Enabling Systemic Circular Public Procurement

A method to build circular criteria checklists

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Abstract

Circular public procurement is an important strategy in encouraging and scaling circular business models. However, today public bodies often lack guidance on how to implement circular public procurement in practice. We propose a method – the Circular Public Procurement Checklist (CPProcC) Builder – that was developed in collaboration with public actors and enables a systemic approach to circular public procurement. In this paper, we present the method and the learnings from implementation.

Keywords

circular economy, circular procurement, public procurement, design research, procurement checklist, CPProcC

Introduction

Currently, the global economy follows a trajectory of unsustainable resource extraction and waste production: if left unchanged, over the next four decades the global resource utilisation will double, while annual waste generation will increase by 70% until 2050 (European Commission, 2020). This trajectory significantly exacerbates climate change, biodiversity loss, and resource scarcity (McLennan and Krebs Schleemann, 2021). To address these risks, the European Union (EU) has identified the transition to a circular economy - where R-strategies, such as reduce, reuse, or recycle, are utilised to improve resource preservation, efficiency and productivity - as a key priority (Hartley, van Santen and Kirchherr, 2020). This strategic shift aims to mitigate the negative impacts and challenges associated with increasing resource use and waste generation.

Municipalities play a crucial role in the transition to a circular economy. Some of the municipal services deal with resources directly, for example, through waste management transportation systems, and urban planning (Bolger and Doyon, 2019; Circle Economy, 2019). Additionally, municipalities can actively contribute to a circular economy as a customer, by stimulating demand for circular offerings through *public procurement* (Klein, Ramos and Deutz, 2020). Including circular criteria as requirements in public tenders offers a direct way for governmental institutions to influence markets and promote the circular economy (OECD, 2016; McLennan and Krebs Schleemann, 2021; Rainville, 2021).

The practice, where the “public sector purchases products and services according to the principles of the circular economy” is defined as circular public procurement (CPProc) by the Ellen MacArthur Foundation (O’Carroll et al., 2023). A growing number of projects, political networks and individual public procurement organisations are attempting to apply CPProc (McLennan and Krebs Schleemann, 2021). Within the CPProc process, including circular criteria in tenders is critical to specify which circular strategies or improvements in resource preservation are expected compared to available linear solutions (Alhola et al., 2019; Tátrai and Diófási-Kovács, 2021). One example of such criteria specifications are the ‘European Green Public Procurement Criteria and Requirements’ (European Commission, 2021).

But despite the existence of such guidelines, implementation rates of CPProc in Germany remain limited to a few cases (Bahn-Walkowiak *et al.*, 2021), such as the "Cradle to Cradle" public procurement strategy in Ludwigsburg (European Circular Economy Stakeholder Platform, no date). Municipalities in other countries, such as Sweden, also struggle with how to implement such processes and define the criteria (Hunka *et al.*, 2023). A systematic literature review of 53 papers on CPProc exposes the need to integrate CPProc in municipalities in a systematic manner that connects to existing cultural, managerial, and operational structures and enables a more holistic and systemic approach (Sönnichsen and Clement, 2020a). A *systemic* approach to circular criteria encompasses a clear understanding of the current linear supply chain and waste management processes, resulting in opportunities to identify circular improvements along the complete value chain (Blomsma and Brennan, 2022). Pursuing this goal requires processes and tools that would enable municipal employees to understand the full value chain and define circular criteria that are applicable in the context of their specific project. Therefore, we ask the following research question:

How can we support municipalities in implementing processes for systemic circular public procurement?

We address this research question by co-developing a method, the Circular Public Procurement Checklist (CPProcC) Builder, that helps to integrate circular criteria into public procurement processes by developing context- and product-specific checklists. Our method development follows an action design research (ADR) approach (Sein *et al.*, 2011): (1) we formulate the problem; (2) we co-develop and evaluate an artefact based on a set of evolving requirements, and (3) we reflect on our learnings and (4) formalise our learnings for CPProc. Following an iterative approach to method design, we co-create and evaluate the emerging artefact in four rounds:

(1) a prototyping workshop with circular economy experts to develop the concept;
(2) a co-creation workshop with a sustainability and procurement expert to define how to embed the tool into the CPPRoc process;
(3) a validation round to evaluate how the tool can help to improve an existing tender; and
(4) an application to develop concrete CPProc checklists.

Our key learnings reveal a strong tension between the resources and capacity of municipal buyers on the one hand and the complexity of the CPProc challenge on the other hand. This tension highlights the importance of specialised sustainability roles within a municipality, at least in times of transition, and the need for an iterative, multi-step process to adjust to

circular practices. The rest of this paper is structured as follows: First, we introduce background knowledge on circular public procurement. Second, we describe how we apply the action design research methods. Third, we explain the artefact: the CPProcC Builder. Finally, we present our findings and discuss the learning for CPProc.

