













Analysing Stakeholder Opinions Within the COST Action CA21103 CircularB and Beyond: Circular Economy Implementation in Construction

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Abstract. This study examines the importance and adoption of circular economy (CE) principles within the construction industry by focusing on stakeholders' opinions on key CE strategies across different building life cycle stages. The study draws insights from the perceptions of European-based stakeholders who actively participated in the CircularB Workshop 1 Part 2, entitled Creating a Roadmap towards Circularity in the Built Environment - State-of-the-Art. The research comprises two parts. In the first part, a structured survey was employed to systematically collect opinions on the levels of awareness and variations among the adoption and importance of selected CE implementation strategies within the construction sector. The second part engaged stakeholders in a dynamic creative thinking activity, posing seven targeted questions allowing participants to offer multiple answers for each query. Overall, the study sheds light on the multifaceted challenges and opportunities inherent in fostering CE within the construction domain by highlighting the significance of recognising and addressing systemic barriers within the CE framework, the importance of product design for disassembly, and the efficient production of reusable and recyclable materials. Furthermore, it emphasises the necessity to motivate industry stakeholders to participate actively in the transition to a CE, bridging the gap between theory and practice frameworks and increasing the engagement of policymakers and governments.

Keywords: Circular Economy · Construction Industry · Stakeholder Perspectives · Building Life Cycle · Policy Recommendations

1 Introduction

The concept of circular economy (CE) is gaining global prominence, particularly in European policy development, where it is now integrated into legal frameworks and national strategies of several European countries, including Spain, Italy, and the Netherlands [1, 2]. Despite widespread efforts encompassing numerous initiatives and programmes introduced to enforce the transition from the conventional linear economic model to a circular approach, the construction sector hardly welcomes innovations, notwithstanding technological advancements [3]. Among different barriers existing in the construction sector to CE development, one of the most critical challenges is linked to the limited involvement, interest, and awareness of stakeholders [4–6]. Recognising the importance of stakeholder involvement in mitigating risks and shaping effective business models, particularly in the context of CE practices, various forms of engagement become crucial [6]. However, a notable challenge is the lack of stakeholder awareness and motivation towards CE, highlighting the need for more inclusive participation [7].

The increasing risks associated with urban challenges, such as climate change adaptation and mitigation, alongside rigorous legislative measures promoting sustainable consumption and production, as well as growing customer interest in environmentally friendly practices, show the necessity of transitioning towards CE practices [8, 9]. In this context, CE drives the construction industry towards adopting innovative and sustainable models, such as green and circular buildings, aligning with environmental objectives and offering long-term economic benefits. Consequently, collecting a comprehensive understanding of stakeholders' perspectives towards CE is essential to effectively implement and maximise the potential of the CE business models. This involves recognising their perceptions, concerns, motivations, and expectations, ensuring a smooth and effective transition to CE systems.

This study aims to understand stakeholder perspectives on CE within the construction industry through two approaches: 1) assessments from a stakeholder survey and 2) insights from a creative thinking workshop using the Six Thinking Hats method. These activities were performed during the workshop of the European COST Action CircularB (CA21103) Workshop 1 Part 2 (WS1P2), providing valuable insights into stakeholders' attitudes and perceptions towards CE in construction. The workshop was held in Cordoba, Spain, between 12 to 15 September 2023.

2 Methods

2.1 COST Action CA21103 CircularB and Its Series of Workshops and Activities in Cordoba, Spain

COST Action CA21103, entitled Implementation of Circular Economy in the Built Environment (CircularB), is a four-year networking initiative that started in October 2022. The primary goal of this Action is to develop a comprehensive circularity framework for new and existing buildings, supporting decision-makers and involved stakeholders in assessing the implementation status of the European Circular Economy Action Plan (CEAP). CircularB Action unites a multidisciplinary group of stakeholders from 39

countries, with a predominant representation from Europe. WS1P2 was an integral activity during the inaugural year of CircularB. It encompassed presentations, discussions and interactive activities on various CE-related topics within the context of buildings and built environments, including circularity criteria and KPIs (key performance indicators), circular business models, standards and legislations promoting or hindering circularity. Additionally, the discussions delved into circular feedback value chains, exploring stakeholder interactions and roles. WS1P2 served as the focal point for the survey activities outlined in this study. CircularB members and specially invited local stakeholders actively participated in these survey activities, contributing valuable insights to further the goals of the Action.

