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Circular Economy in the building industry European policy and local practices

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ABSTRACT

As one of the biggest consumers of natural resources, the building industry is a central target for EU and national Circular Economy (CE) policies. This qualitative case study uses a practice theory approach to investigate how firms in the building industry in Luxembourg and Gothenburg, Sweden, understand CE and develop circular practices. The main findings indicate that the industry is in the early stages of developing CE practices. Most companies are in an orientation process and define the meaning and content of the Circular Economy. The definition and scope of what is included differ in the two case regions and show a clear link to prior policies. We do not find industry-wide practices in firm activities. We find promising developments in individual firms or supply chains, including purchasing for lower waste, CE materials and design using non-virgin materials and using digital tools to increase transparency. The main hindrances, according to interviewees, are the lack of cooperation between actors and guidance from policymakers. They further claim that fragmentation and lack of transparency are barriers to circular practices in the industry.

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Circular Economy; policy; sayings and doings; materiality; building industry; sustainability

1. Introduction

In the last decade, the Circular Economy (CE) has emerged as the preferred strategy for developing sustainable production and consumption. The CE renaissance originated in China with a policy addressing the mounting environmental problems in 2003, followed by the 'Circular Economy Promotion Law of the People's Republic of China' in 2009 (Geng et al. 2012; Lieder and Rashid 2016). The European Union (EU) followed in 2011 with the 'Roadmap to a Resource Efficient Europe' (European Commission 2011), supported by reports and action plans in 2015 and 2020 (European Commission 2015, 2020) and the European Green Deal (European Commission 2019). The action plans specifically discuss the building industry (construction and demolition) as a sector with a significant environmental footprint and potential for developing CE practices (European Commission 2015, 2019, 2020).

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The building industry is one of the most significant industrial sectors in Europe, contributing 5-13% of Gross Domestic Product on average (Eurostat, 2015) as well as being one of the biggest users of natural resources and generates around third of all waste in the EU (Adams et al. 2017). Thus, the industry is a central target for CE policies for reducing primary raw materials and energy consumption, the carbon footprint and waste generation (Adams et al. 2017; European Commission 2014, 2015, 2020). National and industry level numbers for the building industry show some progress, especially regarding waste and energy consumption in buildings. However, little is known about the CE activities in individual building firms or shared practices across the industry. Ghisellini, Ripa, and Ulgiati (2018) find that review papers show a limited amount of research on how, or even if, firms in the building industry respond to CE's growing policy emphasis. These findings imply a discrepancy between the weight on CE given by policymakers and knowledge about current practices in the building industry (Chiappetta Jabbour et al. 2019).

This article aims to respond to this literature gap by investigating how the building industry responds to recent CE policies by developing CE practices in daily activities. Focusing on the link between the formal institutions (laws, regulations and written formalized procedures) represented in CE policies at the international (EU), national or regional level and how firms in the building industry react to these policies, we argue that practice theories offer a useful tool for investigation of such changing routines in economic activities (Radwan and Kinder 2013; Schulz, Hjaltadottir, and Hild 2019). Researchers agree that institutions moderate the effectiveness of policies and the emergence, stabilization, and transformation of social practices (Bathelt and Glückler 2014; Glückler and Lenz 2016). However, exactly how the interactions between institutions and policies can be described systematically for their impact on social practices still needs to be investigated (Welch 2016). We utilize an operationalization of social practice theory and institutionalist perspective for Circular Economy-related research, suggested by Schulz, Hjaltadottir, and Hild (2019). Therefore, we view the transformation from linear systems to CE as a process based on changes in individual views, beliefs, and behaviours that can develop into industry-wide collective practices transforming the industry's structure. This article aims to respond to this gap in the literature dealing with the main research question of how the building industry responds to recent CE policies by developing CE practices in daily activities? The research is a qualitative case study with two cases, that of the building industries in Luxembourg and Gothenburg.

The remainder of the article is as follows: Section 2 deals with current literature on firm-level practices and CE in the building industry, section 3 outlines the research design, while sections 4 and 5 deal with the two cases of the building industries in Luxembourg and Gothenburg, respectively. Discussions of findings from the two cases are in section 6 and conclusions in section 7.

2. Theoretical background

Circular Economy is seen as an alternative economic paradigm that emphasis living within the planetary boundaries. CE includes using less raw materials, keeping current materials in use longer through designing longer living products, reuse and recycle materials and minimize waste at all states. The most cited definition (Kirchherr, Reike,

and Hekkert 2017; Yuan, Bi, and Moriguichi 2006) is provided by the Ellen MacArthur foundation claiming, 'A circular economy is an industrial system that is restorative or regenerative by intention and design' (MacArthur 2013).

Research on CE in the building industry mirrors the definitions focusing on technological solutions and management, mainly waste (Adams et al. 2017; Akanbi et al. 2018; Esa, Halog, and Rigamonti 2017), predominantly the 3R's, recycle, reuse and reduce (Ghisellini, Ripa, and Ulgiati 2018; Kalmykova, Sadagopan, and Rosado 2018), and life cycle analysis of buildings and materials (Soust-Verdaguer, Llatas, and García-Martínez 2017). The accounts reveal an understanding of CE as an assembly of economic practices that are circular and sustainable. The research is based on individual cases or aggregated data, and there is a lack of knowledge about the development of practices on an industry level. We develop a theoretical framework based on the operationalization of practice theory. Practices are here defined as 'sayings, doings and materiality' and applied them to the building industry (discussed in chapter 2.1). We further discuss the connections between policies as formal institutions and practices. Finally, we use state of the art knowledge about the role of different actors and the development of practices to develop codes within the three dimensions of 'sayings, doings and materiality' (see Table 2). We use this approach to identify circular practices at the industrial level with the building industry in a given region as the unit of analysis. We thus illustrate the relationship between institutions and policies in the building industry at a regional level.

2.1. Contextualizing circular business practices with practice theories

A growing number of publications have advocated the utility of a practice theory approach in the study of social phenomena, with some even pledging a 'practice turn' (Barr 2014; Everts and Schäfer 2019), claiming emphasis is now on what people do instead of what they say. Empirical research focuses on daily practices and routines, aiming to evaluate the effectiveness of policies (Jones and Murphy 2010b). Lancaster University in the UK did considerable work on the link between low carbon policy and social practices (Shove 2014, 2015). Elizabeth Shove, Mike Pantzar, and Matt Watson (Shove, Pantzar, and Watson 2012) unpacked the theoretical work and, referring to previous works of Theodore Schatzki (Schatzki, Knorr Cetina, and Savigny 2001) and Andreas Reckwitz (2002), provided a frame of operationalization, explicitly adding a material dimension to social behaviour (Welch 2016). With the focus on social change, the discussion about materiality centres on how this element impacts the circulation of practices (Shove, Pantzar, and Watson 2012, 37–50). In this sense, infrastructure gives access to materiality (e.g. materials, machines) and facilitates transportation (e.g. roads, rails).