Background: Circular Public Procurement

Municipalities exert considerable influence through public procurement (Hunka *et al.*, 2023): around 12% of global GDP is spent by governments on public procurement (OECD, 2016) and between 260-480 billion Euros are spent on public procurement in Germany annually (Becher, 2017). Municipalities are responsible for around 50-60% of this volume. Thus, integrating circular principles into public procurement processes presents an important lever in the transition towards a circular economy.

To harness these opportunities, it is important to raise awareness among municipal employees and provide comprehensive information regarding the potential benefits associated with CPProc (Hunka *et al.*, 2023). These include value maximisation for users and producers, optimising resource efficiency, supporting climate change mitigation strategies, protecting biodiversity, as well as promoting innovation and job creation (O'Carroll *et al.*, 2023). In spite of these benefits, implementing CPProc remains challenging for municipalities and the uptake is slow (Qazi and Appolloni, 2022). Evidence suggests that many of the challenges from green public procurement - which focuses on products and services with a reduced environmental impact throughout their life cycle - also apply to circular public procurement: ranging from individual-level knowledge and perception gaps, through the lack of organisational processes and resources to missing institutional governance systems (Sönnichsen and Clement, 2020a). Since circular public procurement goes one step further and aims to create a closed-loop system for products, circular public procurement is experienced as even more complex due to supply chain interdependencies and network requirements (Hunka *et al.*, 2023).

A compilation of proven circular criteria for public procurement that provides ready-to-use templates for practitioners could mitigate some of these challenges (Sönnichsen and Clement, 2020a; Kristensen, Mosgaard and Remmen, 2021). In particular, such templates can act as boundary objects that bridge between individual and organisational level knowledge and contribute to the emergence and institutionalisation of new routines and processes that increase effectiveness and efficiency (Carlile, 2002, 2004). But just having a catalogue of circular criteria will not achieve the purpose – we also need to offer guidance on how to prioritise such criteria based on a deep understanding of the system, and how to

include such criteria in procurement processes. Thus, in this paper, we aim to alleviate some of the challenges in CPProc implementation by offering a research-grounded and practice-oriented tool for including systemic circularity principles into public procurement processes.

Methods

The research context is the project “bergisch.circular" which aims to support three municipalities in Germany in becoming more circular. To that end, the “bergisch.circular” project team utilised the design thinking methodology to explore challenges in circularity-oriented public administration and prototype solutions with practitioners from the municipalities of Wuppertal, Remscheid, and Solingen in Germany. As a result, the project team developed a comprehensive guide for implementing circular measures within administrative frameworks. This guide supports capacity building as well as practical implementation by offering know-how, best practices, and hands-on tools. Its key focus areas are waste avoidance, circular construction, and public procurement. The CPProcC Builder is part of the latter focus area. Thus, the CPProcC Builder contributes as one method in a larger toolkit that aims to enable joint decision-making and implementation of circular measures.

The development of the artefact follows an *action design research* (ADR) approach. ADR allows to develop and evaluate practitioner-oriented tools, commonly called artefacts, based on scientific knowledge and derive generalised learning from this process that contribute to theory (Sein *et al.*, 2011; Bojer and Møller, 2022). ADR has been developed by merging two approaches: action research (Bradbury, 2017) and design science research (Brocke, Hevner and Maedche, 2020; Seckler, Mauer and Vom Brocke, 2021). From action research, ADR borrows the strong focus on a practitioner problem that guides the iterative search for solutions, whereas from Design Science it borrows artefact development and validation techniques (Mullarkey and Hevner, 2019; Sein and Rossi, 2019). Therefore, while we always start with a practice-based problem in ADR, the sequence of the subsequent steps is cyclical, not linear. We iterate the problem definition and the intervention until we come to a solution that has the required utility. Hence, evaluation, reflection, and learning are constantly repeated throughout the design journey. Accordingly, our study design consists of four iterative, cyclical steps common in ADR (see Figure 1). We explain each step below.

