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Barriers to circular business model innovation: A multiple-case study

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ABSTRACT

The concept of circular economy has been suggested as a possible avenue to sustainable development. The adoption of circular business models at a company level, which is a key element in the transition to a circular economy, has nevertheless been slow. The purpose of this article is to provide an overview of the barriers that hinder adoption of circular business models to facilitate circumvention of the barriers and a faster uptake. The article presents a multiple-case study of the circular business model innovation process in 12 Danish companies that includes a cross-case analysis across start-ups and incumbents and across different company sizes, industries and customer segments. The article furthermore compares the barriers derived from this empirical work to barriers found in the sustainable innovation literature. The research shows that barriers to circular business model innovation are found at all socio-technical levels and, overall, most barriers are encountered by companies at the organisational level, followed by the value chain level, the employee level and, finally, the market and institutional level. However, there are significant variation between the case companies regarding what barriers are encountered and how many in total. The cross-case analysis shows that factors other than company size, industry and customer segment affect what barriers are encountered. The comparison of empirically derived circular business model innovation barriers from the multiple-case study with barriers compiled from the broader literature on sustainable innovation shows a good correspondence between the two lists. The empirical study, nevertheless, identifies additional barriers not previously reported in the literature.

1. Introduction

A circular economy has been proposed as an alternative to the current linear economy that could promote a much-needed shift towards sustainable development (Adams et al., 2016; World Economic Forum, 2014; Geissdoerfer et al., 2017). A circular economy is 'restorative and regenerative by design and aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles' (Ellen MacArthur Foundation, 2012, p. 2). It consists of activities that reduce, reuse and recycle materials in our production, distribution and consumption systems (Murray et al., 2017).

To arrive at such a regenerative economy, companies need to change the way they operate (Bocken et al., 2016) and the adoption of circular business models (CBMs) is one means to do so (Nußholz, 2017). The company-level implementation of circular economy, including the challenges associated with a transition to CBMs, nevertheless remains under-researched (Blomsma and Brennan, 2017; Franco, 2017; Ghisellini et al., 2016; Lieder and Rashid, 2016; Urbinati et al., 2017), resulting in a lack of operational frameworks for, and knowledge about, circular business model innovation (CBMI) processes (Urbinati et al., 2017). This delays the uptake of CBMs (Linder and Williander, 2017) and the transition to a sustainable future (Boons et al., 2013).

Pinpointing which factors constrain CBMI activities in companies is an important step towards empowering practitioners, policy makers and researchers to devise solutions to overcome these barriers and accelerate the adoption of CBMs (de Jesus and Mendonça, 2018; Hölzl and Janger, 2012; Oghazi and Mostaghel, 2018). This study aims to contribute to more detailed knowledge about the research question: *What barriers do companies encounter in CBMI?* We do so by addressing two gaps in the literature in relation to this research question.

First, the relatively few CBMI studies that are reported in the literature tend to focus on the study of individual cases (e.g. Mont et al., 2006; Riisgaard et al., 2016; Linder and Williander, 2017) or specific industries (e.g. Stål and Corvellec, 2018). A broader perspective based on empirical studies with multiple cases across

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industries and across other categories is generally lacking, with a few notable exceptions (e.g. Vermunt et al., 2019). In this article, we take steps to alleviate this gap in the literature, by providing an empirical foundation for a cross-case analysis of CBMI barriers experienced by 12 case companies across different company sizes, industries and customer segments and across circular start-ups and linear incumbents, which can provide first insights into the importance of these characteristics in relation to which barriers are experienced in CBMI.

Second, previous reviews of the literature regarding CBMI barriers (e.g. Linder and Williander, 2017; Rizos et al., 2016) have drawn on literature from a range of related research fields, because only a few studies specifically on CBMI barriers have been reported in the literature up until now. These other research fields include closed-loop manufacturing (e.g. Östlin et al., 2008), remanufacturing (e.g. Nasr and Thurston, 2006) and product−service systems (e.g. Besch, 2005), which are closely related to CBMI, but also broader research fields such as the implementation of environmental technologies (e.g. Lindblom et al., 2007) and green supply chain management (e.g. Luthra et al., 2011) that would seem conceptually farther from CBMI. It remains unclear whether barriers drawn from these related streams of literature from the broader field of sustainable innovation are in accordance with the barriers experienced specifically in CBMI. This article aims to assess the correspondence between the barriers drawn from the literature on sustainable innovation and barriers experienced specifically in connection with CBMI and thus aims to address this gap in the literature.