2.2 Survey Instrument

A survey instrument was developed to measure stakeholders' opinions on CE strategies in construction projects. Strategies were grouped under four life cycle stages (LCS) and presented in a concise manner. Nineteen items were listed and asked. Participants completed the survey using the semi-guidance structure provided by the authors. The survey questionnaire was organised into three sections: socio-demographic parameters, importance, and adoption levels. Figure 1 lists the selected CE implementation strategies under their LCS.

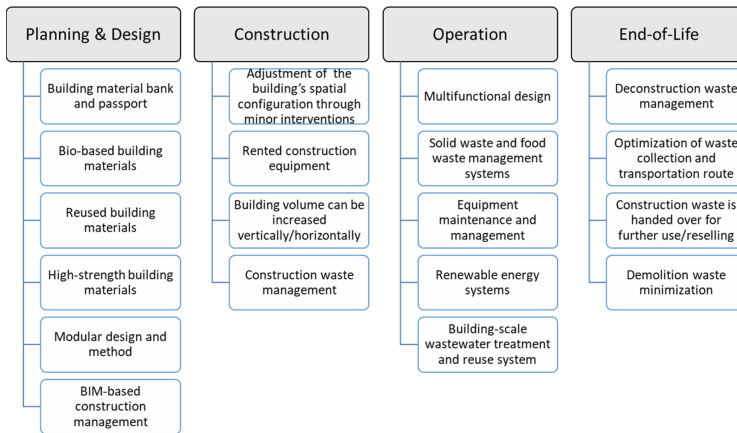


Fig. 1. Selected CE implementation strategies.

2.3 Creative Thinking Activity

On 15th September 2023, the First CircularB Stakeholders Day was held as part of the WS1P2 activities, featuring a dynamic debate that used Mentimeter, an interactive survey tool, to gather and present real-time responses. The debate was enriched by the Six Thinking Hats methodology [10, 11], which explored diverse perspectives arising

from the responses to seven Mentimeter Questions (hereinafter, MQs). The questions investigated policies and initiatives related to CE in Construction and Demolition Waste (CDW) and the adoption process of CE in the built environment. The most highly rated or popular responses were discussed after the online collection of feedback, and valuable insights were extracted from the data. This methodology provided a multi-dimensional perspective on the challenges and opportunities associated with CE in CDW, advancing the study in this domain.

3 Results and Discussions

3.1 Stakeholders' Opinions on the Importance and Adoption Levels of CE Strategies

This study summarises the methodology and findings derived from workshops and activities conducted as an integral part of the CircularB COST Action, *i.e.*, mainly from WS1P2. The primary objective was to investigate stakeholders' perspectives regarding key CE strategies within the building sector and the built environment.

Firstly, a semi-guided survey centred around the importance and adoption analysis was employed to gather insights on CE strategies. This survey first gathered information on respondents' nationality, expertise, company size, and stakeholder category. Then, the stakeholders' opinions on the ranking 19 key CE strategies were collected. The distribution of stakeholders by occupation is summarised in Table 1.

Table 1. Summary of the stakeholders' profile.

Stakeholder type	#
Academician/Researcher	29
Contractor	2
Designer Architect and/or Engineer	4
Government and/or Councillor	1
Manufacturer	3
Urban designer	1
Other, please specify	2
Total	42

The stakeholders in the event primarily belonged to the academic domain. However, there are also individuals directly involved in the construction sector industry, including manufacturers, engineers, designers and contractors, consulting companies, and government-level policy and decision-making processes related to the implementation of CE in the construction value chain, particularly in buildings and the built environment. Participants were mostly from Europe, and specifically from Spain, being the dominating country in terms of numbers as the local host of the event. Typically, the

participants were experienced individuals with more than five years of active engagement in CE-relevant practices.

The survey responses were analysed to measure the opinions on CE implications across LCS, opinions on CE implementation strategies, and considerations specific to stakeholders' countries. The results highlighted the importance of bridging the gap between theory and practice by motivating industry stakeholders to actively participate in the transition to CE. Although the majority of stakeholders acknowledged the importance of implementing CE strategies throughout the building lifecycle, there exists a disparity between the perceived importance and actual adoption levels, particularly concerning the end-of-life stage. This stage was identified as the most crucial, with a significant gap in the adoption of end-of-life strategies on the ground.