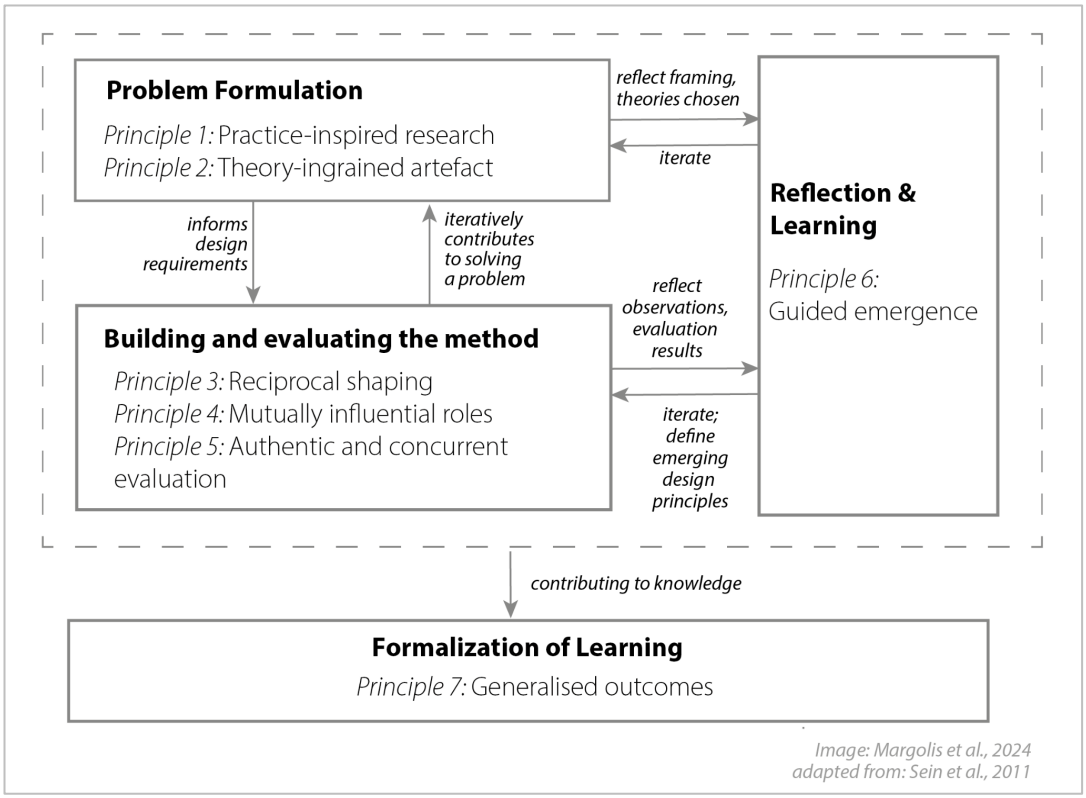

Figure 1: Action design research (ADR) process based on Sein and colleagues (2011)

Problem formulation: Developing design propositions & requirements

Already during the application process for the bergisch.circular project, it was identified through dialog with municipal stakeholders that public procurement can be a central lever for the cities' circular economy activities and moreover, that a much clearer guidance on circular public procurement is needed. The subsequent design propositions and requirements are developed from literature and design workshops with practitioners. They inform the development of the method.

From literature, we adapt the following design requirements:

1. Enable prioritisation of circular criteria based on a systemic perspective (Ahsan and Rahman, 2017; Sönnichsen and Clement, 2020b)
2. Acknowledge the tension between costs, functional attributes, and sustainability requirements (Rainville, 2021; Qazi and Appolloni, 2022)
3. Identify system constraints in implementation: information and knowledge gaps, missing incentives, regulations, or processes (Günther and Scheibe, 2006; Kristensen and Remmen, 2019).

Two further requirements emerged through practitioner collaboration later in the process. Literature points to a critical role of intermediaries in facilitating CPProc (Rainville, 2021). However, our work with municipalities shows that they lack the resources to continuously involve external intermediaries in procurement processes. To that end, municipalities increasingly employ sustainability experts who can act as promoters and knowledge brokers in public procurement (Hunka *et al.*, 2023). Therefore, we add the following requirement:

4. Effectiveness: Reduce the need for the involvement of external intermediaries by translating knowledge into an actionable method that can be applied by employees of municipalities.

Finally, prototype testing in "bergisch.circular" showed that municipal employees prioritise efficiency and favour clear structures and templates due to time and knowledge constraints. This strongly applies to the field of public procurement as most employees only exercise procurement as a part of their job. Therefore, we add the requirement:

5. Usability: The public procurement tool should offer easy-to-use guidance for the most common product categories.

Building and evaluating the method

This phase interweaves building the method (intervention) with evaluating it in multiple validation cycles. The detailed steps are presented in Table 1.

