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## **Integrating stakeholders perspectives: the case of circular concrete pavers in the City of Amsterdam**

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### **Abstract**

Construction activities in the built environment use a vast amount of resources, making the circular economy an attractive paradigm against the linear take-waste-dispose economy to reduce this resource consumption. Within the built environment, this transition encompasses the use of circular strategies across the product life cycle for materials. This entails efforts from multiple stakeholders across the product value chain. In this study we therefore explore how stakeholders engagement can aid the process to arrive at a common understanding of a public sector circular business model (PSCBM) in the case of a circular concrete paver. We conducted a participatory design workshop aimed to design this PSCBM with all relevant stakeholders across the product life cycle were (re)presented. We conclude that the presence of stakeholder perspectives was observed to be necessary in drafting up a PSCBM for a concrete paver, but caution is needed. Outcome-wise stakeholder engagement was necessary to sharpen the dream, indicating stakeholder value propositions, activities required, value trade-offs and to arrive at a relevant set of indicators. Process-wise, stakeholder engagement in this setting was relevant because stakeholders were enabled to share perspectives and challenge each other perspectives accordingly. This leads to the advantage that the practical feasibility of proposed ideas could immediately be challenged. However, outcomes and assumptions should always be cross-validated and updated according to new insights (e.g., relevant outcomes of tests or regulations, latest insights on reuse and recycling innovations). The outcomes are time- and context-bound and very much reliant on the perspectives shared. The findings of this study contribute to our understanding of how stakeholder engagement in a workshop setting, can potentially be useful to strategize about circular products. We conclude that this for example, could help to improve the functional and esthetical requirements for product procurement.

**Keywords:** circular economy, circular procurement, public sector circular business models, public space, stakeholder engagement

### **1. Introduction**

Local governments are expected to play a pivotal role in achieving circularity goals in the built environment (Osei-Tutu et al., 2024). For example, public procurement can play a major role in creating circular buildings and constructions (Alhola et al., 2019). In the Netherlands, municipal efforts to create a circular economy (CE) can very well be enacted in the physical municipal outdoor public space. Municipalities are asset owners and consume a vast amount of materials every year to create and maintain their roads, parks, squares, etc. For example, public spaces in Leiden demand an average of 240 million kilos of material every year (PosadMaxwan, 2022). Creating a circular built environment is considered to be a multi-stakeholder challenge (Osei-Tutu et al., 2024). However, we do not yet fully understand how stakeholder engagement contributes to understanding the circularity of a product. Based on the aforementioned studies, we hypothesize that that stakeholder engagement is required to truly understand circularity of a product. Hitherto, this study aims to understand the benefits and limitations of stakeholder engagement in constituting a circular product. To do so, we use a public sector circular business model

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(PSCBM) framework and applied it for a use case in the city of Amsterdam. In the city, a concrete paver with a relatively low environmental footprint was piloted. We invited all stakeholders and gathered all relevant stakeholders perspectives across the concrete product value chain in one workshop session. The aim of the session was to strategize the future use of circular concrete pavers within the municipality, using a PSCBM template. This study synthesizes this experience of stakeholder engagement to arrive at a shared future of a circular concrete paver in the municipality of Amsterdam.

The aim of this paper is to contribute to the understanding of CE by exploring how stakeholder engagement can potentially be useful to strategize about circular products. This paper is structured as follows: Section 2 provides background information on the circular built environment as a multi-stakeholder challenge and how business models for the public sector can be of use; Section 3 explains the research methodology; Section 4 contains observations of stakeholder engagement in this study; Section 5 discusses these observations and Section 6; provides a summary of the study and conclusions.

## **2. Background**

### *2.1. Moving towards a circular built environment is a multi-stakeholder challenge*

The activities to create a circular economy in the built environment are dispersed among the stakeholders across the product value chain (Ho et al., 2024). To integrate circular economy principles in the built environment many stakeholders are needed with different roles and responsibilities (Osei-Tutu et al., 2024; Schraven et al., 2019). This implies that individual stakeholders need to execute activities (i.e., circular procurement, reuse and recycling activities) taking into account that the circularity of a product is not jeopardized in next product life cycle stages. The lack of stakeholder engagement in the construction industry one of the key barriers to adopt circular procurement (Sajid et al., 2024).