The remainder of the article is organised as follows: Section 2 offers an overview of key theoretical concepts. Section 3 describes methodological approaches applied in the research. Section 4 and Section 5 present and discuss results; Section 4 presents the empirical study, i.e. outlines barriers derived from the empirical data and findings from the cross-case analysis, and Section 5 presents the review of barriers in CBMI-related streams of literature and the comparison with empirically derived barriers. Section 6 concludes on the results and discusses limitations of the research.

2. Theoretical background

2.1. Circular business models

A business model explains how a company does business (Richardson, 2008, p. 136), and it can be perceived as a blueprint of the underlying business logic of a company (Magretta, 2002; Osterwalder and Pigneur, 2010; Teece, 2010). A minimum of three basic components outline a business model: (1) The *value proposition*, i.e. the product and service offering; (2) the *value creation and delivery system* that enables the company to generate products and service offerings and deliver them to customers via the company's internal resources and capabilities as well as via its value chain, activity system, business processes, suppliers, partners and customers; and (3) the *value capture system*, which defines how the firm generates turnover and profit, its revenue sources and the economics of the business (Richardson, 2008) (cf. Fig. 1A).

A traditional linear business model creates economic value for the actors in the value chain (i.e. the focal firm and its partners, suppliers and customers) (Amit and Zott, 2010). By contrast, a sustainable business model entails a broader understanding of value and stakeholders, since it 'captures economic value while maintaining or regenerating natural, social and economic capital beyond its organisational boundaries' (Schaltegger et al., 2016, p. 6).

A CBM is a type of sustainable business model (Adams et al., 2016; Bocken et al., 2014) that integrates environmental and economic value creation by shifting the business logic from generating profits from one-time sales of goods, to generating profits from a continual flow of reused materials and products over time (Bakker et al., 2014a) by capitalising on the value embedded in used products (Bocken et al., 2016; Linder and Williander, 2017).

CBMs thus aim to preserve the embedded value of products at the highest possible level of utility (Velte and Steinhilper, 2016; Webster, 2015) by slowing and closing resource loops (Stahel, 2010; Bocken et al., 2016). The flow of resources through the economy is slowed by an extended product utilisation period or an intensified product usage, and resource loops are closed by recycling post-use materials and re-injecting them into the production system thus extending the material utilisation period (Stahel, 2010; Bocken et al., 2016).

The two primary means of slowing and closing resource loops are circular product designs and circular services. Product designs that fit CBMs are emotionally and technically durable (Bakker et al., 2014a) and are possible to upgrade, maintain, repair, refurbish, remanufacture and recycle (Ellen MacArthur Foundation, 2012). Through the integration of circular services in the business model, a company makes such services available to the customers, i.e. the company offers for instance upgrades or refurbishment of their products, and these services are typically combined with leasing or take-back schemes to ensure products are returned to the manufacturer when the present customer no longer needs them.

Activities related to a CBM do not have to be operated by the focal company itself; instead, CBMs often encompass a network of partner companies in the same fashion a linear value chain does. The international pump manufacturer Grundfos is a case in point: The company has established a take-back system in its Danish home market that utilises its pre-existing distribution setup for the return of products to the company (Guldmann and Remmen, 2018).

The environmental and economic profitability of CBMs for closing and slowing resource loops can be enhanced by improving resource efficiency in the design of the product and the manufacturing process, yet, these strategies, referred to as strategies to narrow resource loops, are insufficient to constitute CBMs in themselves (Bocken et al., 2016). The environmental benefit can also be enhanced by the use of renewable or recyclable materials and renewable energy (Brezet and van Hemel, 1997; Ellen MacArthur Foundation, 2013).

Building on Richardson (2008), we propose that the integration of slowing and closing strategies in a company can be conceptualised as adding a value recreation and redelivery component and a value recapture component to the existing business model, thus offering an extended value proposition vis-à-vis the existing business model.

