FOR DEVELOPING RECOMMENDATIONS

The main objective WP2.3. was to generate a set of recommendations that can help promote the development of CPP projects at municipalities in the EU. In order to achieve this objective the author drafted an initial set of recommendations which then were discussed, modified, and validated by the parnets of the CircularPP project.

DRAFTING RECOMENDATIONS

The initial draft was developed by incorporating three elements: 1) a literature review of academic and practioner contributions as well as EU publications. 2) Insights from Dutch experts and civil servants in regards to circular procurement in the Netherlands and 3) analysis of five CPP cases.

VALIDATION

The draft with recommendations was discussed in a workshop with partners of the CircularPP project. Based on the feedback obtained, the author developed a final version that was circulated once more with the partners to obtain one last round of direct input.

The following CPP pilot projects were analyzed in order to explore barriers and opportunities experienced by the main stakeholders involved, which included project managers, suppliers and procurers.

CPP CASES ANALYZED

Case  Click on the case number to obtain more information

IT take-back arrangement at the city of Aalborg — Case 1

The city of Aalborg set out to procure a service for buy-back of IT equipment. The goal was that all discarded IT by the city were refurbished and re-sold to another user for a new product life or if necessary, recycled.

Refurbished furniture and other services for Malmö municipality — Case 2

Malmö municipality set out to reduce their furniture waste and reduce unnecessary purchasing of new furniture. Therefore, they develop a framework agreement which included a variety of services including furniture repair and refurbishment. The framework is active; three suppliers were awarded the contract.

Catering services for gymnasium at Plavinas — Case 3

Plavinas set out to improve the catering services at their gymnasium. The project, which was facilitated the Latvian Environmental Investment Fund (LEIF), was focused on increasing the quality of the service for pupils and on reducing food waste and other catering waste streams.

Outdoor learning environment at the City of Aalborg — Case 4

The second CPP from the City of Aalborg is an ongoing project related to outdoor learning environments for a new school in Aalborg. This is part of a turn-key construction contract of the school, in which circular economy elements related to the outdoors playground were included based on preliminary market consultations.

Waste collection services for Malmö municipality — Case 5

This ongoing project at Malmö is focused on creating a framework for waste collection services. The focus has been on collection methods, vehicle characteristics and fuels. Pre-competitive market consultations have been conducted but tendering phase has not yet started (therefore, no additional information is available).

WHAT CAN MUNICIPALITIES DO?

THEMES

5

RECOMMENDATIONS

18

Based on the research activities conducted, 17 recommendations were elaborated and divided in 5 themes. These recommendations are relevant for municipalities who wish developing and improving CPP practices. They span from the broadest (strategy and policy) all the way the more specific aspects of CPP contracts (contract management).

STRATEGY AND POLICY

1.- **Develop** a CPP policy
2.- **Scale** up pilot projects
3.- **Empower** project managers
4.- **Prioritize** framework contracts

CAPACITY BUILDING

5.- **Provide** strategic procurement training
6.- **Ensure** necessary conditions

MARKET ENGAGEMENT

7.- **Prepare** a multi-stage strategy
8.- **Be consistent and** allocate enough time
9.- **Embrace** supplier diversity
10.- **Support** with desk research

CALL FOR TENDERS

11.- **Engage** end-users early
12.- **Identify** the best scope of services for circularity
13.- **Incorporate** circularity as requirement and award criteria
14.- **Promote** synergy between CPP and internal service

CONTRACT MANAGEMENT

15- **Design** an implementation strategy
16.- **Follow up** and validate
17.- **Remain** vigilant for emerging innovations
18.- **Collect** and share feedback

STRATEGY AND POLICY

1.- DEVELOP A CPP POLICY

Management support is a necessary condition for the widespread uptake of CPP. This support can be strengthened with a policy and strategy that clearly identifies procurement as a tool for circularity and emphasize that circularity as a priority should be pursued by all departments.

A top-down emphasis on circularity provides a framework for incorporating circularity in both large projects (e.g. construction of new schools) and small department pilot projects.