This conclusion gained further support when examining the correlations among key CE strategies' importance and adoption levels. The averages of the Planning and Design, Construction, Operation, and End-of-Life stages for the importance and adoption scores are given in Table 2.

Table 2. The average scores for implementing CE strategies across building lifecycle stages, measuring both importance and adoption by country.

Country	Adoption				Importance			
	Planning & Design	Construction	Operation	End-of-Life	Planning & Design	Construction	Operation	End-of-Life
Austria	2.8	3.4	4.2	3.8	4.0	4.2	4.8	4.3
Croatia	–	–	–	–	4.3	4.4	4.4	4.8
Czech	2.5	2.8	4.4	3.8	4.5	4.6	4.6	5.0
Denmark	2.2	1.9	2.9	2.9	4.0	4.1	3.6	5.0
Greece	2.3	2.4	2.0	1.0	4.2	4.3	4.2	4.6
Italy	3.0	4.4	3.0	3.0	4.3	3.9	4.2	4.0
Latvia	3.2	3.5	3.5	3.8	4.3	4.3	4.3	4.0
Lithuania	3.7	4.2	4.3	4.8	3.2	3.3	3.2	4.5
Luxembourg	2.8	–	–	–	4.3	3.8	3.6	4.0
Malta	2.0	2.0	2.4	4.3	4.7	4.5	4.9	4.3
North Macedonia	3.1	3.3	3.3	3.1	4.3	3.8	4.3	4.4
Portugal	2.6	3.1	3.6	3.3	4.5	4.6	4.8	4.8
Romania	4.0	3.4	2.8	1.8	4.5	4.6	4.0	5.0
Serbia	2.8	2.9	2.1	2.0	4.2	4.4	4.8	5.0
Spain	2.5	2.8	2.9	2.3	4.1	3.7	4.1	4.7
Turkey	1.9	3.1	3.3	3.2	4.1	4.3	4.3	4.7
United Kingdom	2.2	3.0	2.0	1.5	4.5	4.2	4.4	4.8
Average	2.7	3.1	3.2	3.0	4.2	4.1	4.2	4.6

Notably, strategies such as deconstruction waste management, optimisation of waste collection and transportation routes, construction waste handling for further

use/reselling, and demolition waste minimisation exhibited substantial gaps, requiring increased investment and attention to facilitate their practical implementation.

The survey also indicated that strategies such as building-scale wastewater treatment and reuse systems, modular design and methods, high-strength building materials, and multifunctional design had achieved adequate implementation levels relative to their perceived importance.

Some participants - i.e., three academicians and two manufacturers - did not provide scores for adoption levels, citing a lack of knowledge about the practical situation. This highlights the urgent need to bridge the gap between theory and practice.

Stakeholder scores from various countries were analysed for insights into construction project life stages, with average scores shown in Fig. 2.

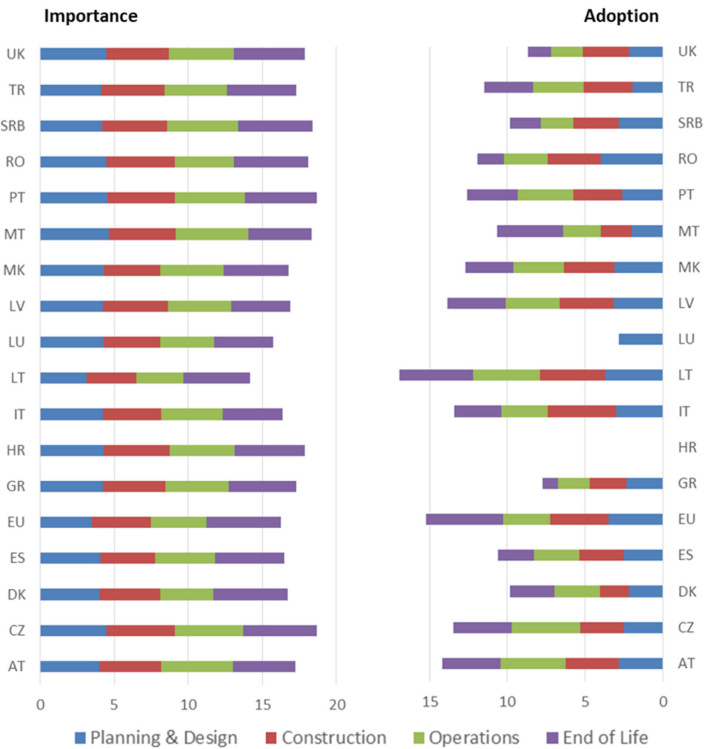


Fig. 2. Average values of the stakeholder responses from participating countries for the CE implementation strategies for their importance and adoption.