### *2.2. The use of business models for the public sector in the circular economy*

Moving towards a circular economy within the construction industry may require the adoption of new business models for stakeholders involved (Torres Curado et al., 2024). Although in the private sector research is conducted on circular business models, integrating public sector bodies more specifically has not been largely explored in academic literature. Efforts have been aimed at connecting supplier business models to procurers business models (Witjes & Lozano, 2016) and to connect public sector and circular businesses models (Lewandowski, 2018). Since local governments play an important role in accelerating the transition in the construction industry (Osei-Tutu et al., 2024), a PSCBM may be helpful as a tool to conceptualize why and how to operate circular strategies within the city. Especially in the municipal public space this is relevant, as municipalities are responsible for designing, maintaining and retrofitting the public space.

## **3. Methodology**

### *3.1. Research design*

We conducted a participatory design workshop with the aim to design a PSCBM for a circular concrete paver in co-creation. Storvang et al., (2017) find workshops in business model research a useful method to engage multiple stakeholders. Hence, we used a workshop setting to discuss a potential PSCBM too. The pilot innovation discussed was a concrete paver (i.e. “betonstraatsteen” in Dutch) applied in a recent roadwork replacement project (Oct 2024). The low impact of the paver originated from the use of secondary materials, that included 15% residue slag from a waste-to-energy plant (WTE-slag) as a replacement for sand and fine gravel and fly ash and blast furnace cement to replace Portland Cement. For aesthetical reasons, the paver had a red natural stone top layer, partly from waste materials of stone mining operations. We used this exercise as a case study to draw empirical observations on stakeholder engagement.

We prepared the workshop in advance by preparing the content in parts of the template, to use the workshop time most effectively and drafted the participation list together with the initiating municipal innovation manager. The motivation for participants to join was to engage in a discussion on the use of circular concrete pavers within the municipal context. The following workshop participants were invited: innovation manager, project leader, project director, buyer, asset manager (advisor), contractor, product supplier (of the piloted product) and high-grade recycler of concrete pavers. Most stakeholders were present at the workshop, but the contractor and buyer were represented by others. The asset management advisor represented the buyer, being involved in establishing product requirements for procurement as well. The recycler represented the contractor, being familiarity with other contractor activities as well. We conducted one 3.5h workshop on 3<sup>rd</sup> of Feb 2025. Prior to the workshop consent forms were signed according to GDPR regulations.

The PSCBM template used in this study, is an adaptation of the Business Model Template (Jonker & Faber, 2020). The PSCBM template includes the opportunity to discuss all value propositions for all stakeholders involved across the product value chain. Furthermore, it includes a multi-value perspective on value generation/capture, including sustainable and public value creation. Besides, it concerns activities on both the municipal as the infrastructural project level. The template has been tested as evaluation and ideation tool in several cases within the municipality of Amsterdam. An overview of the building blocks is included in Table 1.

### 3.2. Data collection and analysis

The session was recorded, audio transcribed and the data coded, using codes that related to the building blocks and content (e.g. scope description, circular strategy, risk, risk mitigation measure etc.) to perform a descriptive analysis of the final business model. All participants were asked for feedback on the final result through email. From the data, observations on the process and outcome were drawn on the use of stakeholder engagement. We coded these observations inductively from the workshop data.

**Table 1. Building blocks of Public Sector Circular Business Model (source: Reijtenbagh et al., (2025) [Manuscript in preparation])**

<i>Phase</i>	<i>Building block</i>	<i>Content</i>
Define value	Circular strategy (& Scope Description)	Description of the circular strategy (and the project)
	Motive & Context	Description of the reasons, challenges, and requirements of execution the circular strategy
	The Dream	Description of the common dream that is worked towards when implementing this circular strategy.
	Value Proposition (for each stakeholder separate)	Description of the value proposition for each stakeholder
Deliver value	Core activities, parties involved and resources required	Description of all activities, actors and resources (incl. artifacts) required
	Risks and risk mitigation	Description of risks and possible measure to mitigate them (and who is responsible to mitigate these)
	(Internal) test	Description of conditions to success and factors that influence feasibility
Generated value	Value created	Description of benefits and costs that relate to the value domains: public, social, environmental/circular and financial value
	Impact measured	Description of indicators that measure the impact

## 4. Findings

The results describe how stakeholders engaged in drawing up a possible future of a circular concrete paver within the municipality of Amsterdam and how this helped in drafting up a public sector circular business model. The results report on the stakeholder engagement in the different phases of the business model: defining value, deliver value and generated value.