An overarching policy is helpful in municipalities with decentralized procurement practices since it can promote a consistent level of CPP throughout the municipality instead of being dependent on the awareness and perception of the leaders from different departments.

Similarly, municipalities with centralized procurement would also be benefited from developing a CPP policy, since it could mean the incorporation of circularity principles into framework contracts used across the municipality.

2.- SCALE UP CPP PILOT PROJECTS

Small-scale projects, below the national threshold set by the EU Procurement Directive, can be a beneficial way to introduce CPP practices into municipalities since they allow more flexible procurement procedures and buyer-supplier interactions as well as minimize their inherent risks and resources required for their execution. Pilot projects are a good source for development of individual and organizational skills as well as promote buy-in from different stakeholders.

Municipalities should develop a strategy for promoting, replicating and scaling up CPP pilot projects in order to create a systemic transformation.

3.- EMPOWER PROJECT MANAGERS

As all innovation projects, CPP is characterized by uncertainties, risks and changing goals. Without a short and direct line of communication between project managers and decision makers, innovation projects can stall.

Therefore, teams leading the CPP project should be empowered to manage the project without continuous political or top management discussions in order to allow the project to move forward more swiftly.

4.- INCORPORATE CIRCULARITY INTO FRAMEWORK CONTRACTS

"(...) if we update one of this catalogues according to circular criteria, then it would be a huge step because all municipalities are using this catalogue" (LEIF project manager).

In Latvia, the Director of the State Regional Development Agency (SRDA), an authority responsible for centralized procurement and developing electronic catalogues for standard goods and services, met with LEIF project managers to discuss the potential for updating some of their catalogues with circular economy principles.

They began working on two specific product groups, printing services and take-back of IT equipment.

This example highlights the importance of updating framework contracts with circularity considerations. Particularly in contexts where procurement is highly centralized

CAPACITY BUILDING

5.- PROVIDE STRATEGIC PROCUREMENT TRAINNING

Conducting a sound procurement procedure that complies with the relevant regulations should be the starting point for procurement. Added value (and successful CPP projects) can only be achieved through the use of strategic procurement mechanisms such as evaluating cost-quality ratio, conducting market dialogues, setting functional requirements, dividing or reserving contracts when appropriate, etc.

Therefore, strategic procurement training should be prioritized and widespread for procurement personnel.

Participating in seminars, procurement academies and communities of practice are useful methods for building capacity, exchange knowledge and share different methods for strategic procurement. This sharing of experience is particularly helpful for smaller municipalities with limited procurement departments.

During CircularPP activities, national seminars where organized at the different partnering countries. The open seminar format consisted in 1-day or half-day events with specialized presentations e.g. how to use functional specifications in tender documents. Followed by break-out sessions where participants discuss the content presented and address how can it be applied in their context.

6.- ENSURE NECESSARY CONDITIONS FOR CPP DEVELOPMENT

Even with a procurement policy, CPP is driven by individuals and groups. Therefore, municipalities should ensure that there is sufficient awareness, experience, skills, knowledge and resources available for carrying out CPP projects.

These can be held by a single individual or collectively by the team leading the project, likewise, they can be currently available or might be outsourced from 3rd parties.

AWARENESS

Of the importance of circularity and the role that procurement plays in promoting it.

KNOWLEDGE

Of the specific category groups of the tender and the overall market conditions

SKILLS

For implementing strategic procurement mechanisms

EXPERIENCE

Working inside the municipality and understanding its internal functioning.