Practices should thus not be seen as actions of individuals or particular firms but as shared 'sayings and doings' by a group of actors. Therefore, this research focuses on shared business practices contributing to the CE in the building industry.

Works that deal with sustainability practices in firms cover, e.g. environmentally friendly and socially acceptable corporate practices, the financing of alternative business models and networks (e.g. clusters for knowledge transfer). Empirical research in firms shows that practices, i.e. what people actually do, can differ significantly from corporate rules and regulations and formal job profiles (Jarzabkowski and Wilson 2002). Only a few scientific publications examine sustainable practices in companies with a practice theory approach. Practice

theories are widespread in organizational research (Geilinger et al. 2016) but often focus on areas with no relation to the Circular Economy: practice boundaries and coordination of work or transformation of work practices (Erden, Schneider, and von Krogh 2014, 714). These works emphasize, among other things, the importance of materiality on work practices, both of the carriers or performers of practice and of 'things' such as technologies or objects (Nicolini and Monteiro 2016) whose full potential has not yet been scientifically recorded (Vaara and Whittington 2012). The nexus between humans and technologies crystallises as one of the trends in management studies, discussed, e.g. as sociomateriality or socio-material practices, interactions (Gherardi 2019). Outside of organizational research, many empirical studies focus on everyday practices such as driving a car, brushing teeth or washing clothes. Above all, however, these studies examine energy policy measures to reduce air pollution, such as in Shove and Walker (2010). Only one publication discusses environmentally conscious behaviour in an English construction company from a praxeological point of view (Hargreaves 2011). In this study, the researchers accompany the entire process from the development of ideas to the implementation of resource-saving measures. Theoretical developments of social practices in economic geography mainly derive from social science and (social) philosophy grounded on the work of Pierre Bourdieu, Anthony Giddens, and Theodore Schatzki (Faller 2016). T. Schatzki defines social practice as nexus of doings and sayings organized by understandings, rules, and 'teleoaffective structures' (Schatzki 2005), thus emphasizing its goal orientation. Schatzki summarizes his definition with the words 'people do what makes sense for them to do' (Schatzki 2010, xiii). Based on the diverse theories and methods that constitute the family of social practice theories, Davide Nicolini proposes a toolkit approach for empirical research, e.g. in companies, that follows zooming in and out on practice (Nicolini 2009). This approach 'requires a reiteration of two basic movements: zooming in on the accomplishments of practice, and zooming out of their relationships in space and time' (Nicolini 2012, 213). This perspective makes it not only possible to understand social (and thus also economic) phenomena as constellations of different practice-arrangement bundles and as processes that produce social and economic practices and their spatial dimensions (Wiemann, Schäfer, and Faller 2019, 306).

Concerning the CE, a current framework provides an approach to guide empirical research on circular business practices (Schulz, Hjaltadottir, and Hild 2019) based on the three constituting dimensions of practice sayings, doings, and materiality (Shove, Pantzar, and Watson 2012). In this paper, we adopt the framework for CE practices in the building industry:

1. **Sayings**: Analyze how people speak about CE and frame CE practices in the building industry.
2. **Doings**: The routines of actors in a building company/the building industry of doing things that contribute to a CE, including standardized processes, procedures, and patterns of individual strategies, such as design for CE or reuse of building materials.
3. **Materiality**: The preconditions influencing CE's implementation in the building industry and evaluate the physical outcome of CE practices. This may include the availability assessment of physical infrastructure (roads, technical facilities), tools, and technologies (e.g. modelling software, materials passports) and the inventory of energy needs, secondary raw materials, and produced wastes, as well as the industrial structure and flow of knowledge within the industry or on a given building site.

The access and management of resources – raw materials, energy and waste – in a given industrial sector are communal. Different agents (firms, stakeholders) share established attitudes and routines and thus form communities of practice.

The connection between CE policies and practices in firms are the institutions that regulate activities within and between organizations. North (1990, 3) defines institutions as 'the rules of the game in society', thus focusing on regulations as formal institutions that influence informal institutions such as value systems, culture, the way of doing business in a given industry, and practices. Glückler and Lenz (2016, 260) build on prior work, but further claim an interdependency between informal institutions and practices understood as 'how the game is actually played'. Thus, CE policies can influence institutions and lead to changes in CE practices in the building industry. Simultaneously, changes in practices can influence the informal institutions in the industry and, therefore, how CE develops in the daily activities and the norms and values within the industry (Glückler and Lenz 2016; Schulz, Hjaltadottir, and Hild 2019). This understanding, highlighted by Figure 1, underlines the importance of local governments in facilitating CE practices development through cooperation with local industry actors (Bolger and Doyon 2019; Horne and Moloney 2019).

2.2 The building industry and Circular Economy practices

The implementation of CE in the building industry further includes several industry-specific challenges, notably the lack of policy priority (Kanters 2020), complexity of the building projects (Adams et al. 2017; Kanters 2020) and the fragmentation of the

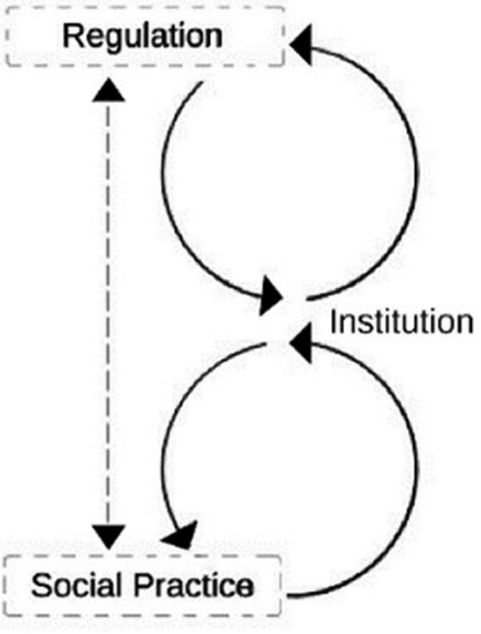

Figure 1. Interdependent relationship of practices and institutions (adapted from Glückler and Lenz 2016, 263).

supply chains (Adams et al. 2017; Akinade and Oyedele 2019). Most building projects include multiple actors with different visions, priorities, knowledge and business models that influence their views and commitment to CE. Kanters (2020) thus finds that the client's commitment is a critical factor in successful CE building projects together with architects that design for CE and work with expert consultants and contractors that have the knowledge and competences needed to fulfil the vision. Figure 2 is an overview of stakeholders in the building industry. It emphasizes the role of customers in the building process and onwards to the use and end-of-life stages of the building and how they affect the firms' activities in the building industry. The fragmentation of the supply chain and lack of communication between the stakeholders can lead to failures in delivering sustainability goals, customer demand and CE designs (Adams et al. 2017; Akinade and Oyedele 2019). The government's role here relates to policy priority or the lack thereof. That is, the setting and governing of building and facilitating the interpretation of CE regulations into institutions and industry practices (Bolger and Doyon 2019; Lenz and Glückler 2020). Government organizations are also important clients that can lead the way in implementing CE in the building industry. Customers are not included as industry actors in this research but rather as an important influence on the firms and their development of CE practices.