Fig. 1B illustrates this conceptualisation, and the left side of the figure represents value creation, delivery and capture activities known from linear business models. This is value creation that comes from converting virgin raw materials into new products; value delivery in the form of selling the new products; and value capture from the associated sales revenue.

The right side of Fig. 1B represents the value recreation, redelivery and recapture activities that are added to the business model when slowing and closing strategies are integrated into the company through the introduction of circular products and services. Value is recreated, for instance, when products are reused, repaired or remanufactured or when recycled materials are used for new circular products. In other words, value is recreated via the implementation of circular services. Value redelivery happens when the reused, upgraded or remanufactured products are offered via ordinary sales or through leasing and sharing schemes. Finally, value is recaptured when profit is generated from sales, leasing and sharing of the circular products and from the circular services such as repairs, upgrades and remanufacturing.

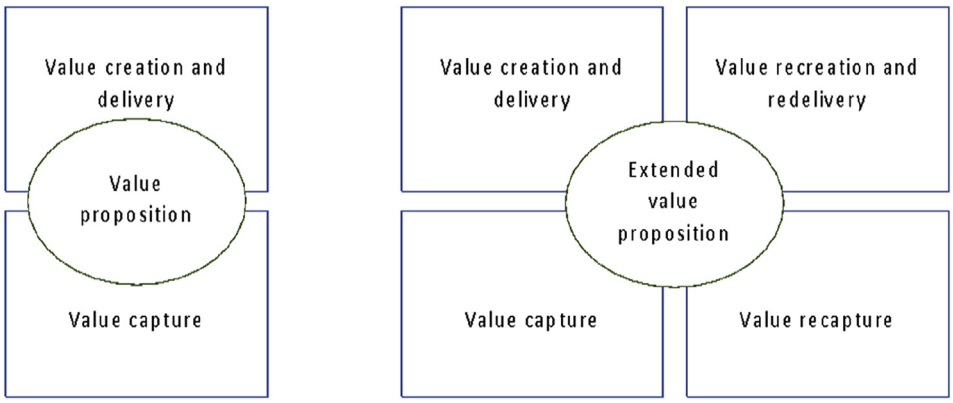

Fig. 1. (A). Key elements of a linear business model (Richardson, 2008). (B). Key elements of a circular business model. Developed from Richardson (2008) and Bocken et al. (2016).

The extended value proposition resulting from the addition of value recreation, redelivery and recapture activities to the business model could be in the form of the convenience of a longer product life with a higher level of technical functionality; reducing the consumers' overall lifecycle costs; the appeal of a more sustainable product; a lower price of reused or repaired products or a lower price of products made from recycled materials; lower up-front investment in leasing or pay-per-use models; and economic bonus when returning the product to the producer or selling the product to a new user (Hopkinson et al., 2018; Bocken et al., 2016).

Fig. 1A and B illustrate that CBMs (Fig. 1B) are more complex constructions than purely linear business models (Fig. 1A), among other things because of the co-existence between traditional linear business model components and circular components. The co-existence is found in both linear incumbents that integrate CBMs in the company and in circular start-ups. Photocopier and printer company Ricoh, for instance, has operated CBMs for more than 30 years but continues to derive much of its profits from sales of new equipment (Hopkinson et al., 2018). Similarly, Danish circular start-up Better World Fashion, which manufactures jackets from recycled leather, offers one-time sales in addition to leasing and take-back schemes, although the company was founded on circular economy principles (Huulgaard and Vingwe, 2017).

Rethinking the business model to include CBM components (i.e. value recreation and redelivery, value recapture and an extended value proposition) enables a company to align the value creation logic with circular principles, and although a company can work with the integration of a subset of the CBM components in the existing business model, the best results are attained from a concerted effort that takes all of these elements into account (Geissdoerfer et al., 2018).

2.2. Circular business model innovation

The process of making changes to existing business models to devise new business model configurations (in a mature company) or crafting entirely new business models to create, deliver and capture value in novel ways (in a start-up or within a new business area of a mature company) is termed business model innovation (Mitchell and Coles, 2003; Osterwalder and Pigneur, 2010; Zott and Amit, 2010).