MARKET ENGAGEMENT

PREPARE A MULTI-STAGE STRATEGY

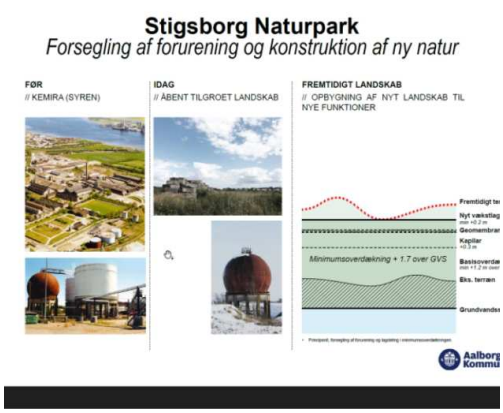
7

A multi-stage strategy for market engagement allows generating insights and feedback from one event, which and used for the next round of dialogues. Project managers should select the best set-up for the interaction, including determining the necessary information to be shared with potential suppliers beforehand.

It is important to see suppliers as potential partners and active participants in the innovation proces omstead of followers of strict technical requirements.

Covid-19 pandemic has highlighted how digital technologies can be used to facilitate interaction with potential suppliers. This approach opens the door for multiple visits, demonstrations and interaction by investiging limited resources in traveling.

For example, a webinar for discussing the potential for developing circular learning environments for a new school was held as part of the activities of case 4 of the CircularPP project.



BE CONSISTENT AND ALLOCATE ENOUGH TIME

8

Market readiness is necessary for successful CPP projects. From an individual project perspective, enough time should be allocated for conducting market dialogues and allowing the market to respond accordingly, specially if its an innovative project. From a big picture perspective, municipalities need to be consistent in sending signals to the market in regards of prioritizing circularity to encourage them on making the necessary investment and participating in future tendering procedures with confidence that circularity will be rewarded.

EMBRACE SUPPLIER DIVERSITY

9

Increasing the diversity of suppliers involved in market dialogues allows the buyer to obtain a more comprehensive understanding of market capabilities, innovation potentials and avoid being overly influenced by the perceptions of a few suppliers. Social enteprises, for example, are good source of inspiration for incorporating social elements into the tender.

SUPPORT WITH DESK RESEARCH

10

Best practices and case studies can help as inspiration for market dialogues. While a CPP project be innovative for a specific municipality, there might be examples of similar products and services being supplied to other municipalities. Municipalities should prioritize finding examples from similar context since it can facilitate obtaining organizational support.