Some stakeholders, like Croatia, didn't score certain stages due to a lack of expertise. European policymakers were represented as the 'EU'. Stakeholders from the Czech Republic, Portugal, Croatia, Serbia, and Malta rated the highest importance, while Lithuania and Luxembourg were the lowest. Nine countries, including Turkey and Romania, had higher adoption rates. Interestingly, stakeholder opinions varied; German

stakeholders rated implementation strategies important but low on adoption, whereas Lithuania scored high on adoption but low on importance.

Zhang et al. [12] ranked European countries on mineral landfilling, with Lithuania at the top and Spain, and Romania at the bottom, matching our adoption rankings. However, Greece and the UK, lower in our study, ranked higher in theirs.

At a country level, Czech Republic, Portugal, Croatia, Serbia, and Malta scored the highest in terms of importance levels, while Lithuania and Luxembourg scored the lowest. Regarding adoption levels, noticeable divergences were observed across most participating countries compared to their importance levels. Out of all the European countries, it is surprising to note that Germany and the UK had the lowest scores when it comes to the adoption of CE practices. This is despite the fact that they have better overall performance compared to other countries in Europe. On the other hand, Lithuania emerged as the leader with a high adoption score of 4.2, which is slightly higher than “important”. However, it is still hard to comprehend why Germany and the UK performed poorly in terms of adoption, as they are both highly developed countries with advanced economies.

When we look at Lithuania’s stakeholders, we see that they have the highest adoption scores but the lowest importance levels. This is a paradox as the country has been consistently progressing year after year, and they have shown remarkable improvement in their CE indicators [13]. It is difficult to explain why the stakeholders in Lithuania have a low perception of the importance of CE practices despite their impressive adoption scores. Further research and analysis are needed to understand this phenomenon better.

The adoption scores for both “end-of-life” stages were the lowest in Germany, the UK and Romania, with averages of 1.0, 1.5, and 1.8, respectively. It is understandable to see the low score in Romania, as it is listed as the lowest-scoring country in Europe’s circularity ranking [14]. However, Germany and the UK are among the leading countries in CE-related publications and have achieved excellence with advances in the construction industry that promote efficiency and sustainability [15]. For instance, the UK, as a territory with a huge quantity of inert raw materials, imposes an Aggregates Levy - a tax on sand, gravel and rock that is dug from the ground or dredged from the sea in UK waters - to encourage the use of secondary materials. Despite the high level of performance and importance given to CE in Germany and the UK, this lower adoption score of “end-of-life” practices might be related to the legislative framework, which is mainly moving towards the elimination of landfilling through increased taxes: *e.g.*, specific bans or taxes to increase the fees of landfills. The high cost of landfill tax may encourage stakeholders to prefer other types of waste destinations, particularly for end-of-life waste [16]. This situation requires a more in-depth analysis, and conducting in-person interviews with stakeholders may be necessary for better justification.

The operation stage had the highest average adoption score of 3.2, but this was not significantly different from the other scores given for the other life stages. For instance, the minimum average adoption score was calculated for the planning and design stage at 2.7. All the scores for the adoption levels were around 3.0, indicating neutrality. The stakeholder ratings for the adoption of CE implementation strategies were analysed, and it was found that the average scores were the lowest for the Design and Planning stage. In particular, the strategies related to “bio-based building materials” and

“building material bank and passport” received the lowest average scores of 2.27 and 2.53, respectively. This result indicates that there is a need to focus more on these aspects during the Design and Planning stage. Additionally, the recent literature supports the findings that circular design principles, such as modular design, have been promoted in the construction industry. However, there have been fewer attempts to implement these principles during the Design stage. This low adoption is mainly due to the complexity of building multiple lifecycles and the unsuitability of certain building components for this design concept, as noted by Yang et al. (2022) [17]. Therefore, we highlight the necessity to create awareness about the benefits of circular design principles and encourage their implementation during the Design stage.