Finally, Figure 2 emphasizes the importance of finances in the building industry where financing CE projects that often include higher initial cost, new building methods and (or) materials can be challenging and a barrier for clients such as investors that can be exclusively profit-driven (Kanters 2020).

The importance of networks and cooperation is also relevant for knowledge flows between stakeholders regarding policy development and implementation, CE innovations, and the anchoring of CE practices in business strategies within the industry (Bolger and Doyon 2019). The building industry also has an extensive influence on the social aspects of sustainability (Gencel et al. 2012), while the CE literature, in general, has largely neglected the socio-political implications of the implementation of CE (Hobson 2016).

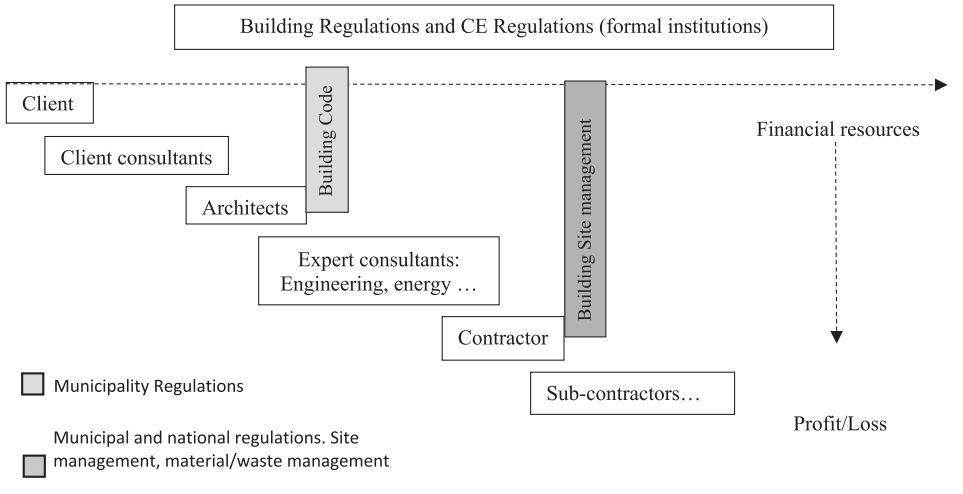

Figure 2. Stakeholders in the building industry (adapted from Kanters 2020).

To sum up, this section deals with the theoretical framework where we combine Glückler and Lenz (2016)' theory – on the interconnections between formal institutions as CE policy, informal institutions at regional and industry level and social practices in firms – and the operationalization of practice theory in three dimensions. The framework further uses CE literature in the building industry to develop codes within each dimension of 'sayings, doings and materiality'. The following section further discusses the research design and the link between the practice dimensions and individual codes (see Table 2 for an overview).

3. Research design

The article presents current applications, limitations and future perspectives of the CE in the building industry. The study is a multiple case design with two case studies sampled as a replication (Yin 2009) where the primary sources of data are at a firm-level while the unit of analysis is the building industry in each region. The aim of investigating the building industry in two case regions is thus not to make a parallel comparison between the two cases. Based on the replication design, the two cases should be similar in their contextual conditions while differing in key aspects directly relating to the area of interest (Yin 2009). In this research, the two cases regions were dependent on the steel industry, and the building industry is incremental in the current regeneration (see further discussion in section 3.1 below). The contrasting factor between the two case regions is the different background regarding sustainability and later circular policies and projects in the regions. The comparison is a cross-case analysis (Yin 2009) where each case is analyzed separately, and the findings compared, focusing on the similarities and differences in the communities of practice. We thus include regional stakeholders such as industry organizations and municipality experts in the sampling (see Table 1).

3.1. Selection of study regions

This research is a part of the project CIRCULAR focusing on Circular Economy in the Grand Duchy of Luxembourg and the Swedish region of Västra Götaland. The case selection is based on several factors fitting the replication design of multiple case studies. Firstly, the building industry is one of the most important industries in both regions with big ongoing urban development projects. In the last five years, both regions have launched various initiatives to foster CE approaches (EPEA 2014; Johnsen et al. 2015), especially in the building sector. Secondly, the two cases show similarities in their

Table 1. Overview of interviewees.

	Gothenburg	Luxembourg
Explorative expert interviews	**8**	**9**
Industry experts – industry organizations and municipality Eexperts	8	9
Semi-structured firm interviews	**17**	**30**
Architects	1	6
Contractors – lead contractors, sub-contractors and renovation firms	9	11
Expert consultants – engineering and consultancy firms	2	5
Materials professionals –manufacturers, expert services and demolition companies	5	8
Total number of interviews	**25**	**39**

industrial past and regional contextual conditions, ongoing economic restructuring processes, the importance of the building industry, and the current dynamics in green business development and low-carbon building (Hermelin and Rämö 2016; Schulz and Preller 2016). The two regions further differ in their history and the implementation of environmental and sustainability policies. They thus offer different insights into the link between CE policies and the development of practices in the building industry. These differences give a varied view on the internal dynamics of communities of practice by focusing on how the stakeholders from the building industry express their understanding and relevant conditions of the CE concept concerning their business practices.

3.2. Interviews and sampling

From July 2017 to September 2018, a total of 64 interviews were conducted in the two regions in two rounds (see Table 1). The first round included explorative expert interviews with individuals with a broad overview of the building industry in the case regions (industry organizations and municipality experts) conducted in 2017. These interviews gave information about the municipality organizations' viewpoints on the development of CE practices in the building industry and the cooperation with industry actors. Further aims included gathering information for the final design of the interview guides and sampling strategy for the industry interviews. Second, we sampled interviewees from the spectrum of industry stakeholders and conducted semi-structured interviews from January to September 2018 (see Table 1). Our semi-structured interview guide focused on the Circular Economy concept, the challenges involved in the implementation, intra- and inter-organizational knowledge sharing, local networks and incentives, as well as future developments and potential barriers.