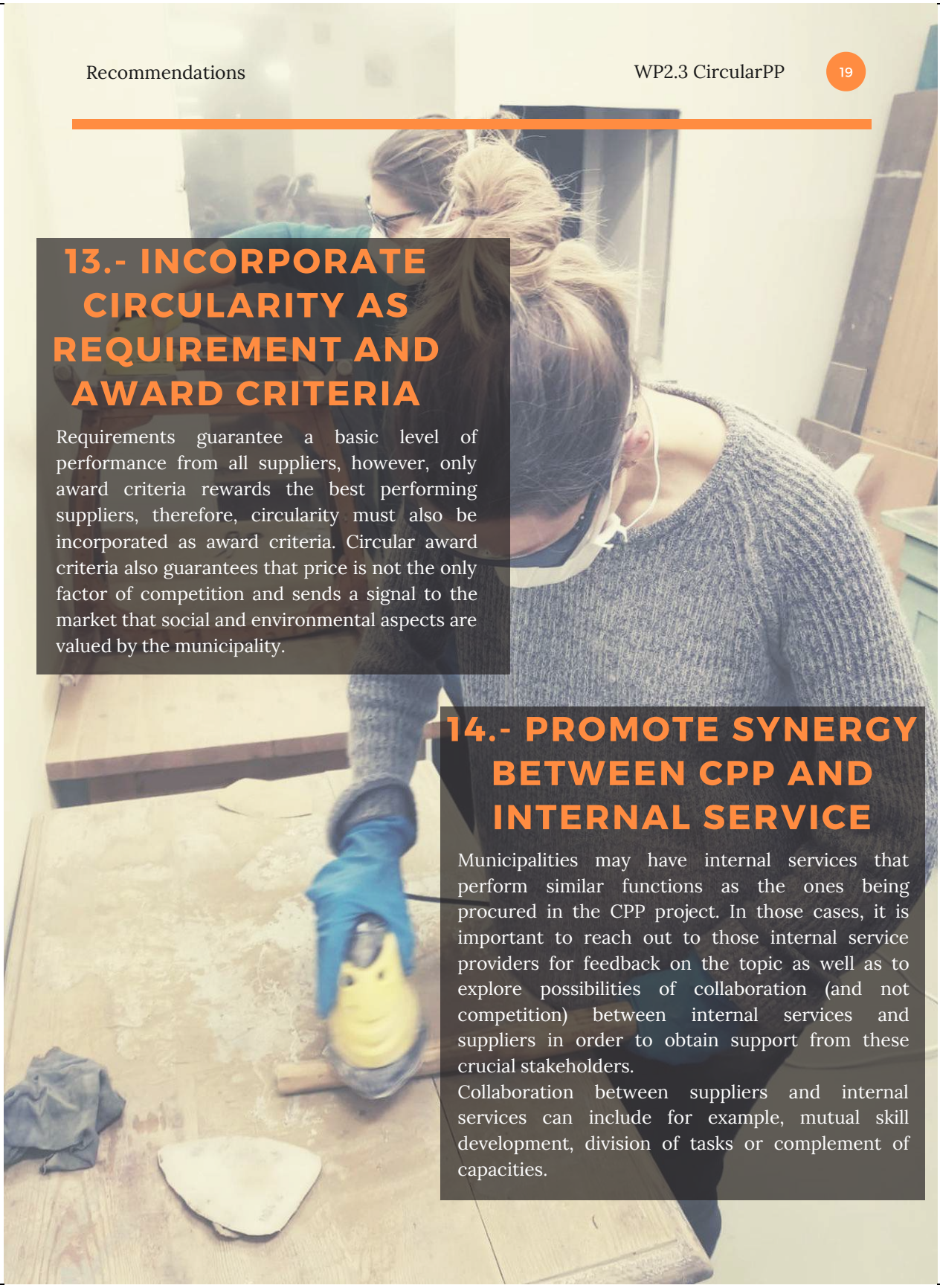
CALL FOR TENDERS

11.- ENGAGE END-USERS EARLY

Assessing the needs of end-users is crucial for developing functional or outcome-based specifications; one of the main mechanisms used in CPP. However, a lack of collaboration across departments makes reaching end-users a challenge. This is particularly visible in large municipalities, where end-users might be geographically dispersed and having different contexts. Therefore, municipalities should encourage direct interaction with end-users. In some cases, interaction between end-users and potential suppliers might be relevant.

12.- IDENTIFY THE BEST SCOPE OF SERVICES FOR CIRCULARITY

Circularity can be achieved by several suppliers performing unique tasks or by a single supplier, able to perform all of the scope of services involved in circularity. Buyers should identify the right scope of services to promote circularity, which is determined case-by-case depending on the organizational needs and the available business models in the market.



13.- INCORPORATE CIRCULARITY AS REQUIREMENT AND AWARD CRITERIA

Requirements guarantee a basic level of performance from all suppliers, however, only award criteria rewards the best performing suppliers, therefore, circularity must also be incorporated as award criteria. Circular award criteria also guarantees that price is not the only factor of competition and sends a signal to the market that social and environmental aspects are valued by the municipality.

14.- PROMOTE SYNERGY BETWEEN CPP AND INTERNAL SERVICE

Municipalities may have internal services that perform similar functions as the ones being procured in the CPP project. In those cases, it is important to reach out to those internal service providers for feedback on the topic as well as to explore possibilities of collaboration (and not competition) between internal services and suppliers in order to obtain support from these crucial stakeholders.

Collaboration between suppliers and internal services can include for example, mutual skill development, division of tasks or complement of capacities.