Table 1: Steps in building and evaluating the method

Step	Objective	Activity	Result/Evaluation
1	Discover knowledge-creation target	Literature review; Practitioner discussions	Research question defined
2	Select input knowledge	Literature Review; Preliminary discussions with Circularity Thinking expert	Circularity Thinking selected
3	Learn how to apply the input knowledge	Digital workshop with 10 participants facilitated by an experienced Circularity Thinking facilitator. Technology: Zoom, Miro-Board.	Workshop completed for three product categories
4	Operationalise	Defining two additional design	Additional design

	input knowledge for public procurement	requirements (#4,#5) based on the workshop insights: The core team (5 participants) proposed the requirements based on insights from the workshop.	requirements defined
5	Identify a solution that fulfils the requirements	The core team develops a prototype tool in several interactive sessions.	Prototype I exists
6	Validate Prototype I focusing on completeness and usability	Physical workshop with 7 participants where the prototype is presented and improved.	Completeness and usability improved leading to Prototype II.
7	Validate Prototype II focusing on effectiveness and efficiency in relation to public procurement processes	Workshop (3 sessions) with one practitioner and three experts comparing an existing call (electric desk) with a result that the method would generate.	Effectiveness and efficiency demonstrated. Additional insights generated on how to integrate the method into existing procurement processes leading to Prototype III.
8	Validate scalability of Prototype III across different product categories and context scenarios	Three project members apply the method to develop circular criteria checklists based on specific scenarios. Two Circularity Thinking experts check and comment on the resulting checklists.	Scalability is confirmed for manufactured goods

The next step in constructing the method was to identify input knowledge that would help to address these requirements. We started with principle one that called for a systemic perspective on circular criteria. When selecting approaches that would support this requirement, we decided to use Circularity Thinking (see next section for details) as it is a proven method to support a systemic approach to circularity: Circularity Thinking allows to understand which problems occur along the linear value chain and subsequently map and prioritise context-specific circular solutions that could address these problems (Blomsma and Brennan, 2022). Throughout this process a circular framework, the Circularity Compass,

acts as a boundary object that allows linking different elements of the value chain (Blomsma and Brennan, 2019; Blomsma, Tennant and Ozaki, 2023).

As the Circularity Compass allows to map specific contexts, using it as a tool to facilitate discussion also addresses requirement two: acknowledging the tension between costs, functional attributes, and sustainability requirements. Circularity Thinking allows the users to have a discussion around which problems they need to address in terms of functionality and sustainability and prioritise solutions based on the resulting criteria. Equally, Circularity Thinking can help to address design requirement three as the Circularity Compass offers a system map where users can map system constraints, such as knowledge gaps or missing regulations. Thus, Circularity Thinking offers very high utility in the early stages of understanding the problems of a linear system as well as developing and prioritising circular solutions.

But to translate the insights that Circularity Thinking generates to be used within public procurement processes, we also needed to address design requirements four and five that are very specific to the context of public procurement. Public procurement tends to rely on lists which specify product requirements. But, as the literature review above and practitioner feedback has shown, municipal employees do not know how to define circular criteria for tenders. Therefore, in discussions with practitioners, it was decided that what is needed is a method that would support the development of circular criteria checklists while integrating systemic insights from the Circularity Thinking Process. So, with the CPProcC method we are attempting to bridge the tension between systemic complexity in circular systems and a user-friendly format that is widely applied in public procurement processes.

The CPProcC method was iteratively created in a series of workshops (see Table 1). Initially, these sessions followed the Circularity Thinking format (see details in the next section). Specifically, we have selected three product examples that (a) corresponded to common products in public procurement and (b) resembled diverse circular challenges. The analysed products and categories are presented in Table 2.

Table 2: Analysed products and categories

Category	**Product**
Office furniture	Desk (electrically height-adjustable)
Elections supplies	Ballot paper; Process digitisation
Outdoor equipment	Playground swing

As a result of the sessions, we developed a catalogue of questions, generic solutions, and action examples along the product life cycle. In particular, we could demonstrate how circular strategies complement each other or compete. We also demonstrated that procurement actions may range from 'best practice' (e.g. including existing certifications), over structured and analytical (e.g. defining specifications), to complex and experimental collaboration (e.g. digitising the election process).

The solution was validated in three ways following the design evaluation framework by Venable and colleagues (2016). First, we held a prototype workshop with seven participants where we presented an early prototype of the CPProcC and asked for detailed feedback. Second, we presented the prototype to a municipal employee from the City of Remscheid who was skilled in sustainability and public procurement. Together, we applied the CPProcC to an existing tender from the City of Remscheid and analysed if the CPProcC would have led to higher efficiency and a more systemic solution (effectiveness). Building on these insights, we co-developed an approach for integrating the prototype into the overall procurement process. Finally, together with a practitioner, we applied the method to develop examples of context-specific checklists for different product categories, which helped to validate the scalability of our solution.

Reflection and Learning

Reflection and learning was integrated as a key activity throughout the process. The core team met after each workshop to discuss insights and adapt the method. The first author led a journal that documented key insights. Critically, the core team was iteratively extended as the solution evolved. For example, a Circularity Thinking expert (author one) was onboarded after identifying the input knowledge. Towards the end of the project, the municipal employee from the City of Remscheid also joined the reflection sessions. One of the outputs from the reflection and learning sessions was the definition of design requirements four and five. Further, these sessions also contributed to defining which validation rounds are needed to evaluate the utility of the solution.