### 4.1. *Define value: Identify value propositions for each stakeholder and shape a collaborative dream*

Drafting a collaborative dream that is agreed upon by each stakeholders worked as a steering wheel in the business model. *If activities were proposed that that did not match the objectives in the dream, stakeholders activated each other to rethink these activities.* The participants discussed the dream, and agreed that it is not a vision or a requirement, but rather a shared idea that can change over time. The subsequent presentation of the stakeholder *value propositions of all stakeholders involved, opened up a discussion on what product's properties are needed to maintain circularity across the value chain.* This increased awareness on the different stakeholder perspectives. The question was asked: who's value proposition is not met? Only the recycler responded with a 'no' as he would face problems in his recycling process. This led to suggestions on how to change the product design such that it could be reused and recycled in the future ahead and the possible feasibility of doing so.

### 4.2. *Deliver value: creating a comprehensive co-created overview of activities and requirements*

The identification of risks and risk mitigation measures were helpful in reshaping activities of stakeholders and requirements, like rules, regulatory measures and contracts. A collaborative discussion on conditions for success and feasibility factors further helped (re)shaping these. *Because stakeholders could immediately react to each other, proposals on requirements and activities could be challenged.* For example, according to the recycler the use of WTE slags impedes the recycling process involved in producing cement powder from concrete. Then a discussion unfolded by the asset manager adviser, supplier, innovation manager and recycler on the implications of replacing these slags by other materials.

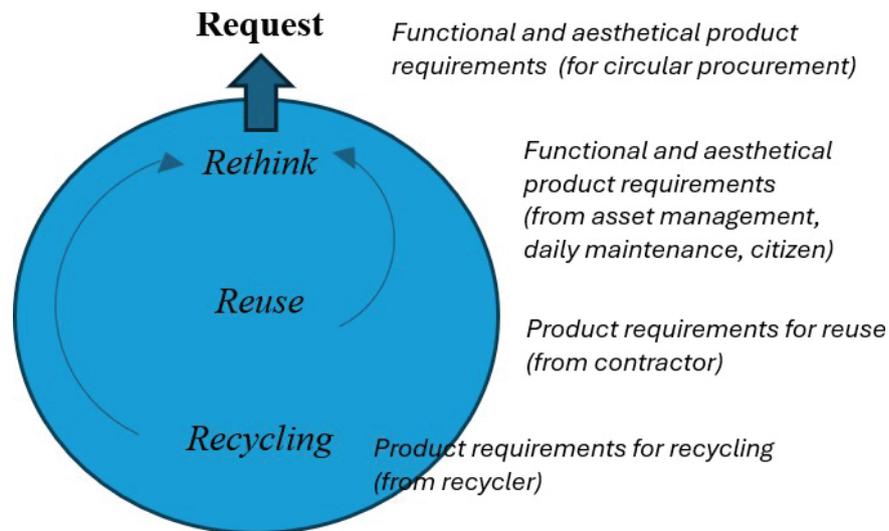
### 4.3. *Value generation: debating value trade-offs between stakeholders and evaluating the practical logic of impact indicators from different stakeholder perspectives*

Discussing value generation with different stakeholders provided insights into *possible value trade-offs between stakeholders.* During discussions on the value created anecdotes were shared upon possible value trade-offs. These did not concern only concrete pavers, but nevertheless gave clear illustrations on value trade-offs. For example, in the past, granite curbs have been used, but they cause slipperiness problems. From an aesthetic point of view, it is a 'good' choice, but the slipperiness led to many claims. Another value trade-off was mentioned: during execution of a project you often experience a choice between nuisance and ease and quality of the execution. A short and intense execution with more workspace was considered better, but it creates more nuisance/obstruction for local companies and citizens. In addition, *collaboratively debating impact indicators made the participants aware of which indicators do (not) make (practically) sense.* For example, local employment was not considered important, since labour shortages force contractors to work with people nationally and even internationally.