The sampling strategy was to interview industry actors from the whole building process, including architects, building experts and engineers, lead contractors and firms doing sub-contracting work and renovations, material producers and providers, and firms in demolition (see Figure 2). The sampling process in both regions was a purposeful sampling from a set of industry actors active in the areas. In Luxembourg, the research team compiled a list of actors based on desk research and industry knowledge from previous research projects. In Gothenburg, the sampling process used data from local building industry organizations and online search. In both regions, the sampling further included snowballing, where the initial sampling was augmented by adding firms suggested by interviewees. The aim was to include new actors that might not be included in the original sampling lists. We did not sample customers as though they are important in the building process. Our research question relates to the building industry actors and how the firms are responding to CE policies. We, therefore, included questions regarding how the managers interviewed see the role of the customer in the development of Circular practices in the building industry in their region.[1]

There is a notable difference between the two samples as interviewees in Luxembourg are mainly top-level managers. In contrast, the interviewees in Gothenburg are mostly middle management or owner/managers of smaller firms (see Appendix A for an overview). This difference influences the focus and view of the interviewees, as top management is more involved in strategic discussions while middle management has closer connections with daily activities at the building sites. This can further influence the

managers' connection with different stakeholders and their view on policy and practices. While parallel comparative analysis of the results from the two cases is not the aim, this needs to be considered when discussing the results. This difference is partly reflecting the different configuration of the building industries in the two case regions as Luxembourg has a higher proportion of big firms but also reflects a different trajectory of implementing CE in the industry. This will be discussed further in the discussion section below.

3.3 Data and analysis

In this research, the primary data source was interviews augmented by documents and reports on CE implementation in the two regions. To offer interviewees the choice to express themselves in a language they are comfortable with, we conducted interviews in four different languages. The interviews were transcribed in the original language and analyzed using qualitative content analysis, with the summation of findings written in English. The choice to conduct the interviews and the coding process in different languages, rather than translate them into English before coding, intended to minimize the loss of information. Firstly, doing interviews in a language the interviewee has less than perfect grasp can limit their utterances, and secondly, translation of interviews can lead to loss of information.

In total, we recorded 50 h of interview material, with the interviews ranging between 30 and 80 min in length, average interviews around 45 min. A coding tree was developed in an iterative process using the theoretical framework supported by literature search and expert interviews (explorative interviews). The coding scheme in Table 2 shows the first level codes categorized into sayings, doings and materiality and the first level codes for each category. The first level codes focused on the interviewees' views and rationalities and founded on theory and CE literature – while second-level

Table 2. Coding Scheme.

Practice dimension		Code	Explanation
Sayings	How interviewees define and talk about the CE.	Definition	Definition and understanding of the CE and which topics they consider into the concept (framing the CE).
		Future of CE	Vision for the future of CE in the industry
Doings	The routines of doing things in the industry	Business Models	CE business model(s) set up or in design
		Cooperation	CE information and knowledge, cooperation practices with partners regarding CE and innovation
		Design	Product and process design for circularity
		Energy	Practices of energy efficiency in the firm, both in activities and the buildings
		Purchasing	CE purchasing practices: minimize waste, CE products, reused products
		Waste	Waste management, waste prevention, recycling, reuse and renovation practices
Materiality	Physical infrastructure, tools, and resource availability	Government	The role of the government in CE implementation
		Incentives & Barriers	Barriers and incentives for CE practices in firms, e.g. access to resources, finance, institutions and customer demand

codes where based on the data and focused on the practices and level of engagement.[2] Based on this two-step coding scheme, we carried out a qualitative content analysis to capture patterns of practices and understandings associated with each theme and the three dimensions of practice – sayings, doings, and materiality.. The analysis utilized the software MaxQDA, where the transcribed interviews were firstly coded into the first level codes and then the second level codes in the following round of coding (Kuckartz and Rädiker 2019).

In each case region, a single person conducted all the interviews and the qualitative coding, analyzing that individual case and summation into English, thus limiting coding bias. Each case was coded and analyzed separately using the same coding scheme in close cooperation between the researchers. The aim is not to make a parallel comparison between the two cases. Our aim is using richer information from the two cases to discuss how the building industries in the two regions respond to CE policies.

The analysis process further included several reflexive workshops (focus group style) in the case regions to discuss preliminary findings with local practitioners and experts and get feedback regarding our understanding of the data. The participants in the workshops were individuals that participated in interviews and other local stakeholders. These workshops were a valuable part of the process as an opportunity to present our findings to the local stakeholders and validate them.

Specific consideration for disseminating results from this project is that both case-regions are small, and the building industry actors are part of a close network. The authors have taken special care to ensure interviewees' anonymity; this includes not naming the interviewees' firms and refraining from using direct quotes in this article.

4. The building industry in Luxembourg

The Grand-Duchy of Luxembourg (see Figure 3) is one of the six founding countries of the European Union and is exemplary for transforming an industrial economy towards a service economy. Starting in the 1960s, the government worked on the diversification of Luxembourg's Economy, mainly dominated by the iron and steel industry. Through different policy implementations – e.g. measures to encourage external investment – the country advanced to an international financial centre. Today, Luxembourg has the 3rd highest per capita Gross Domestic Product (GDP) globally, mainly due to the economic concentration of the financial sector (Allegrezza et al. 2018).

Since the governmental programme of the legislative period 2013-2018, the political vision is to transform Luxembourg's Economy from a linear produce-use-dispose system to functioning in loops. In this period, the government commissioned two studies that impacted Luxembourg's pathway towards a CE significantly. In 2014, a study of the country's potential economic benefits identified sectors with the capability to create social and economic value while mitigating resource depletion and environmental damage (Hansen, Mulhall, and Zils 2014). In 2016, chaired by the American economist Jeremy Rifkin, Luxembourg developed a so-called 'third industrial revolution strategy', building on new economic models rooted in sharing and circularity (TIR 2016). In both analyses, the building industry remains a crucial driver for the CE due to the critical resource flows involved (i.e. materials, energy, money, labour).

Figure 3. Map of Luxembourg.

4.1 Circular Economy and the building industry in Luxembourg

Understanding the concept of a CE, that is, the definition and concept is generally good in Luxembourg over the whole sample, and little differences are detected between the

groups. Most of the interviewees are familiar with the relevant publications and stakeholders working in the field. Some even mentioned the distinction between the biological and technical cycles put forward in the general CE discussion. With relevance to business practices, the interviewees focus mainly on three topics:

- circular buildings (e.g. modular/prefabricated/demountable buildings; incl. a life cycle perspective);
- materials (incl. material passport for buildings as a linking element between the circular buildings and materials perspectives);
- digitalization (esp. BIM and smart homes/energy/city concepts rely on connectivity and the internet of things).

These focus areas show that design paradigms from the last decades are again gaining in popularity. In architecture, flexible design concepts (i.e. modularity) that combine resource and time efficiency (i.e. prefabrication) have a long tradition (e.g. Bauhaus). In Luxembourg, green building approaches traditionally concentrate on energy efficiency improved by technology (Preller 2018). The internet of things can connect different technologies intelligently, and the sector advertises the smart home and smart city concepts that build on circularity and prosumerism (TIR 2016).