Formalisation of Learning

Formalising our learnings by generalising the outcomes is the final step in our study design. The objective of this step is to project the situated learnings from the bergisch.circular project onto a class of field problems. Sein and colleagues suggest three levels of generalising: (1) problem instance; (2) solution instance; and (3) deriving design principles from research outcomes.

As the study will continue until Q3/2024, formalising the outcomes is still ongoing. Currently, we have generalised the problem instance as enabling processes in CPProc in Germany. Correspondingly, our solution is the CPProcC method that can be applied by

municipal employees across Germany. We are planning to publish details on how to do this in a practitioner guide later in 2024. Formulating design principles from our process can support researchers and practitioners in other geographies who are attempting to enable CPProc processes. The development of such principles is still ongoing. However, first insights are presented below in the Findings and Discussion sections.

Designing the Method: The Circular Public Procurement Checklist (CPProcC) Builder

Our objective is to support municipalities in implementing systemic CPProc. This results in the development of a *Circular Public Procurement Checklist (CPProcC).* The CPProcC is the result of applying the design requirements (see Methods section) to an existing approach for systemic circular analysis: Circularity Thinking. Therefore, below, we describe both: Circularity Thinking and the CPProcC method.

Circularity Thinking

Circularity Thinking allows us to analyse resource streams along the supply chain and identify systemic circular solutions with corresponding implementation approaches (Blomsma and Brennan, 2019, 2022; Margolis and Blomsma, forthcoming). The strength of Circularity Thinking is its systemic perspective: it builds a picture of the whole resource life cycle - from material, through parts and products and subsequent circular strategies - and invites the identification of seen as well as less obvious types of waste. In turn, this enables the identification of a comprehensive set of problem and solution spaces, linking material flows and supply chain actors (Blomsma, Tennant and Ozaki, 2023).

The Circularity Thinking process employed in this study consisted of seven modules: the first four modules focused on the identification of waste and corresponding solutions to address this waste. These modules are mandatory in every Circularity Thinking analysis as they allow users to define the systemic context, understand the problems, and prioritise solutions. The subsequent Circularity Thinking modules (5–7) were selected from a set of elective modules, which can be configured depending on the concrete use case. We decided to focus on three modules that cover implementation and actor analysis. These seven modules are summarised in Figure 2.