## 5. Discussion

In this study we observed stakeholder engagement in a workshop setting to discuss a circular concrete paver with a PSCBM lens. The recycler (also in his contractor role) was able to explain how the piloted products affects the concrete recycling and reuse process, meanwhile the supplier was able to explain the potential pitfalls of changing the product design. Because of the workshop set-up, perspectives could immediately be challenged. Municipal officials contributed their ideas on aesthetics, functional quality

and low environmental footprint to the discussion and provided relevant examples from their experiences and daily practices. Stakeholder engagement in this setting facilitated immediate knowledge exchange, the ability to hear each other perspectives and assessments on feasibility of suggestions during discussion. Hence, the results showcase that the inclusion of all relevant stakeholders across the value chain aids understanding of what is required to reuse and recycle products in later phases of the product life cycle. This can lead to new insights on how products design could be adapted to safeguard future reuse and recycling, in sum *circularity*.



**Figure 1. Proposed integration of requirements of all stakeholders responsible for maintaining circularity across the product's life cycle**

In the workshop, all stakeholder perspectives were necessary to be able to consider what is required to maintain circularity across the product's life cycle (visualized in Figure 1). As a result, this input can be useful to (re)shape product design requirements. This contributes to the call of Alhola et al., (2019) that shaping better conditions for procurement needs market innovation towards creating novel products and solutions that are improved in terms of recyclability, the use of recycled materials, proven disassembly, and increase in life span. Effective circular procurement includes collaborative capabilities of trust, coordination of supply chain activities, decision-making power, technical knowledge, and information sharing capabilities (Ababio et al., 2025). Stakeholder engagement in this workshop setting, especially enabled information sharing capabilities.

Though, we found benefits of stakeholder engagement in this setting, there are also limitations to the representativeness of the perspectives shared and hitherto to the final outcome of the PSCBM. An inevitable bias is introduced due to that 1) only perspectives from workshop participants are shared and these may not be representative or not congruent with sectoral positions or other market parties, 2) the perspectives shared can only be argued and challenged during discussion, but not be verified as such, 3) if stakeholders are not present, representation of stakeholders makes the input of these perspectives less reliable 4) participants have only their (limited) technical knowledge and experience and 5) they may have limited ability to express these. As a result, in further research endeavors that include multiple stakeholders, we advocate for taking some time to discuss and evaluate assumptions explicitly. Cross-validation with other sources (e.g. research reports on recycling opportunities) is needed to check validity of outcomes and assumptions. Also, regular updates of the model are needed to the latest insights on reuse and recycling possibilities and regulatory requirements. Lastly, the experience of the co-creative process in this study may not necessarily compare to the development of other road construction products. Hence, further research could follow the same procedure used in this study and compare the findings.

## 6. Conclusions

In this study we explored how stakeholders involvement can aid discussions in a participatory design workshop aimed to design a PSCBM for a circular concrete paver. In this workshop all relevant stakeholders across the product life cycle were (re)presented. The presence of stakeholder perspectives was observed to be necessary in drafting up a PSCBM for a concrete paver. Outcome-wise stakeholder engagement was necessary to sharpen the dream, indicating stakeholder value propositions, activities required, value trade-offs and a relevant set of indicators. Process-wise, it was relevant *because stakeholders were enabled to share perspectives and challenge each other perspectives*. This leads to the advantage that the practical feasibility of proposed ideas could immediately be challenged. Outcomes and assumptions should always be cross-validated and updated according to new insights (e.g., relevant outcomes of tests or regulations). All in all, we can conclude that shared perspectives from stakeholders across the product life cycle are needed to effectively evaluate the feasibility the product in terms of upcoming reuse and recycling activities across the product's life cycle, which supports our hypothesis. However, there are limitations to stakeholder involvement in a workshop setting with respect to representativeness, that ultimately affect the initial outcome. Further research, could focus on identifying what information or process is needed after a co-creative workshop, that can lead up to a final outcome of an envisioned PSCBM for municipalities.

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