Circular Economy in the Construction Industry

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Manila Time (UTC +8)
Online via Zoom

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Agenda

Dr Dina Azhgaliyeva: Introduction

Prof Dr Luis Braganca and Dr Rand Askar: CircularB - Aims and Goals

Dr Rand Askar: CircularB - Achievements

Prof Dr Ferhat Karaca: Importance of Stakeholders' Opinions in Implementing CE

Dr Aidana Tleuken: Research Method and Results

Dr Dina Azhgaliyeva: Policy Recommendations
Introduction

The construction industry significantly impacts the environment. Building construction alone is responsible for 10% of global GHG emissions and 6% of energy use.

The sector faces challenges in decarbonizing by 2050 due to rising CO2 emissions.

Adopting Circular Economy (CE) principles can reduce GHG emissions in construction by creating a closed-loop system, resource efficiency, and minimizing waste. Despite available technologies for circular construction, high costs are a concern.

This study examines stakeholder perceptions of these issues and solutions.
“COST provides networking opportunities for researchers and innovators in order to strengthen Europe’s capacity to address scientific, technological and societal challenges.”

COST implements its mission by funding bottom-up, excellence-driven, open and inclusive networks for peaceful purposes in all areas of science and technology.
The main aim of the Action is to define the methodology to develop a common circularity framework for inclusive application and assessment in new and existing buildings to support decision-making for all value chain stakeholders and appraise the implementation level of the European Circular Economy Action Plan (ECEAP)

https://circularb.eu/
https://www.cost.eu/actions/CA21103/
CircularB – MC and WG membership

Start Date: 1 November 2022
End Date: 31 October 2026
Proposal Phase:
- 28 Countries
- 61 Supporters

Updated on the 13 February 2024

MC Countries: 40 out of 41
MC Members: 76
MC ITCs: 24
WG Members: 382 (and counting…)

<table>
<thead>
<tr>
<th>WG1</th>
<th>WG2</th>
<th>WG3</th>
<th>WG4</th>
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<tr>
<td>287</td>
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CircularB Working Groups (WGs)

**WG 1** (9 Tasks)
Circularity strategies and best Practices
Viorel Ungureanu + Katerina Tsikaloudaki

**WG 2** (7 Tasks)
Circular value chain and stakeholder engagement
Diāna Bajāre + Gabriel Zsembinszki

**WG 3** (8 Tasks)
Circular KPIs framework
Helena Gervásio + Rand Askar

**WG 4** (10 Tasks)
Dissemination and results communication
Philip Griffiths + Adriana Salles
## CircularB – Current Activities

<table>
<thead>
<tr>
<th><strong>WS1 P1 Proceedings</strong> “Creating a Roadmap Towards Circularity in the Built Environment”</th>
<th><img src="image" alt="Create a Roadmap Towards Circularity" /></th>
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<tr>
<th><strong>D2 Publication</strong> “Circular Economy Design and Management in the Built Environment – A Critical Review of the State of the Art” (ready for publication)</th>
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<tr>
<th><strong>Collaborative Journal Papers</strong> (Aprox. 7 publications and many others planned and under development), about topics such as business models and circularity management, cost-benefit analysis, best practices and stakeholders perspectives</th>
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<th><strong>D3 Publication</strong> “Report on technical challenges and barriers for circular strategies implementation” (in progress)</th>
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<th><strong>Standards and policies at International, National and European levels</strong> (factsheets for 21 COST countries)</th>
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<th><strong>D8 Publication</strong> “Circular KPIs”, a dashboard for circularity indicators in buildings covering environmental, technical, economic, governmental, organizational and social dimensions</th>
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Spring series

- **Academia and Research** – Thursday 18 April 2024, 13:30-14:45 CET

- **Policy Shapers and Regulators** – Tuesday 14 May 2024, 13:30-14:45 CET (To be confirmed)

- **Investors, Developers, and Insurance Providers** – Tuesday/ Thursday 18 or 20 June 2024, 13:30-14:45 CET (To be confirmed)

Autumn series

- **Building Design Teams & Building Users, Facility Managers, and Owners** – Tuesday 17 September 2024, 13:30-14:45 CET (To be confirmed)

- **Contractors, Builders, and Manufacturers of Construction Products** – Tuesday 15 October 2024, 13:30-14:45 CET (To be confirmed)

- **Deconstruction and Demolition Teams & Waste Management Industry** – Tuesday 12 November 2024, 13:30-14:45 CET (To be confirmed)
Why stakeholders' opinions are critical in implementing CE?

Construction as an industry is often characterised as conservative and slow to change.

Financial considerations are a major hurdle for the construction industry.

Construction companies and professionals are often hesitant to embrace new practices due to concerns about potential cost increases.

This hesitancy can stifle innovation and hinder the adoption of circular economy principles.

The drivers of a sustainable construction sector:
- government regulations
- external and internal pressure from stakeholders
- perceptions of cost-effectiveness
How to overcome these issues?