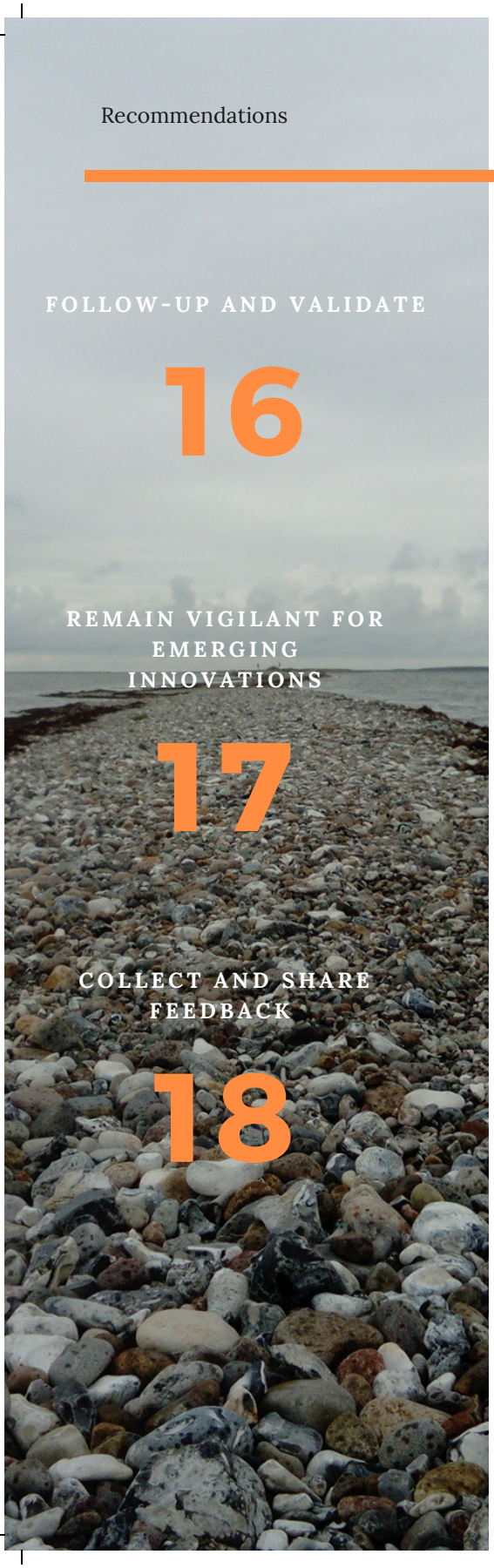
CONTRACT MANAGEMENT

15.- DESIGN AN IMPLEMENTATION STRATEGY

CPP contracts will require new practices and behaviors from end users and buyers. Project managers should facilitate this transition into new practices through implementation campaigns that raise awareness of the new contracts, provide necessary training. Demonstrating the actual products or services can be the basis for communication campaigns in order to counter misconceptions of circular related products and services.

In September 2019, once the contract for non-new furniture services became valid (case 2), Malmö municipality began executing an implementation strategy focused on raising awareness of the contract, encouraging its use and promoting behavioral change.

The strategy including two seminars for buyers and a furniture exhibition used to display examples of refurbished furniture aimed to general employees.



FOLLOW-UP AND VALIDATE

16

Circularity often takes place in the form of on-going actions during the lifespan of the contract. Therefore, it is important to anticipate how these actions are going to be verified. This requires allocating necessary resources and selecting the appropriate methods for collecting the relevant information. It is important to find synergies between buyer and supplier so both actors are involved in verification and reporting.

REMAIN VIGILANT FOR EMERGING INNOVATIONS

17

Unexpected innovations and benefits can emerge from the new practices generated by CPP contracts. Project managers should include some level of flexibility or continuous improvement in order to adjust to any potential innovations emerging during the contract.

COLLECT AND SHARE FEEDBACK

18

Valuable lessons are learned with each CPP, therefore, municipalities should ensure that these are recorded and shared in order to communicate lessons learned from individual project participants to the whole organization.

Furthermore, the municipality should also encourage collaboration between buyers of different public sector organizations, for example by participating in buyer-groups. These groups can for example define circular economy priorities for specific product groups, which can send a consolidated signal to the market and incentivize the participation of suppliers in future CPP projects.