Following this understanding, we define CBMI in incumbent companies as the process of reconfiguring an existing *linear* business model to include CBM components in the form of value recreation, redelivery and recapture and an extended value proposition, or the process of reconfiguring an existing *circular* business model to include more of, or better versions of, these CBM components. In start-ups, we define CBMI as the process of crafting a CBM based on those CBM components from the ground up.

Business model innovation is a challenging type of innovation (Chesbrough, 2010; McGrath, 2010) that is different from more familiar types of innovation such as product and process innovation (Amit and Zott, 2010). Companies often do not have the tools and business processes in place to deal with this kind of innovation, and the needed break with the company's old value creation logic, locked-in management structures and distribution of resources etc. can severely inhibit the innovation process (Chesbrough, 2010). Such challenges are particularly evident in CBMI, where not only the above, but also a paradigm shift from a linear economic understanding to a systemic, circular economic understanding (Geissdoerfer et al., 2018), has to be dealt with in the innovation process.

Furthermore, sustainable business model innovation generally involves more stakeholders than their traditional linear counterparts (Roome and Louche, 2015) and, due to the systemic nature of CBMs, co-development is needed externally with existing or new value chain partners (Bocken et al., 2018; Guldmann and Remmen, 2018; Geissdoerfer et al., 2018) and internally in the focal company in the form of cross-organisational collaboration. Internal collaboration is required because multiple departments such as product development, manufacturing, sales and after sales service have to work together to devise viable CBMs (Geissdoerfer et al., 2018; Guldmann and Remmen, 2018).

The complexity of CBMI also relates to the fact that the CBM configuration has to consider how to recreate, redeliver and recapture value in every cycle the product goes through in its lifetime and ensure an attractive value proposition to customers in each cycle (Nuβholz, 2018). The first cycle is when the product is initially manufactured and sold or leased to customers, a second cycle could be a product upgrade, a third cycle may concern remanufacturing and the last cycle could entail material recycling, and the business model design has to encompass each of these cycles. A linear business model, in contrast, usually only considers the first cycle and occasionally some activities related to after-sales service.

Depending on the particular focus of the company, the CBMI process can be oriented at a beginning discussion of the relevance of CBMs for the company at one end of the scale, all the way to an action-oriented CBMI process aimed at radically transforming the current business model at the other end of the scale. Regardless of the focus, the complex nature of the CBMI process is best dealt with via internal and external experimentation (Weissbrod and Bocken, 2017; Linder and Williander, 2017; Bocken et al., 2018) and through this experimentation, the company can explore different

possibilities for value creation, delivery and recapture and for offering customers an extended value proposition.

Mapping out business model ideas in a business model canvas and discussing the potentials and issues associated with the idea is an example of a company-internal experiment (Chesbrough, 2010; Weissbrod and Bocken, 2017; Guldmann and Remmen, 2018). Customer interviews and developing and testing a prototype together with a trusted supplier are examples of external experiments (McGrath, 2010; Linder and Williander, 2017; Bocken et al., 2018; Guldmann and Remmen, 2018). The point of the experimentation is to articulate possible CBM configurations, i.e. ideas for CBMs, and receive feedback on what will and will not work in a particular business context through the experimentation. This knowledge is then incorporated in progressively refined configurations of the new business model (Bocken et al., 2018).

The detailed unfolding of the CBMI process will depend on the specific company setting (Guldmann and Huulgaard, 2019), but the process will often include an open-minded search for business opportunities, the generation of multiple CBM ideas, and further exploration and development of a few of these ideas through experiments that test their rationale (Guldmann and Huulgaard, 2019; Guldmann and Remmen, 2018; Linder and Williander, 2017; Bocken et al., 2018).

3. Methodology

3.1. Research design

The empirical study of barriers to CBMI was designed as exploratory action research and organised as a longitudinal, multiple-case study. In action research, the researcher is directly involved in activities that are intended to foster change on the group, organisational, and societal levels (Dickens and Watkins, 1999), while observing and reflecting upon the unfolding processes. In this study, the aim of the collaboration was to inspire and support ongoing development of CBMs in the case companies through internal and external experimentation. The unit of analysis was the CBMI process in the companies and this research design allowed the researchers to examine the CBMI process extensively as it unfolded and to collect rich data about the encountered barriers (Orum, 2015; Yin, 2014).