Costs associated with CE in construction sector are related to four main factors:

- market development,
- measurement methods,
- policy, and
- knowledge

Considering the geographic dimension, different countries and regions incur varying costs and benefits based on contextual considerations.
Advantages vs challenges

**ADVANTAGES**
- Reduction in waste generation, diminished use of virgin resources, lower environmental impacts, decreased energy consumption and GHG emissions, cost-effective refurbishment, enhanced economic competitiveness by opening new markets, reducing reliance on imports, generating new employment opportunities, tax benefits

**CHALLENGES**
- Quality and usability of reclaimed materials for different applications, various direct costs, including energy and water consumption, transportation, and additional machinery and equipment maintenance, a shift in product design methods, such as Design for Disassembly (DfD) and modular design, requiring changes in technological software, and specific expertise, ...
Costs and Benefits of Circular Economy in the Construction Industry

- It may pose challenges, such as initial investment costs and changes in product design methods.
- The benefits of adopting CE principles outweigh the costs.
- It is crucial to involve decision-makers and engage stakeholders in clearly defining the costs and benefits associated with circular business models and ensure the successful and sustainable implementation of this transformative approach.

The adoption of circular economy principles in the construction industry is an essential step towards a more sustainable future.
Research Concept

Five research questions are explored:

Q1) the impact of CE strategies on construction costs,

Q2) how these strategies increase costs,

Q3) the CE strategies’ contribution to overall benefits,

Q4) how they enhance benefits, and

Q5) activities affecting construction companies' financial performance
Methodology

Identification of the CE Practices and Stakeholders
- Literature review of the CE practices in construction industry related to construction materials
- Literature review on the possible stakeholders in the construction industry
- Organization of the practices by 3R principle groups

Survey Design and Data Collection
- Development of the survey tool based on the practices identified
- Validation: Two round tables for discussion of the questionnaire with academic experts
- Collection of the responses using Qualtrics

Analysis/Cost Benefit Modeling
- Statistical Analysis
- XGBoost (eXtreme Gradient Boosted decision tree)
- SHAP (SHapley Additive exPlanations)

Deliverables (models)
- Importance of CE Implementation Strategies
- Impact of CE Strategies on Cost Increase
- CE Strategies and Overall Benefits
- Activities Affecting Financial Performance
Methodology

Benefits
- Less waste generation
- Less use of virgin materials
- New resale markets
- Less reliance on import materials
- New job opportunities
- Tax benefits.
- Improved collaboration among stakeholders
- The company’s brand and image improved.
- Attracting potential funding

Costs
- Waste sorting.
- Recycling/sorting equipment, etc
- Resources consumption for aggregate cleaning
- Transportation costs in general
- Maintenance costs
- Technological software
- Expenditures on staff expertise
- Workflow change
- Schedule delay due to lack of expertise
- Workers’ resistance to change.
- Violations ending up with fines/penalties.
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<th>NOR</th>
<th>PAK</th>
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RQ1

SHAP values plot from top to bottom (A) European, MAPE: 31.15%, (B) non-European, MAPE: 30.65%
SHAP VALUES PLOT FROM TOP TO BOTTOM (A) EUROPEAN, MAPE: 29.89%, (B) NON-EUROPEAN, MAPE: 33.10%
RQ3

SHAP VALUES PLOT FROM TOP TO BOTTOM (a) EUROPEAN, MAPE: 38.51%, (b) NON-EUROPEAN, MAPE: 27.48%
RQ4

SHAP values plot from top to bottom (a) European, MAPE: 32.55%, (b) non-European, MAPE: 17.75%
RQ5

SHAP VALUES PLOT FROM TOP TO BOTTOM (A) EUROPEAN, MAPE: 28.81%, (B) NON-EUROPEAN, MAPE: 29.63%
Policy Recommendation

- CE Strategies and Overall Costs:
  - Europe: Focus on optimizing reuse, Design for Disassembly (DfD), and offsite production.
  - Non-Europe: Similar concerns, with an added emphasis on offsite production and material reuse.
  - Recycling materials less prioritized in both regions.
  - Need for global cost-benefit analyses on offsite production.
  - Importance of R&D investment and collaboration platforms for cost-effective CE practices.
Policy Recommendation

- Influence of CE Strategies on Cost Increases:
  - Europe: Fines from circular regulations are a major concern.
  - Non-Europe: High waste treatment costs, indicating less-developed waste management.
  - Recommendations include addressing fines, worker motivation, and maintenance costs in Europe; and improving waste treatment and logistics in non-Europe.
Policy Recommendation

- CE Strategies and Overall Benefits:
  - Strong endorsement for material reuse and maximizing storage for reuse universally.
  - Regional variations in prioritizing practices: reuse and recycling in Europe; disassembly in Non-Europe.
Policy Recommendation

- Impact of CE Strategies on Benefits Increase:
  - Europe: Greater emphasis on waste reduction.
  - Non-Europe: Focus on resale markets, collaboration, and funding due to reduced environmental impacts.
  - Both regions motivated by resale markets and environmental benefits.
Policy Recommendation

- Prioritization of Activities Affecting Financial Performance:
  - Europe: Lower transportation costs, resale markets, and stakeholder collaboration seen as financially beneficial.
  - Non-Europe: Focus on reduced use of new materials, workflow changes, and staff training.
  - Minimal importance on brand improvement, indicating a need for public awareness policies.