Participants agree that the circularity concept does not accelerate key CE strategies. This may indicate the sector is influenced by other concepts like “sustainability”, “resource efficiency”, “waste management”, and “green building”. Despite circularity’s growing awareness, with its importance scoring around 4.5 (between “important” and “extremely important”), its diffusion remains “neutral”. This shows a limited shift towards circularity in practices and projects. It’s crucial to note that European sectors’ circularity performance is influenced by concepts overlapping with CE. Thus, enhancing understanding and showcasing the benefits of circularity is key to its broader adoption across sectors and industries.

Unfortunately, there is a widespread lack of comprehension regarding the precise meaning of circularity and its principles in many countries, which poses a major challenge to the development of proper supporting policies for CE strategies. This fact spotlighted the pivotal role of governments, policy-making bodies, and institutions in steering the transition to a CE in the construction sector. Concurrently, numerous initiatives across countries aim to promote CE implementation, with notable examples highlighted, particularly in the UK and Spain.

3.2 Six Thinking Hats

The second activity, conducted using Mentimeter as a guiding tool along with the Six Thinking Hats method, engaged 24 stakeholders through seven proposed questions (Fig. 3), allowing participants to offer diverse answers for each query. Although this activity encompassed various stakeholder types and multiple industry sectors, a majority hailed from academia. On the front of policies and legislation, the prevailing policies predominantly focus on waste management and recycling.

The activity facilitated a discourse on the impediments to CE implementation, with stakeholders underscoring the deficiency in legislation and policies as a primary barrier. Other obstacles identified included costs and the need for proper education. Participants proposed indicators for monitoring the transition, predominantly focusing on end-of-life indicators for recycling, reuse, and CDW management, albeit with minimal consideration for social factors. Crucial future steps to enhance CE implementation in the sector involve increased engagement of policymakers and governments, adopting digital tools and technologies, illustrative case studies showcasing the technical and economic viability of CE solutions, heightened awareness, and establishing standards and incentives.

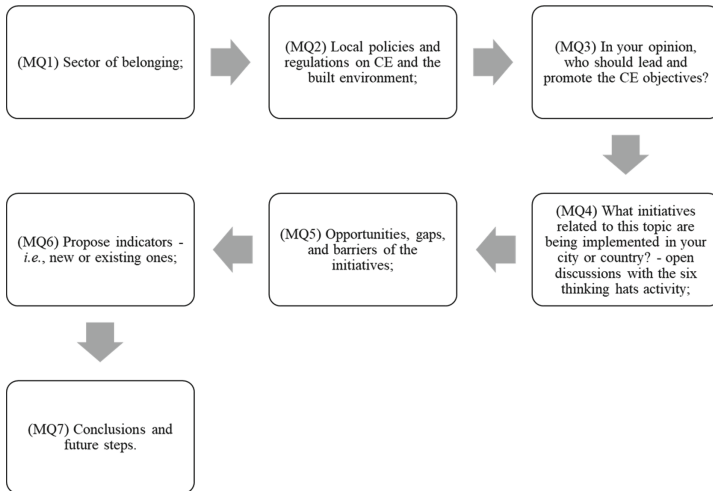


Fig. 3. Seven questions and steps of the creative thinking activity.

4 Conclusions

In conclusion, this research highlights the importance of gaining a deeper understanding of stakeholder perspectives on various aspects of CE within the built environment. To achieve this, it is necessary to conduct further research by increasing the sample size and diversifying respondents in the survey. The methodology employed in this study for ranking and prioritising key CE strategies needs further refinement through an exhaustive literature review, including stakeholders' input on crucial strategies not covered in the initial survey. A more comprehensive evaluation of circularity performance in buildings can be achieved by transforming the ranking and prioritisation into a multi-criteria model that encompasses technical, economic, environmental, and social dimensions. This will provide a more holistic perspective on the sustainability of buildings.

Overall, the findings highlighted the significance of systemic barriers in the CE, product design for disassembly, the role of packaging processes in generating CDW, and the efficient production of reusable and recyclable materials. Furthermore, the conclusions highlighted the imperative of bridging the gap between theory and practice by motivating industry stakeholders to participate actively in the transition to a CE. Finally, increasing the engagement of policymakers and governments, adopting digital tools and technologies, illustrative case studies showcasing the technical and economic viability of CE solutions, heightened awareness, and establishing standards and incentives are crucial future steps to enhance CE implementation in the sector.

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