4.2. Trends in circular construction

Although well informed about the theoretical foundation of circularity, the interviewees are partially sceptical about the time horizon given for implementing a CE. Some think that the building industry firms are not ready yet, and transitioning change will not happen within the upcoming five years. This is especially true for contractors and material providers. Other interviewees argue that nobody knows if a CE performs better from a holistic perspective than the 'business as usual'. Concerns include that prefabrication could lead to uniformity of buildings or the disappearance of jobs on-site for local craftsmen. At the same time, these interviewees acknowledge that measures have to be taken to allow the selective deconstruction of buildings in 30 years, e.g. building up a materials database based on standardized materials datasheets/passports.

The respondents confirm that architects speak and think more and more about sustainable construction, which is, for many, a synonym for circularity in construction. They say that because of the Rifkin process (i.e. the report published in 2016 and the follow-up task forces at the ministerial level) and ongoing public building projects, many architectural and engineering offices are involved in circular planning. In some specific fields, interviewees across the industry see potentials for Luxembourg towards a CE; they mention mainly three trends:

- Recycling materials: Different interviewees, specifically architects and expert consultants, think and work on technical and legal solutions to apply building materials out of recycled components, e.g. concrete, with aggregates out of construction and demolition waste, that is the materiality. Especially public organizations are involved in related projects and think tanks, i.e. the University of Luxembourg, the National Roads Administration.

- Enhance efficiency: Luxembourg should build more efficient, e.g. build less new constructions and think more about reuse and conversion concepts for existing buildings, developing practices of 'doing'. This approach covers multifunctional buildings that are a workplace and an urban garden at the same time. Energy consumption would decrease. Materials with a smaller grey energy footprint should have priority. The use of more efficient materials would reduce the volume of used materials. This view is expressed across the field and links to this being part of a public discussion on CE in Luxembourg.
- Be integrative: The building process should be more integrative and collaborative, e.g. involve all stakeholders in the planning/building process as soon as possible; the sector can get inspiration from other sectors, like the space sector (transfer of knowledge, esp. in materials). In the future, the planning team will be more diverse; architects will be only one member of a big team.

Interviewees view the CE as a trend in construction and that all constructions have to be circular in the future. At the same time, contractors are specifically sceptical about the practicalities of the implementation of circular practices. In this sense, wood becomes more and more popular in Luxembourg, including hybrid constructions in wood and concrete. People think that wooden constructions will replace buildings in concrete because they are less resource-intensive, lighter, and produce less waste to deposit. They expect that modular buildings become normality in the future, and wood is an especially appropriate material for this construction technique. Other examples cite robotization/digitalization as a driver to revolutionize the industry. Autonomous driving vehicles could access construction sites in urban settings and consequently reduce air pollution locally. Another mentioned scenario focuses on drones helping with large blocs, hence reducing human physical workload. These changes in practice require diverse planning teams; interviewees assume that the architect will change responsibility losing the leader's role.

4.3. Circular business practices

The study reveals a different maturity level of the interviewees in construction (and adjacent industries) in Luxembourg. Asked about their internal strategy to prepare for the CE, interviewees from the building industry prepare differently. Actors across the building industry mention the need to building-up expertise on different aspects of CE. Examples include, e.g. concerning life cycle thinking (especially consultants and contractors), to implementing eco-design such as choose construction materials based on their environmental, economic, and social profile (architects and contractors). Interviewees from all groups emphasize the importance of participating in research projects that include prototyping, e.g. emission-free lorry transports or smart waste collection systems. In the end, we identify three stages of readiness for circularity in Luxembourg:

- **Group 1**: Interviewees who are less convinced of the positive impacts of a CE tend to refer to the next generation as the leaders towards a change. They argue that the young generation is more sensitized to sustainability and circularity as these concepts were

part of their academic education. This group thinks that young people consume differently and do not have private cars, for instance.
- **Group 2**: Some of the interviewees in Luxembourg are in an orientation phase. Developing a vision and strategies for what could be their role in a CE is currently ongoing. This group covers stakeholders from adjacent industries or service providers, e.g. the Luxembourg National Railway Company; specialized companies in BIM.
- **Group 3**: Some interviewees and their firms already integrate circular thinking. This group mainly includes the building industry as project managers or consulting engineers. The leaders in this field elaborate already specific offers for their clients and provide circular engineering.

To conclude, firms in Luxembourg ask for more guidance towards Circular Economy practices. The government could take an active part in providing guiding principles, for instance, what means circularity in public building projects. Interviewees argue that material inventories for buildings only make sense when the data fluxes are stored and managed by a public entity. A Luxembourg Materials Agency (LMA) could take over the responsibility, for instance, as part of the Land Registry and Topography Administration. When a deconstruction project starts, the administration could provide material quantities and qualities necessary to reuse materials and building units.

5. The building industry in Gothenburg

Gothenburg is the second-largest city in Sweden, with 571,900 inhabitants (Göteborgs Stad 2019) and 0.9 million inhabitants in the metropolitan area (Rosado, Kalmykova, and Patrício 2016) and is located on the west coast in the region of Västra Götaland (see Figure 4). Historically Gothenburg was highly dependent on its maritime activities, trading houses, and in the twentieth-century, shipbuilding and later automotive industries became the dominant activities (Abrahamsson 2015).

Sweden has a long history of focusing on environmental protection and sustainability policies, with the first Environmental Protection Act from 1969. In recent years Sweden entered CE policies into legislation and regional policies, e.g. in Västra Götaland and Gothenburg"s municipality.

Currently, Gothenburg is facing challenges relating to fast population growth and aims for a sustainable city. In 2010 the city embarked on an urban planning and building projects called River City, utilising land at the riverfront previously occupied by heavy industry such as harbours and shipbuilding. The new development should aim for sustainable urban planning and buildings (Brorström 2015).

The following paragraphs focus on the interviewees define their understanding of the CE in the building industry, their views on the development of CE practices and future trends for CE in the building industry in Gothenburg.

