Evaluating Regional Strategies towards a Circular Economy in the Built Environment

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Evaluating Regional Strategies towards a Circular Economy in the Built Environment

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Abstract. In particular relation to the UN 2030 Agenda for sustainable development goal No. 12 ("responsible production and consumption"), the implementation of a circular economy into the building industry has special potentials. More circular flows of material and information can simultaneously decrease resource extraction, fossil energy consumption and environmental pollution, while allowing new business models. However, this chance still remains largely neglected by decision makers. In order to transform this situation, it is necessary to understand and re-weave the entire value chain – requiring new collaborations between various stakeholder groups. In a three-year project that was dedicated to setting up a strategy for the implementation of circularity in the building sector within a region in Germany, stakeholders were involved to work towards circular value creation beyond waste management. The project proceeded in three dimensions: 1) Action-oriented networking and strategy making, 2) Conceptualizations and implementation steps for a pilot location that makes high-value products from building waste, 3) Identification of action items and project initiations. Based on a stakeholder analysis, this paper reflects upon the entire process, with a focus on qualitative information flows. The paper concludes with a critical view regarding the stakeholder network method of the project and its efficiency in implementing the circular economy on a regional scale.

1. Introduction

Sustainability and circularity have gained increased attention in the global architectural discussion. This is caused by the evident contribution of the building sector to environmental impact including climate change [1]. Due to energy efficiency restrictions, implemented across Western Europe in the 70'ies of the last century [2], this impact could be reduced significantly for the usage phase. Nevertheless, energy and resources used for the production and deconstruction have been neglected as potential to further reduce energy consumption. Since the building industry uses 40-50% of the global resources, produces 60% of the global waste and 33% of the global CO_2 emissions [3], the pressure on improving in sustainability and circularity is growing. In Germany at this stage, the economy works still rather linearly, meaning resource flows are designed to end as downcycling or landfilling [4]. To succeed in the transformation towards a circular economy (CE) in the building sector, entire value flows and stakeholders have to be addressed in new manners. Due to the complexity at hand, innovative and active stakeholders play a major role in contributing to the transition towards CE [5]. Currently, the building industry is moving towards CE, however rather slowly in comparison to other industries. Moreover, several aspects including lack of communication between stakeholders, poor transportation of relevant information and simply a low level of awareness in relation to preserving natural resources, still restrict circular material flows within the building sector [6]. In order to change that, new and innovative projects related to CE have to be developed and executed by various stakeholders. Hence, this paper follows two research objectives: 1) to measure and reflect the impact of stakeholder involvement in a project entitled 'Circular Economy in the Building Industry' (CEBI), especially regarding the process

of generating new actions/projects related to CE, 2) to identify the most important stakeholder groups and their compounds to achieve actions/projects leading towards CE in a regional context.

2. Method

By analysing the stakeholder network of the CEBI project, conducted within a time frame of 3 years, the research objectives mentioned above are targeted. For this, the investigation refers to an industrial region in Western Germany as a case study. The selected Rhenish Mining Area (RMA) in the federal state North Rhine-Westphalia, is home to 12,544 building industry companies, the highest number in Germany [7]. The area is historically determined to deal with the extraction of primary material such as coal [8].

2.1 Strategic project

The project's goal was to establish circular value flows in the building industry of the RMA by focusing on three action fields as following [9]:

1. Designing a strategy to implement CE in the building industry in a regional context through establishing a new network of stakeholders through individual meetings, workshops, events/conferences, project proposals. Cooperation between industry, research, authorities and other interested parties had the objective to establish circular material flows within the field of production, planning/construction, deconstruction and recycling.
2. Development of basic principles and design considerations towards an exemplary model project. Therefore, an expert team evaluated technical and economic aspects for establishing a high value recycling plant for building material [10]. Partners from industry introduced an ideal location for future implementation. Followed by a concept study with structural plans for spatial implementation [11] and a proposal for an industrial park focusing on CE.
3. Generating further ideas and emergent projects for the gradual establishment of CE. The project team, together with cooperating partners in the network, provided impulses as followed: (A) concept for a deconstructable building prototype, (B) first-time use of recycled concrete in a construction project in the federal state, (C) applied research study for renewable construction logistics, (D) technical preliminary study for sorting masonry debris for further recycling, (E) participation in the development of a digital market platform for circular building products, (F) successful project acquisition for a new think tank for circular building economy, (G) proposal for establishing a regional network focused on resource-efficiency in built environment.

Items in the third action field were not planned beforehand by the project team and only occurred due to new stakeholder cooperation within the CEBI-project's time frame. However, transitions of these cooperations into real projects can be understood as major steps for moving towards a CE in the regional building industry. Therefore, the question ‚how to achieve and establish successful stakeholder cooperation and new projects' will be assessed in the following section by analysing the stakeholder network and information flow.