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APPENDIX B

This appendix includes two tables that complement Chapter 3. Table B-1 presents the practice-derived literature included in the review, and Table B-2 includes the academic studies.

Table B-1: Project reports included in the literature review

#	Reference	Title	Project	Commissioned/ Funded by
1	Green Deal Circular Procurement, 2017	Added value: Reaping the benefits of 3 years of the Green Deal on circular procurement	Green Deal on Circular Procurement	Ministry of Infrastructure and Water Management (Rijkswaterstaat) in cooperation with EU LIFE +
2	European Commission, 2017	Public procurement for a circular economy: Good practice and guidance	-	European Commission
3	Sustainable Global Resources Ltd, 2017	European textiles & workwear market: The role of public procurement in making textiles circular	European Clothing Action Plan (ECAP)	Ministry of Infrastructure and Water Management (Rijkswaterstaat)
4	Alhola et al., 2017a	Circular procurement in the Nordic countries	-	Nordic Council of Ministers
5	Thiebault and Tonda, 2018	Building circularity into our economies	Platform for Accelerating the	UN Environment Program

		through sustainable procurement	Circular Economy (PACE)	
6	Jones et al., 2017a	Circular public procurement: best practice report	Sustainable Public Procurement Regions (SPP Regions)	Horizon 2020
7	Vanacore et al., 2018	Circular public procurement toolbox	Public Procurement with a Circular Economy Edge (PROCEED)	Sweden research funding agency (VINNOVA)
8	Salonen and Vangsbo, 2019	The challenges and potential of circular procurements in public construction projects	Klimate Knowledge and Innovation Community (Klimate-KIC)	Europe Institute of Innovation and Technology (EIT)
9	van der Zande et al., 2019	Towards climate-neutral and circular procurement: An analysis of the procurement system and a proposed roadmap for an	-	Ministry of Infrastructure and Water Management (Rijkswaterstaat)

		effective monitoring framework		

Table B-2: Academic studies included in the literature review. Column "Type" refers to type of document and includes: A: Article B: Book Chapter C: Conference paper R: Review

#	Reference	Title	Source	Type
1	Ntsondé and Aggeri, 2021	Stimulating innovation and creating new markets—The potential of circular public procurement	Journal of Cleaner Production	A
2	Peñate-Valentín and Sánchez-carreira, 2021	The promotion of innovative service business models through public procurement: An analysis of Energy Service Companies in Spain	Sustainable Production and Consumption	A
3	*Jacobson et al., 2021*	Legal, environmental and economic issues with functional sales—A case of indoor lighting	Journal of Cleaner Production	A
4	Rainville, 2021	Stimulating a more Circular Economy through Public Procurement: Roles and dynamics of intermediation	Research Policy	A
5	Kristensen et al., 2021	Circular public procurement practices in Danish municipalities	Journal of Cleaner Production	A
6	Milios, 2021	Overarching policy framework for product life extension in a circular economy—A bottom-up business perspective	Environmental Policy and	A

			Governance	
7	Bougrain, 2020	Circular economy performance contracting: The contract that does not exist…yet	IOP Conference Series: Earth and Environmental Science	C
8	Soto et al., 2020	An approach to environmental criteria in public procurement for the renovation of buildings in Spain	Sustainability (Switzerland)	A
9	Braulio-Gonzalo and Bovea, 2020	Criteria analysis of green public procurement in the Spanish furniture sector	Journal of Cleaner Production	A
10	Gåvertsson et al., 2020	Quality labelling for re-used ICT equipment to support consumer choice in the circular economy	Journal of Consumer Policy	A
11	Klein and Ramos, 2020	Circular economy practices and strategies in public sector organizations: An integrative review	Sustainability (Switzerland)	R
12	Sonnichsen et al., 2020	Review of green and sustainable public procurement: Towards circular public procurement	Journal of Cleaner Production	R
13	Luciano et al., 2020	Demolition and construction recycling unified management: The DECORUM platform for the improvement of resource efficiency in the construction sector	Environmental Science and Pollution Research	A