5.1. Circular Economy and the building industry in Gothenburg

CE is a new term to many of the discussants in Gothenburg, and sustainability or the Swedish term 'Hållbarhet' are still more common. Specifically, the sustainability managers of the larger contracting firms (see Appendix A), the architects and the

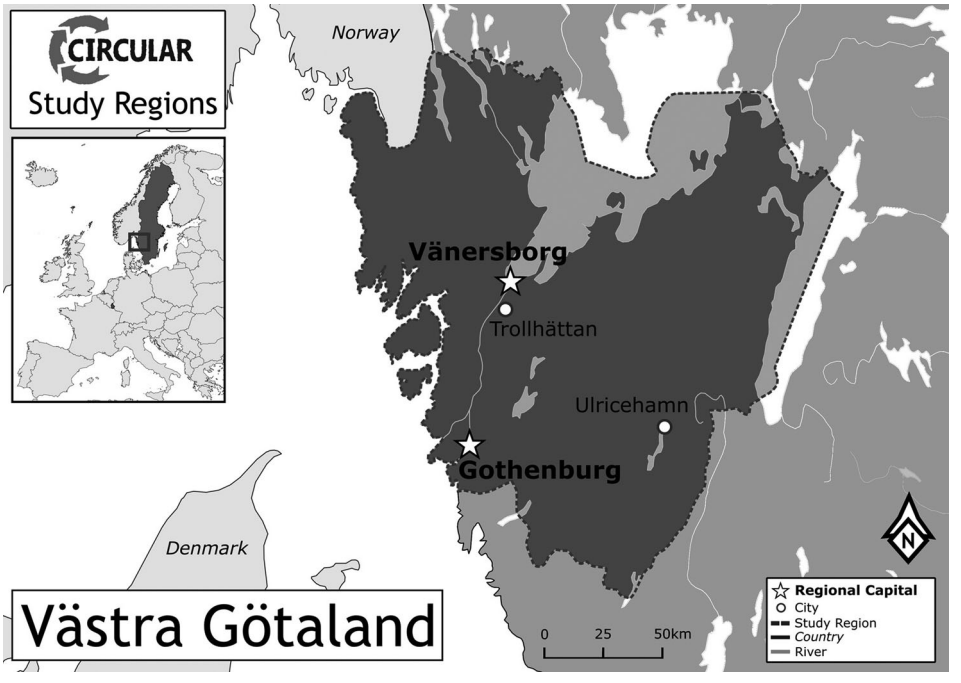

Figure 4. Map of Västra Götaland.

consultancies have a good understanding of CE. These firms have often participated in CE projects, and most are working on developing CE practices. The interviewees that are less familiar with CE are mainly from the smaller firms that do sub-contracting or specialize in renovations. They either have a narrow understanding focusing on waste and recycling materials or have not heard the term at all. These are mainly smaller firms, most with under 20 employees that do not have dedicated sustainability managers as they do not have the resources.

Regarding business practices of 'doings', the interviewees mention a wide range of practices, mainly focusing on three topics:

- Waste management – all the interviewees are concerned with waste minimization, notably sorting of waste and reuse, as these are in focus by local policymakers in the region. Other topics discussed include the design for repurposing, deconstruction, and reuse of materials. Two of the biggest contractors are developing 'doings' of precision purchasing for waste minimisations, including cooperation across the supply chain.
- Energy efficiency – designing and building energy-efficient buildings such as zero-energy houses. Energy efficiency is a topic of focus in Sweden for the last decades, and all the interviewees discuss the topic.
- The building industry organization (multi-layered with a myriad of firms involved in most building sites) – this part of the local 'materiality' works as a barrier to CE. The complexity hinders cooperation and information flow in the supply chain, and using

digital tools such as BIM can increase the transparency regarding materials used in buildings. This is mostly the concern of the construction firms, with the larger ones focus on cooperation and overview. In comparison, the interviewees from the smaller ones focus on the complexity and management time concerned.

These topics show a path dependency in the sense that they relate to a strong focus on energy efficiency and waste management that have been prevalent in Swedish sustainability policies and culture for the last decades.

5.2. Trends in circular construction

The interviewees differ in their view on CE as a strategy for sustainability in the building industry. Many interviewees, especially the contracting and material providers, underscore a growing demand from customers for certified buildings, CE practices, and materials and that developing CE expertise gives a competitive advantage. The contractors further claim the competition is, in most projects, based on the lowest offer winning the bid for a project. Contractors and expert interviewees claim this as one of the main barriers for CE in the building industry. At the same time, tenders for new buildings increasingly have conditions that exceed the regulatory demand on sustainable aspects (use of reused or re-produced insulation, higher energy efficiency or environmental paint), not the least for public buildings. This shows the importance of public procurement in developing CE practices in the building industry and the potential effect of customers. Sceptics focus on the problems in adopting CE practices. 'Doings relating to the complexity of comparing materials on multiple aspects (price, CO2 emissions, toxicity and efficiency) making purchasing processes difficult are mostly discussed by the smaller construction firms lacking management capacity. These sceptics also mention growing demand for time-consuming registration (e.g. use of BIM) and management time and barriers associated with the building industry's organizational structure. Regarding the future potential for CE in the building industry, three main trends emerged from the data:

- Planning for CE: The interviewees, specifically the larger contractors and experts, mention several pre-building practices as 'doings', from design for CE and end-of-life reuse or repurposing buildings to purchasing accuracy and coordination activities between the different actors on the building site.
- Reuse and up-cycling of materials: There are some examples of recycling practices, off-cuts of insulations into the same quality loose-fill insulation and crushed concrete as aggregate in concrete. The interviewees claim there is potential for other such practices. Reuse of building materials has potential, especially in the refurbishing of buildings but comes with legal and organizational barriers. Interviewees in all groups discuss this, including the experts' interviews, and this is part of the local discourse both in public reports, by industry organizations and in policy documents.
- Building materials: There is potential in using materials designed for circularity, materials with a long life-span and (or) designed for being reused or recycled. Building in wood is also gaining momentum by architects and contracting firms, and several projects are ongoing to develop new CE building methods. The interviewees have

widely different views on this matter spanning from being quite sceptical to working on expanding their use of such materials. The interviewees from the material providers are mostly positive and are developing 'doings' relating to providing CE materials. For the other interviewees, we do not detect specific patterns relating the type of firms to their position on this matter.

The interviewees' general view is that the building industry must develop CE practices to respond to new policies and for environmental reasons. The sustainability managers and consultant further state that there is potential for cost savings with, e.g. more precise purchasing leading to less waste, less work dealing with and transporting waste material, reuse and decrease of raw materials and better organization of building processes, leading to decrease in energy use. These interviewees also mention that the estimation of cost needs to change from the current method of including only investment cost for most projects, including the cost of running the building and calculations of payback time of using CE materials that can have a higher purchasing cost.