The CBMI was carried out in collaboration between the case companies and the researchers. The collaboration was organised in a flexible manner that allowed the companies to set the pace of the CBMI process, determine which business areas to focus on and which stakeholders to involve. In some cases, the researchers would take part in driving the CBMI process and suggest next steps, such as what stakeholders to involve, in what way and which tools to apply. In other cases, the researchers mostly served as a sparring partner to support the companies' own initiatives.

Fig. 2 illustrates the different elements of our research. The top left corner of the figure illustrates our empirical study, which leads to our first result, namely a cross-case analysis of the 12 case companies (cf. Section 4.3). The empirical study together with our literature review, illustrated in the top right corner of Fig. 2, leads to our second result, which is a comparison of the empirically derived barriers and the barriers found in the literature (cf. Section 5.2).

3.2. Literature review of CBMI barriers

As part of this study, a literature review was conducted to identify CBMI barriers in the literature. As a first step, a search was conducted in Web of Science, combining the subject keywords 'circular economy' and 'barrier*' or 'challenge*'. These broad terms were used in recognition of the lack of convergence on terminology within the CBM and CBMI fields to capture as much relevant literature as possible. The search included all peer-reviewed articles in English that were published before 2018 and resulted in 173 articles that were examined based on title and abstract to single out those that dealt specifically with barriers in relation to the adoption of CBMs in companies in a European context. The 14 articles that remained after this process were studied in full, and seven of these proved relevant to the CBMI context, two of which contained a relevant review of the literature on barriers to CBM adoption, namely Linder and Williander (2017) and Rizos et al. (2016). Applying a snowball sampling approach (Bryman, 2012), references from these reviews were examined in the same fashion as the literature from Web of Science and 18 peer-reviewed references were enfolded in the review in addition to 10 peer-reviewed references cited in a recent Mistra REES report on CBMI (Mont et al., 2017).

3.3. Case selection

The case companies for the multiple-case study were selected among a group of 26 companies in a large research project involving 12 researchers from two different research groups. In case study research, it is typical to select cases by applying specific criteria, instead of selecting a random or stratified sample (Eisenhardt, 1989). In the present study, companies were selected if (1) the company was a wholesale or manufacturing company with either in-house or outsourced production (i.e. the company sold products whose design it was in control over), and (2) the authors had either worked with the company directly in the research project or had access to detailed information about the CBMI process during the research project via co-researchers from the authors' research group.

The resulting 12 case companies comprised circular start-ups and linear incumbent companies of different size and from different industries (i.e. the apparel, textiles, furniture, machinery and mechatronics industry) that served different customer segments (i.e. B2C and B2B companies) (see Table 1). The large variation between the case companies allowed the authors '[t]o obtain information about the significance of various circumstances for case process and outcome' (Flyvbjerg, 2006, p. 230) and thus to begin to examine the effect of characteristics such as company size, industry and customer segment on the encountered barriers through literal and theoretical replication (Yin, 2014).

The companies were divided into four groups based on their age and size for the cross-case analysis. The first group consisted of start-ups less than three years of age, i.e. companies A and B. The second group comprised micro-companies more than three years of age with fewer than 10 employees (Eurostat, 2016), i.e. companies C, D and E. The third group consisted of small companies more than three years of age with fewer than 50 employees, i.e. companies F, G and H. The final group comprised large companies more than three years of age with more than 250 employees, i.e. companies I, J, K and L.

The two start-ups, case companies A and B, were already developing CBMs, when the research collaboration began, which meant that the starting point was different for these two circular start-ups compared to the rest of the companies. The companies nevertheless engaged in a collaboration process in which the pre-existing CBM ideas were examined closer and developed further. As such, the collaboration with these companies also represented a CBMI process, albeit a process starting from a more advanced state.