2.2 Stakeholder Analysis

Innovative and active stakeholders is crucial for realising a successful CE. However, understanding the relationships in stakeholder networks and to qualify these networks is challenging – due to their complexity, unpredictable nature and lack of visualization tools. In order to understand the impact of direct and indirect relationships between stakeholders and their exchange of information, this paper refers to a method that displays the relationships between components of a system by identifying iterations [12]. Don Steward's Design Structure Matrix (DSM) from 1981 is a model that analyses dependencies between tasks, information [13] and respectively stakeholders [14]. For this paper, the DSM has been used to answer the following questions: 1) what types of cooperation had to be initiated in order to generate new projects, 2) who are the most important stakeholders for initiating new projects?

First, data was collected by categorizing hierarchically the work flow between stakeholders and rating it as followed: 1) individual meetings, 2) conference contribution, 3) project proposals /member of project committee, 4) project partners. If more than one action was conducted, rating numbers were added up. Furthermore, the stakeholders were categorized into 5 groups: a) association, b) NGO, c)

local/national authority, d) industry/private investor, e) research institute. Based on these categories and hierarchies, a DSM was created with 76 individual stakeholders and a total amount of 454 interactions. In order to simplify the diagram for this article, stakeholders and interactions have been added up further. Numbers in column-direction visualize the output activity (stakeholder on X-axis *sends* information to stakeholder on Y-axis), numbers in row-direction visualize input activity of each stakeholder group (stakeholder on Y-axis *receives* information from stakeholder in X-axis).

Table 1. DSM (simplified representation) of stakeholder's input/output activity

	CEBI	*Association*	*NGO*	*Authority*	*Industry / private investor*	*Research institute*
CEBI	-	33	32	22	85	59
Association	4	-	3	-	4	5
NGO	12	3	2	-	10	-
Authority	9	-	8	-	-	-
Industry	9	-	6	3	33	23
Research	10	-	15	-	24	26

The third action field of CEBI's objective, was to generate additional projects by interested stakeholder teams, or at least project proposals (projects are listed above in 2.1.3). These initiatives were created anew during the CEBI-project's timeframe of 3 years. In order to analyse the dependency of each new project on the existence of CEBI, a score was developed by adding all activities (in-and output flows) of the stakeholders and dividing it with the total sum of activities by CEBI, e.g. a direct link from the project CEBI to a new project was numbered with a score of 1,0. Initiatives that interacted relatively independently achieved a higher score than 1,0. Initiatives that were highly dependent on CEBI had a lower score than 1,0. The total numbers are shown in Table 2.

Table 2. Stakeholder involvement into new projects listed in 2.1.3.

	CEBI	*Association*	*NGO*	*Authority*	*Industry / private investor*	*Research institute*	**Score**
Project A	37	-	26	-	12	26	**2,7**
Project B	52	-	9	6	43	5	**1,1**
Project C	4	-	-	-	-	4	**1,0**
Project D	23	-	-	-	3	-	**0,1**
Project E	28	-	-	-	-	18	**1,0**
Project F	54	-	12	-	12	12	**0,7**
Project G	35	12	26	-	-	26	**1,8**

3. Results

The most active stakeholders were industrial partners or private investors and research institutes with 85 and 59 input activities (see Tab. 1). In total they had the highest involvement in CEBI, due to both in- and output activities. Besides, these two stakeholder groups cooperated the most with each other and started new projects or project proposals (Tab.2). The project CEBI itself mostly addressed NGOs (total output of 12, Tab. 1) and research institutes (total output 10, Tab. 1). The involvement of associations related to the building economy into CEBI was relatively high (input of 33, Tab. 1) but did only lead to more than one project, as depicted in Tab. 2 (Project G). This was contrary to expectations of the project team at the beginning of CEBI. In total, 7 new projects were generated through the involvement of the CEBI team. The score developed in Tab. 2 shows how far the projects were dependent on CEBI and therefore would not have been realised without it. New initiations of projects with a high number of stakeholders were relatively independent from CEBI with a score above 1,0 (project A, B and G, project title in Chapter 2.1.3). Projects with only one stakeholder (C, D, E) were directly related to the project and would not have been realized without CEBI (Project E was based on commission). Nevertheless, this cooperation did not lead to new long-term projects with

independent character. The initiation of Project F involved several stakeholders and was led by the CEBI team and therefore achieved a low score of 0,7.

4. Conclusion

In order to transform an industry into a CE, innovative projects reflecting the paradigm shift have to be initiated. For this, stakeholders related to all steps of value creation envisaged need to get activated. In this context, a project with adaptive space for initiating and pursuing additionally emerging projects during its course can be effective. Due to unpredictable stakeholder activity and willingness for cooperation, the outcome of stakeholder involvement is difficult to plan and has to be initiated within a flexible process that is to some degree incremental. None of the above listed projects could have been realised without the involvement of the CEBI project, while cooperation with a high number and variety of stakeholders succeeded best in initiating new projects. Consequently, future research could investigate, if new cooperation should be generally structured in highly diverse ways, and to which degree. In any case, a successful CE within the building industry needs open minded stakeholders that are willing to share ideas and to cooperate with others – beyond single specialisations and institutional types. In this regard, non-profit and impartial initiatives like the CEBI project can facilitate circular value creation, bring actors together and promote new ideas. Hence, they offer new ways to begin and facilitate the implementation of CE in the building sector.

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