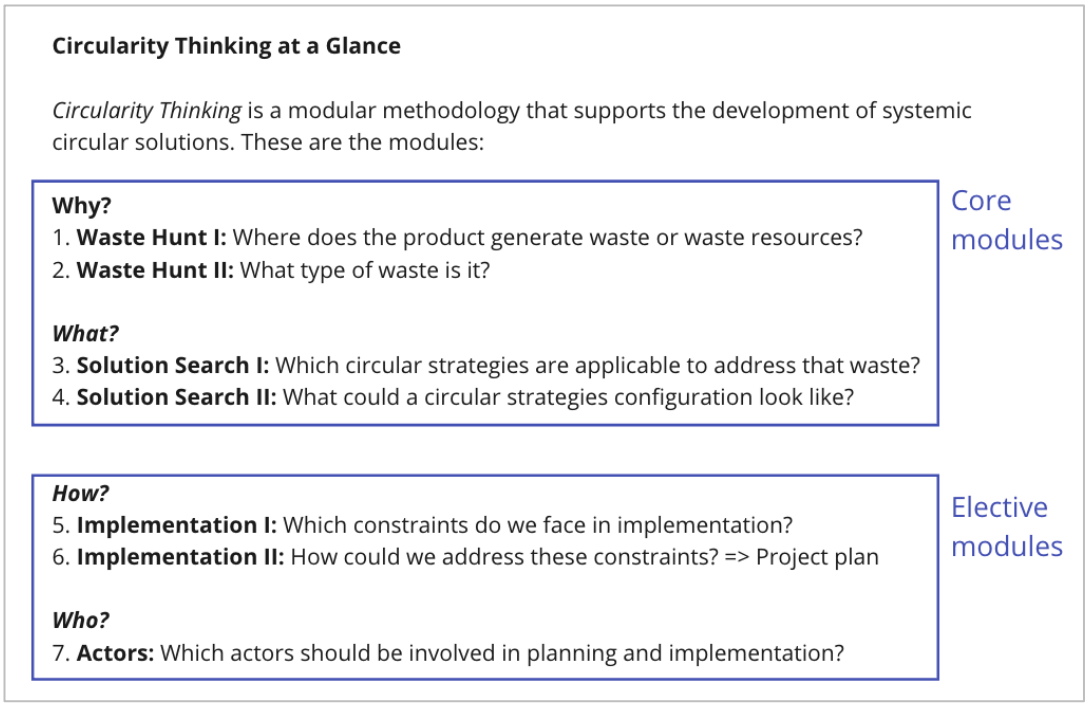

Figure 2: Circularity Thinking modules

The CPProcC Builder: Prototype III

The CPProcC method is embedded within a comprehensive guide for municipalities on how to contribute to the circular economy. This guide is the result of the "bergisch.circular" project. In the guide, we refer to the method as CPProcC Builder as the method is not an actual checklist but a combination of a circular criteria catalogue with detailed guidance on how to select circular criteria appropriate for a specific context. The CPProcC method covers six elements (see Table 3). Together these elements build up a comprehensive catalogue of critical questions and systemic solutions in circular procurement with guidance on how to assess and apply the criteria. The interactive visualisation supports buyers in navigating the supply chain and understanding the systemic connections.

Table 3: Elements included in the CPProcC Method

Element	Format	Function
Rationale	Video, text, visual	Explain why circular procurement needs to take a systemic perspective.
Interactive tool	Visual: Circularity Compass with interactive buttons	Demonstrate how material flows move along the value chain and how they are interconnected.
Analysis questions: waste hunt	Table with questions specific to a certain problem space. Formulated in a language suitable for tenders.	Sensitise buyers where waste may occur along the supply chain. Demonstrate that waste may be caused in one part of the supply chain but occur in a different part.
Solution proposals	Table with solutions specific to a certain solution space. Formulated in a language suitable for tenders.	Offer buyers a catalogue of possible circular solutions at each stage of the value chain. Buyers can use this catalogue to select solutions that will work in their context.
Prioritisation guide	Table with 'rule of thumb' instructions on how to prioritise among solutions.	Enable buyers to resolve goal conflicts based on a systemic approach. Highlight the difference between anchor and support strategies.
Examples	Checklists for three products. Icons signify different scenarios.	Offer buyers concrete ideas for common product categories. Demonstrate that circular procurement can follow different implementation approaches.

The six elements are described below. First, Circularity Thinking and the main rationale behind using the approach is explained to the user (see Figure 3).

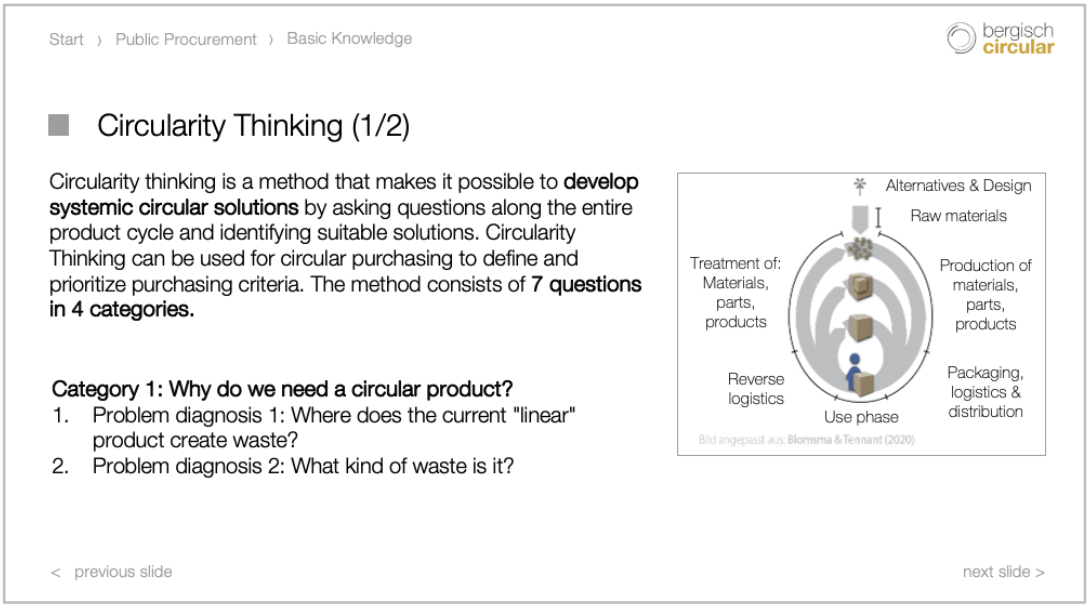

Figure 3: Extract from the draft of the first element.

Second, we introduce an interactive version of the Circularity Compass where the content for a specific problem and solution space can be accessed with one click on the corresponding button (e.g., Alternatives, Design, Raw Materials, etc.) (see Figure 4).