3.4. Data collection

The collaboration with the case companies lasted between six

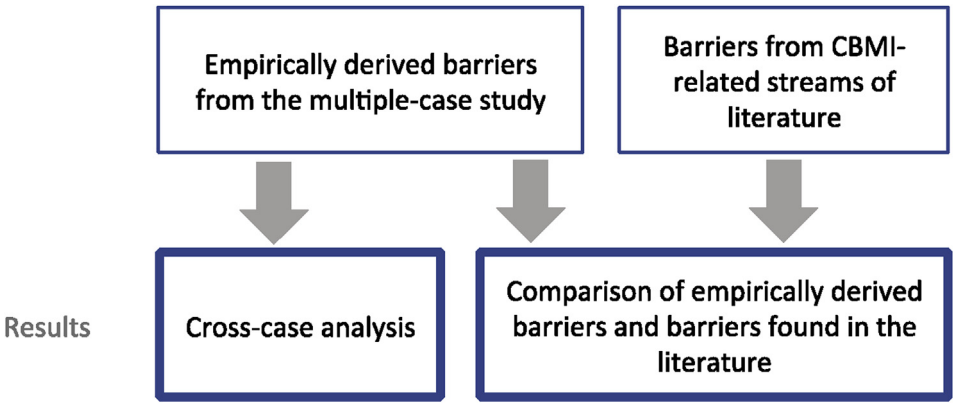

Fig. 2. Overview of the different elements of the research and how these are connected.

Table 1
Overview of case companies.

Case company	Company type	Customer segment	Industry	Project anchoring in the company	Duration of CBMI collaboration	Approx. no. of meetings and work-shops
A	Start-up	Consumer	Apparel	Owner-manager	1.5 years	10
B	Start-up	Consumer	Apparel	Owner-manager	2 years	20
C	Micro	Business	Textiles	Owner-manager	0.5 years	5
D	Micro	Business	Machinery and mechatronics	Owner-manager	3 years	10
E	Micro	Business	Furniture	Business manager	0.5 years	10
F	Small	Consumer	Apparel	Owner-manager	3 years	10
G	Small	Business	Furniture	Owner-manager	2 years	15
H	Small	Consumer	Furniture	Owner-manager	1 years	10
I	Large	Business	Textiles	Project manager, Quality, Environment and production	3 years	10
J	Large	Business	Machinery and mechatronics	Environmental manager and PhD student	2 years	5
K	Large	Business	Machinery and mechatronics	Chief technical advisor, R&D	2 years	10
L	Large	Business	Machinery and mechatronics	Corporate sustainability director	3 years	10

months and three years, depending on the motivation of the individual company. The researchers interacted with the companies in meetings, phone calls and email correspondence with individual company contacts, and in working meetings and workshops that involved multiple stakeholders from the companies. Data on the encountered barriers was collected through unstructured interviews that were conducted during the interactions with the companies and participant-observations during these interactions. To allow for data triangulation (Yin, 2014), these data sources were supplemented with document analysis of official documents such as sustainability reports and company websites and in some cases with semi-structured interviews with key internal and external stakeholders. Case study data was captured in meeting minutes, which were shared with the companies, and in interview transcripts, field notes and memos that were saved in a case study database (Yin, 2014). A detailed description of the collaboration process in seven of the case companies is available in a report by Guldmann and Remmen (2018).

3.5. Data analysis

The empirical data was analysed using an inductive approach, where a list of barriers was first identified for each company. The list of barriers was compiled using data triangulation between multiple sources of evidence (cf. Section 3.4) (Yin, 2014). The individual company lists were then compared and discussed between the six researchers that carried out the research in the 12 case companies, thus applying investigator triangulation (Yin, 2014; Eisenhardt, 1989). Barriers of a similar character were grouped into one heading and organised into barriers within the emergent categories market and institutional barriers, value chain barriers, organisational barriers and employee level barriers.

For the purpose of cross-case analysis, we compared the number and type of barriers experienced by each company across company size, industry and customer segment in order to identify any preliminary patterns. The result of the cross-case analysis is discussed in Section 4.