5.3. Circular business practices

The data reveals that the building industry stakeholders in Gothenburg are applying different approaches when it comes to CE strategies and practices. The strategies diverge in the level of engagement, from being reactive and mainly responding to laws, regulations and customer demand to proactively develop CE practices for perceived competitive advantage and vision of sustainable gains. They further diverge in their focus from building up expertise in building sustainable considering economic, environmental and social sustainability or aims for gains in specific practices such as waste management or material efficiency. Firms size and where they fit into the overall organization of the industry is a decisive factor. The contractors specializing in either renovation or work as subcontractors, mainly small firms with less than 50 employees, mention having limited autonomy regarding building methods and materials choice. The customer, architects, and the main contractor are responsible for these choices. The largest building firms and the expert services providers tend to have dedicated staff to develop sustainability strategies and practices. Therefore, power relations between the different actors in the building industry seem a critical factor that warrants further investigation. Based on the above mentioned, we identify three groups of firms at different stages of implementing circularity:

- **Group 1**: Interviewees that are responsive rather than proactive in developing CE practices, mainly smaller contracting firms. This group emphasizes barriers such as the risk of using new materials and methods, increased administrative time in, e.g. purchasing CE materials and using BIM, and that CE leads to increased investment and that customers are unwilling to pay this cost.
- **Group 2**: The interviewees in this group are developing strategies and practices, working on educating their employees and finding ways to cooperate with the supply chain for including the different actors in the process. This group includes the biggest construction firms and some support organizations, e.g. providers or special services. Most of these firms have started to implement practices as 'doings'

in waste management, mainly sorting and purchasing but are mostly at the level of organizing and planning changes.

- **Group 3**: Some interviewees report they have started integrating CE practices in their activities and adapting their business model. The examples include upcycling of materials and processes to increase the building process's visibility, including a clear indication of what materials subcontractors can use, use of BIM by all that workers on the building, and developing cooperation in the supply chain for sustainable purchasing practices. In this group are two of the biggest contractors and examples from the material providers and the smaller contractors. In the case of the smaller firms, the drive tends to be personal interests and convictions regarding environment and responsibility rather than firm strategy.

The interviewees emphasize that the government at all levels needs to be active in supporting the development of CE policy into practices by developing favourable aspects of 'materiality'. Such support needs to include; cooperation between industry and policymakers, clear guidance from the government, measurements, indicators and tools for the industry, further develop the use of public procurement for CE buildings as lighthouse projects, further develop the ICT tools offered such as the existing BIM tools, and provide support and incentives to accelerate the adoption of CE practices.

6. Discussion, policy and circular practices

In this section, we discuss the results of the building industries in the two case regions. The replication design aims to utilize the similarities and differences between the case regions to investigate if the building industry actors respond to CE policies by developing strategies and changing from linear to circular practices.

In both case regions, the building industry is in the early stages of responding to CE policies by developing practices as 'sayings and doings' shared by actors in the industry (Reckwitz 2002). Thus, many of the firms are in an orientation phase, concentrating on developing CE strategies, educating their employees, and organizing closer cooperation with partners and managing materials. The emphasis on discourse and planning implies that the industry develops the 'sayings' of CE practices rather than the 'doings'.

The 'sayings' encompass the meaning of CE in public discourse and the framing of topics (Schulz, Hjaltadottir, and Hild 2019); hence this relates to the definition of CE and which topics it includes and are relevant in the public discourse. Most interviewees have a clear theoretical understanding of CE, referring to the definitions used in the policy documents and discourse in their region, on the EU level and from the Ellen MacArthur Foundation. Interviewees in some of the small building firms in Gothenburg are the exemption, having either a limited view on CE focusing on recycling or referring to sustainability in their discussions; the same firms are also mostly reactive in their CE development. The main difference between the two regions is what the interviewees include under the term CE, where prior policy focus and practices get rebranded or continued as CE (Gibbs and O'Neill 2014; Jones and Murphy 2010a). Actors in Gothenburg thus focus on waste management – mainly sorting and waste prevention – and energy efficiency of the buildings, topics that have been prevalent in Swedish sustainability policies and culture for the last decades dating back to the oil crises in the 1970s

(Abrahamsson 2015; Thews, Höjding, and Jansson 2017). Waste management, especially sorting, is not part of the discourse about Luxembourg's Circular Economy, while interviewees include recycling and reuse of materials in the CE (see chapter 4.2). Reasons for excluding waste relate to 'sayings' as some actors make a sharp distinction between CE and waste management linked to the successful implementation of waste management systems in businesses. The SuperDrecksKëscht (SDK) is a private-public-partnership in Luxembourg in the optimal management of waste (GDL 2018, 193) recognized by the European Commission as an example of 'best practice' for waste prevention in Europe.[3] Thus, the two cases highlight the link between prior sustainability policies, public discourse development, and the framing of CE issues as 'sayings'. Relating to the theoretical framework, these findings highlight that local policies as formal institutions (see Figure 1 in section 2.1) affect the forming of practices as 'sayings' at a regional level (Lenz and Glückler 2020). The building industry in the two case regions is influenced by EU regulations regarding CE, and the difference in 'sayings' is linked to local policy development. Understanding institutions' regional specificity for place sensitive policies is a fundamental link between CE policies and practices (Lenz and Glückler 2020).

Our data shows little evidence for new CE 'doings' developing as operational routines, processes or strategy patterns shared by a significant proportion of the industry actors. We observe mainly CE projects within individual firms – developing CE activities within the firm or project, and growing interest and knowledge of potential CE practices, not the least by architects and expert consultancies. In both case study regions, the contracting firms demonstrate little collaboration or knowledge transfer underpinning the complexity of transitioning towards a CE. The few pilot circular construction projects seem to be instructional for the people involved but are not sufficiently documented to serve as a didactic piece.

The data nevertheless includes two big construction firms in Gothenburg that are working on changing the supply chain relationship and including both upstream and downstream partners. Both projects have several aims, including to use precise purchasing to minimize waste – this entails cooperation with architects and suppliers – and to develop strategies for closer contact between the construction firm and sub-contractors. Therefore, these projects are changing relationships and responsibilities in the supply chain and the 'doings' of multiple industry actors, creating CE practices. These changes include developing contracts between construction firms and sub-contractors to incorporate CE materials (i.e. designed for circularity or reused, up-cycled, recycled), purchasing practices, and using BIM for registering which materials contractors use in the building and where they are. The lack of similar examples for Luxembourg can relate to the difference in the samples in the two cases, with interviews in Luxembourg favouring top-level management focusing on CE's strategic development rather than the development of 'doings'. At the same time, the interviewees in Sweden are the sustainability managers in charge of these projects. We thus do not claim that no such projects are developing in Luxembourg but that further research is needed on the matter. We see from our data that the development of 'doings' is lagging behind 'sayings', underlining the importance of local discourse to support 'sayings' as the first step in developing CE practices in the industry.

The practice dimension of 'materiality 'deals with the local conditions that formalize the relationship between policies and practices. These conditions include infrastructure,

tools, and the human body, thus emphasizing the regional conditions and context. Regarding the 'materiality' dimension, the interviewees focus on cooperation with the government, fragmentation of the building industry, resources and enablers and barriers. The 'materiality' the interviewees connect with CE is thus relating to institutional infrastructure and material. The infrastructure discussed is mainly the development of recycling and reuse of building materials and support form research and development institutions. The stakeholders in both regions highlight the vital role of the government and the importance of cooperation between industry and policymakers (Bolger and Doyon 2019), i.e. development of guidelines and standards, use of public buildings to develop and showcase CE building materials and management of tools such as BIM to support industry-wide use and collaboration (Ajayi et al. 2017; Akinade and Oyedele 2019; Steel, Drogemuller, and Toth 2012). These findings highlight the importance of local policy instruments in creating an environment or 'materiality' that supports the development of CE practices in the building industry.