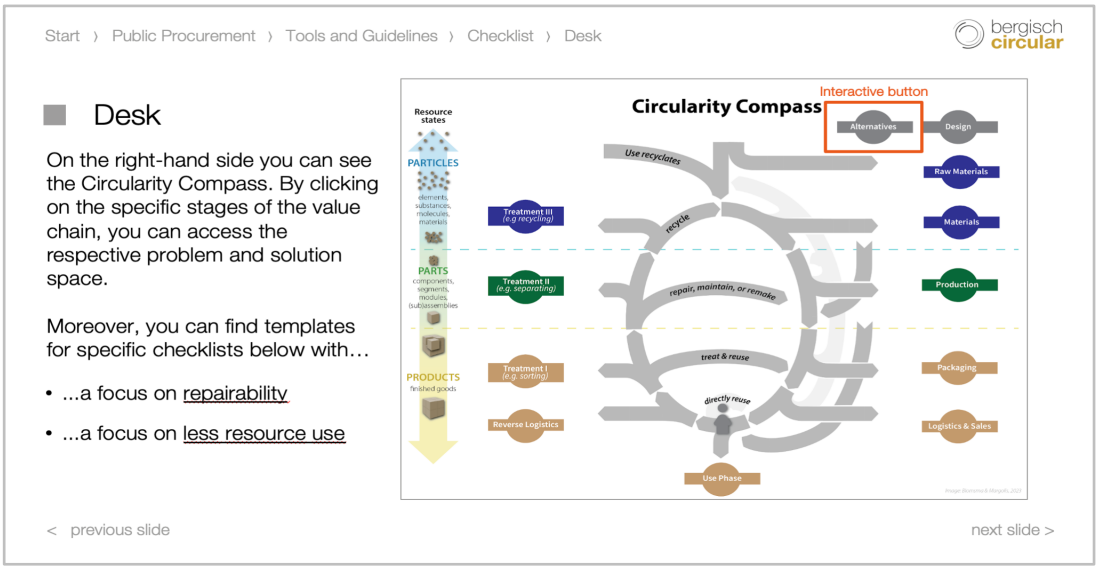

Figure 4: Circularity Compass with interactive problem/solution spaces before clicking the interactive button (example "Alternatives").

Third, a list of relevant questions in order to identify waste streams at each problem space is offered. This resembles the *waste hunt* in Circularity Thinking. Fourth, possible solutions for these problems, which can be preselected in the form of a circular criteria are proposed. The fifth element focuses on how to prioritise circular criteria, i.e. how to decide which of the many points on the checklist are the most important. Here, we offer guidance on how to identify anchor strategies and how to complement these with support strategies, building on Circularity Thinking. For example, when procuring reusable to-go dishes for a canteen, *reuse* will be the anchor strategy as this is the focus of the project. However, after several use cycles the dishes still have to be recycled. So, *recycle* will be a support strategy. As the development of the CPProcC is still ongoing as of April 2024, elements cannot be shown visually in this paper. They will be accessible upon the publication of the guideline later in 2024.

Finally, the CPProcC offers examples of concrete circular procurement checklists for three products configured based on different context scenarios (see excerpt in Figure 5). The three products were selected in discussions with the municipalities with the objective to cover very different but also very common procurement categories, resulting in the following product selection: height-adjustable desks, laptops, and pens. For each of these products we create two to three context-specific scenarios. The scenarios are important to remind users that circular procurement projects can follow many routes: from largely adopting the procurement requirements from other actors with suitable 'best practices' (clear project), over developing a detailed catalogue of procurement criteria (structured/complicated project), to initiating an innovation project with several value chain participants (agile/complex project). Route selection will depend on the system constraints and the available resources and capabilities.

ll Design: Ideally, you should combine several strategies, e. g. a product could be reusable and recyclable.

Aspect	Open question	Purchasing criteria (example)	
1. Longevity	How many years can the desk be used at least?	„The desk has been designed so that it can be used for at least 10 years“	☐
2. Design for Reuse	How do you deal with modules in good condition?	„The contractual partner shows how individual modules of the desk that are in good condition can be removed and reused after use"	☐
	Can you guarantee that the desk will be taken back at the end of its useful life?	„The contractual partner guarantees that the desk will be taken back at the end of its useful life (also possible by third parties)“	☐
3. Design for repairability	For how many years do you guarantee the supply of spare parts?	„The contractual partner guarantees the supply of spare parts for at least 8 years" (if necessary, by providing proof from spare parts manufacturers)	☐
	What features simplify the repair of the desk?	„The desk has a modular design and can be dismantled into individual parts. Simple disassembly with standard tools is possible."	☐
	What features simplify the repair of the desk?	"Instructions are available (in writing or as a video) on how to disassemble and repair the product"	☐
	Were additives used that could hinder the repair?	"No additives (paints, adhesives, coatings) were used that could hinder repair"	☐

Figure 5: Excerpt from a CPProcC example for a height-adjustable desk.