14	Paganin, 2020	Circular economy and sustainable procurement: The role of the attestation of conformity	Springer Tracts in Civil Engineering	B
15	Iannone et al., 2020	The role of Green Public Procurement in circular economy policies: An international comparison	Economics and Policy of Energy and the Environment	R
16	Marrucci et al., 2019	The integration of circular economy with sustainable consumption and production tools: Systematic review and future research agenda	Journal of Cleaner Production	R
17	Bao et al., 2019	Procurement innovation for a circular economy of construction and demolition waste: Lessons learnt from Suzhou, China	Waste Management	A
18	Campbell-Johnston et al., 2019	City level circular transitions: Barriers and limits in Amsterdam, Utrecht and The Hague	Journal of Cleaner Production	A
19	Grandia and Voncken, 2019	Sustainable public procurement: The impact of ability, motivation, and opportunity on the implementation of different types of sustainable public procurement	Sustainability (Switzerland)	A
20	Alhola et al., 2019	Exploiting the potential of public procurement: Opportunities for circular economy	Journal of Industrial Ecology	A

21	Dalhammar et al., 2019	Public procurement of reconditioned furniture and the potential transition to product service systems solutions	Procedia CIRP	C
22	Alhola and Nissinen, 2018	Integrating cleantech into innovative public procurement process—Evidence and success factors	Journal of Public Procurement	A
23	Crafoord et al., 2018	The use of public procurement to incentivize longer lifetime and remanufacturing of computers	Procedia CIRP	C
24	Faure and Dalhammar, 2018	Principles for the design of a policy framework to address product life cycle impacts		B
25	Milios, 2017	Advancing to a circular economy: Three essential ingredients for a comprehensive policy mix	Sustainability Science	R
26	Lohse and Riel, 2017	Implementation of advanced DER. EPC business models in dormitories in Mannheim/Germany	ASHRAE Transactions	C
27	Dahlbo et al., 2017	Increasing textile circulation—Consequences and requirements	Sustainable Production and Consumption	A
28	Witjes and Lozano, 2016	Towards a more circular economy: Proposing a framework linking sustainable public procurement and sustainable business models	Resources, Conservation and Recycling	A
29	Yeow et al., 2015	Closing the loop: Examining the case of the procurement of a sustainable innovation	Public Procureme	B

			nt for Innovation	
30	Gee et al., 2013	A role for public procurement in system innovation: The transformation of the Greater Manchester (UK) waste system	Technology Analysis and Strategic Management	A
31	Bratt et al., 2013	Assessment of criteria development for public procurement from a strategic sustainability perspective	Journal of Cleaner Production	A
32	Ceschin and Vezzoli, 2010	The role of public policy in stimulating radical environmental impact reduction in the automotive sector: The need to focus on product-service system innovation	International Journal of Automotive Technology and Management	A
33	Chateau, 2007	Environmental acceptability of beneficial use of waste as construction material-State of knowledge, current practices and future developments in Europe and in France	Journal of Hazardous Materials	A

SUMMARY

Public sector organizations can help drive a Circular Economy through Circular Public Procurement (CPP), which leads to the uptake of products and services deriving from Circular Business Models (CBM).
The goal of the dissertation is to provide research-based insights and recommendations that can help in the development and implementation of CPP and CBM.
Chapter 3 presents a systematic literature review on the concept of CPP. Chapter 4 presents provides an overview of processes and tensions experienced in market consultations, a key phase in CPP. Chapter 5 describes the main paradoxical tensions faced by CBM, and their related management strategies. Lastly, Chapter 6 integrates insights from the previous three chapters into a crosscutting discussion of the innovation dynamics of CPP.
Overall, the dissertation structures the diffuse and increasing knowledge of the field of CPP. It provides an in-depth empirical and conceptual analysis of market consultations. It outlines the main paradoxical tensions faced by CBM. And lastly, translates the main theoretical insights into practice-oriented recommendations for improving the implementation and diffusion of CPP.

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