Our findings show a link between developing CE practices, especially the framing and meaning of CE discourse and earlier policy focus in both regions. It is not easy to distinguish between re-named sustainability practices responding to CE policy. The legacy of incremental change becomes apparent, and that the building industry is in the early stages of developing CE practices.

7. Conclusions

This article deals with how firms in the building industry respond to policy changes, especially the recent emphasis on CE, by developing new practices that can transform the industry. The main contribution of the paper is twofold. Firstly, we contribute to the growing literature on how the building industry responds to the recent policy focus by developing CE practices. Specifically, we add to the knowledge regarding the building industries in Luxembourg and Gothenburg and the links between policy and CE practices. The research further takes a systemic view, thus expanding the knowledge of how the building industry is developing regarding CE at the industry level rather than the firm level. Mostly the academic literature has looked at individual cases or processes (Adams et al. 2017). The second contribution is theoretical as we expand a practice theory framework developed by Schulz, Hjaltadottir, and Hild (2019) and apply it to an empirical case study. Thus, we formalize the relationship between policy and practices as 'sayings, doings and materiality' for developing practices in the building industry.

The findings show that the building industry focuses on 'sayings' and developing CE's framing and meaning. There are differences between how 'sayings' are developing in the two case regions, mainly in which topics actors include in the CE discourse and the emphasis on different trends. In both cases, the variation links to earlier policy focus in the regions. The lack of industry-wide 'doings' in the data implies the industry is in the early stages of developing CE practices and as evidence of a traditional industry that changes slowly and is anchored in a culture of incremental changes linked to sustainability policies of the past. The ongoing projects of adapting the purchasing procedures and increasing cooperation and transparency in the supply chain aim for circular 'doings'. However, they are not at the level of industry-wide practices. Nevertheless,

these changes influence multiple actors' activities and can develop into industry practices in the foreseeable future.

Regarding the 'materiality', the interviewees highlight two main areas as critical factors. Firstly, the government's role in promoting and supporting CE practices and the importance of cooperation between policymakers and industry. The interviewees emphasize the development of guiding principles (e.g. for public procurement) and monitoring procedures (incl. measurements and indicators) that the government should provide to the building industry. Secondly, the system view of the building industry reveals that the lack of collaboration and knowledge transfer within the industry is one of the main barriers to the development of 'doings' at an industry level and that CE projects are isolated and have limited effect outside the project.

In both case regions, the highlighted trends in circular construction rely on materials and their management. Potential CE practices cover suggestions for designing materials for circularity and using reused, up-cycled or recycled materials; and applying digital tools such as BIM to increase the transparency regarding materials used in buildings. Future research should thus focus on understanding the implications for the building industry in transitioning to CE practices. Especially emphasizing the multiple links between different practices and their material dimension (so-called practice-arrangement bundles), including the relationship with individual actors and intermediary institution builders, as highlighted by Horne and Moloney (2019). Our findings further show a need to research the role of government and how local policymakers can support 'doings' by facilitating cooperation between actors is needed and the use of public procurement in supporting CE in the building industry.

Notes

1. For further information about the sampling and interview guides, please contact the corresponding author.
2. For further information about the coding scheme, contact the corresponding author.
3. For more details, see the website of the EC: https://ec.europa.eu/environment/waste/prevention/practices.htm.

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Appendix A

	Case	Actor group	Firm's main activity	Number of employees	Interviewee	Interview language
Gothenburg	1	Materials	Insulation	18	Owner manager	Swedish
	2	Materials	Insulation	18	Product development	Swedish
	3	Materials	Demolition	30	Manager	English
	4	Materials	Concrete prefab units	270	Marketing manager	English
	5	Contractors	Bulding company		CEO	English
	6	Contractors	Bulding company	75	CEO	English
	7	Contractors	Bulding company	50	Project manager	English
	8	Contractors	Bulding company	200	Environmental manager	English
	9	Contractors	Bulding/renovaton	6	Project manager	English
	10	Contractors	Bulding company	116	Environmental manager	English
	11	Expert consultants	Environmental consulancy	15	Environmental consultant	Swedish
	12	Materials	Concrete producer	290	Quality manager	English
	13	Contractors	Bulding company	15,000	Environmental manager	English
	14	Contractors	Bulding company	>200	Environmental manager	Swedish
	15	Expert consultants	Building consultancy	?	Consultant	Swedish
	16	Architects	Architect office	10	Architect	English
	17	Contractors	Renovations	50	Manager	Swedish
Luxembourg	1	Contractors	Building company	120	Quality manager	German
	2	Materials	Cement producer	160	Construction consultation	German
	3	Architects	Architecture in wood, other materials	25	Board member	German
	4	Materials	Manufacturer of paints, coatings	107	CEO	German

(*Continued*)

Continued.

Case	Actor group	Firm's main activity	Number of employees	Interviewee	Interview language
5	Materials	Materials testing	15	Head of Laboratory	German
6	Architects	Architecture in wood	5	Owner	German
7	Materials	Concrete producer	550	CEO	German
8	Expert consultants	Consulting engineers	300	CEO	German
9	Architects	Architecture in wood, other materials	14	CEO	German
10	Contractors	Wood construction	300	Sales representative	German
11	Materials	Wood panel producer	260	Managing Director	German
12	Contractors	Lighting, electrical installations	78	CEO	German
13	Architects	Architecture, urban planning	9	Partner	German
14	Expert consultants	Training in (sustainable) construction	30	Managing Director	French
15	Expert consultants	Sustainable construction	11	Architect	German
16	Expert consultants	Consulting engineers	49	Managing Director	French
17	Materials	Miscanthus producer	3	Managing Director	German
18	Architects	Architecture in wood, other materials	28	Partner	German
19	Architects	Architecture in concrete	21	Owner	German
20	Contractors	Building company	255	Director Business Development	German
21	Contractors	Project management	68	Director	German
22	Contractors	Project management	45	Managing Director	German
23	Materials	Floorings	554	Director Innovation & Environment	French
24	Contractors	Building company	> 250	Innovation Manager	German
25	Contractors	Project management	45	Architect	German
26	Materials	Deconstruction	255	Manager	German
27	Contractors	Building company	130	Managing Director	French
28	Contractors	Building company	60	Managing partner	French
29	Contractors	Building company	62	Managing partner	German
30	Expert consultants	Circular economy	62	Manager	German