Findings

This study is still ongoing until Q3/2024. The preliminary learnings from the tool evaluation are presented below.

Organisational roles

Organisational roles differ not only in their job description but also in levels of knowledge, engagement, and time availability. For example, municipal employees often have to do procurement tasks alongside their other responsibilities. This reduces specific task expertise and increases the need for time- and resources-efficient approaches.

Correspondingly, tools for different actor groups within a municipality may differ. Specifically, we differentiate between two groups of employees: (1) *municipal sustainability experts* and (2) *buyers*. We describe this finding in more detail in the following section.

Process perspective

While the CPProcC represents an important step in achieving a circular public procurement, it will require two additional process steps to institutionalise circular public procurement and make it mandatory across the organisation.

First, the CPProcC must be translated into concrete priorities for specific products. The main advantage of the current CPProcC is that it represents a comprehensive catalogue of criteria. However, these criteria have to be screened, operationalised for a product, and prioritised. These actions require an understanding of circular principles that is inherent to municipal sustainability experts but less common across the organisation. Left alone, municipal buyers may struggle with criteria prioritisation and will need support from sustainability experts. Here, the CPProcC offers municipal sustainability experts a good starting point to reflect on circular procurement criteria and translate these into specific checklists for the categories or products most commonly purchased in the municipality.

Second, these product-specific checklists should be institutionalised. It is recommended that the product-specific checklists become obligatory in the respective organisation by means of mandatory organisational directives. However, mandatory checklists should never be copied from other municipalities without involving a sustainability expert as they have to reflect the local context.

Tension between procurement and circular perspectives

In procurement, project relevance is assessed based on financial volume. Projects with a high volume receive more attention and explicitly formulate tender criteria. However, to achieve circularity, the amount of prevented waste streams should be the critical indicator. Resolving this tension may need an additional step where the circular potential of the

overall procurement portfolio is assessed and linked to non-financial indicators. As a result, products that have a lower financial volume may still be of high priority from a circular perspective.

In summary, applying CPProcC has shown that while public actors often ask for simple solutions, getting to these solutions will require embracing complexity first. We need to start by asking systemic questions about the waste impacts along the product life cycle. Translating these questions into simple solutions that can be managed by non-experts requires a series of steps and an understanding of specific product categories, application contexts, and ecosystem offerings.

Discussion

Our objective was to develop a tool that supports municipal buyers in circular procurement. Below, we discuss how our key findings contribute to the literature in circular public procurement.

First, CPProcC supports municipal users in acknowledging and discussing goal tensions. This includes not only the commonly mentioned cost-sustainability tension but also the tension between functional requirements and circular principles. While these tensions have been acknowledged in literature (cp. Rainville, 2021; Qazi & Appolloni, 2022) bringing them to the foreground will allow a more specific inquiry into municipal practices.

Second, the CPProcC offers specific guidance on how to prioritise circular criteria. This is extremely valuable to overcome the perception that CPProc is very complex and only accessible through intermediaries and experts (Sönnichsen and Clement, 2020a; Rainville, 2021). The use of examples with varying levels of complexity can support buyers in growing on the maturity curve as they can start with best practices and potentially move to the more complex practices as their knowledge and network increase (Hunka *et al.*, 2023).

Finally, the testing process shed light on the roles and processes in CPProc inside the municipal organisation. One of the biggest tensions in designing the CPProc was the tension between usability and effectiveness on the one hand and the systemic perspective of the supply chain on the other hand. In short, the tension between ease-of-use and analytical complexity. Municipal sustainability experts can play a critical role in resolving this tension: they are capable of performing the complex analysis that translates the checklist into the local context and specific products. This confirms the critical role of internal sustainability experts in promoting CPProc (Hunka *et al.*, 2023) and sheds light on how such experts can initiate, scale, and institutionalise CPProc. With this, we contribute to the emerging

research stream on the CPProc processes and roles (Sönnichsen and Clement, 2020a; Kristensen, Mosgaard and Remmen, 2021; Rainville, 2021).

Research opportunities are twofold: First, we propose to extend the naturalistic testing and apply the CPProcC in some large tenders. Second, a comparison of using the CPProcC across geographies could shed light on the differences in public procurement practices across countries. Third, we propose to further explore how each step in the CPProc process: from initiation, through scaling, to institutionalisation can be supported by science-based tools.

Conclusion

Circular public procurement can play a significant role in advancing the circular economy transition. We conceptualise, design, and test a tool – the Circular Public Procurement Checklist (CPProcC) Builder – that facilitates the practical implementation of circular procurement practices in municipalities. The CPProcC addresses five design requirements that are critical to overcome implementation challenges. Insights from testing the CPProcC Builder shed light on key roles and the need for process adjustment in circular public procurement.

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