The barriers found in the literature were divided into barriers related primarily to external or internal conditions. In the process of comparing barriers from the literature with empirically derived barriers, we have looked for both direct comparisons and closely related issues. For example, the empirically derived barrier *difficulty securing funding for CBMs* was linked to barriers 2 (*no government support in the form of training, funding, legislation…*) and 7 (*lack of external funding opportunities*) from the literature, which constitute barriers directly comparable to the observed barrier. The empirically derived barrier was also linked to barrier 8 (*financial, legal and operational risk increase in CBMs compared to linear business models…*) from the literature, which is a barrier that describes an underlying explanation why the funding is difficult. The comparison of empirically derived barriers and barriers described in the literature is shown in Table 5 and discussed in Section 5.

4. Results and discussion of the Empirical study

This section presents the results from the empirical part of the study, starting with a presentation of the process outcome of each of the 12 case company collaborations in Section 4.1. Section 4.2 presents a total list of barriers experienced in the case companies and Section 4.3 presents a cross-case analysis.

4.1. Process outcome

In all case companies, the innovation processes resulted in the generation of multiple ideas for CBMs for slowing or closing resource loops and in the refinement of some of these business model ideas. The developed CBMs were generally not implemented during the research collaboration. However, in start-ups A and B, which were already well underway with CBMs prior to the research collaboration, the existing CBMs were developed further and implemented during the research project, and in company D a small-scale CBM was implemented. Table 2 summarises the main outcome of the CBMI process in the case companies.

4.2. List of empirically derived barriers

The barriers that were identified during the course of the CBMI process in the 12 case companies can be organised into external barriers at the market and institutional as well as the value chain levels and into internal barriers at the organisational and employee levels. The barriers are described below and listed in the left column of Table 3.

4.2.1. Barriers at the market and institutional level

Regulatory barriers are one type of barriers observed at the market and institutional level, for instance the taxation of labour (rather than raw materials), which mean labour-intensive reuse, repair, upgrade, remanufacturing and recycling activities are expensive compared to the manufacturing of new products. Classification of recaptured goods as waste is another example, which induces restrictions on handling and transportation of recaptured goods, especially across borders. Taxation and market structures mean the case companies had little incentive to use recycled materials, as *virgin raw materials are almost as cheap* and are considered easier to manage in the manufacturing system because they have a more consistent quality and reliable supply.

Funding difficulties was another barrier. For instance, banks were reluctant to support the development and implementation of a CBM in start-up A, and the small company F failed to attain financial support for market testing of a CBM from public environmental innovation funds, because the funds were largely earmarked for the development of clean-tech solutions, while the proposed CBM would instead test new ways of interacting with customers and offer services to slow resource loops. The lack of funding opportunities likely relates to the *unclear market demand* for CBMs, which was a major concern for the case companies. While circular economy-oriented public *procurement policies* could potentially alleviate this issue for companies with business-to-government sales, the reviewed public procurement policies were generally more oriented at cost than sustainability.

4.2.2. Barriers at the value chain level

At the value chain level, *investments* made in existing manufacturing facilities and value chain setups were an issue for some of the incumbents. Much time, money and effort went into building the existing infrastructures, and starting to build new ones that would potentially divert business away from the profitable, established setups was perceived as unattractive by the case companies. The companies also worried about how to ensure a high, uniform *quality output* from the product-life extension activities and about consistency of the *return-flow* of goods or recycled materials. Globally and culturally *dispersed and highly complex value chains* rendered it a complicated task to establish new circular systems for many of the case companies.

The case companies were *reluctant to involve value chain partners*, including customers, in the development of CBMs in many cases and it seemed there was little prior experience with this kind of collaboration. Building CBMs that serve all the involved partners and establishing mutual trust in the expanded value networks required for the operation of new CBMs is often highly recommended, but extending attention beyond the existing supply chain to find new partners and start *building mutual trust* is a demanding and time-consuming task that was a barrier for some companies.

Table 2
Outcome of the CBMI processes.

Case company	Key features of developed CBMs
A	An internally operated return scheme for apparel. The scheme would support a CBM based on peer-to-peer resale of apparel that would intensify product use and extend product life, which was at the testing stage, when the collaboration began.
B	Improvement of a CBM under implementation when the collaboration began. The pre-existing CBM was centred on apparel made from second-hand materials coupled with a take-back and leasing scheme for apparel that would intensify product use and extend product life. The CBMI process facilitated by the research project was focused, among other things, on improving the customer interaction. Furthermore, the potential for an industrial symbiosis created between company B and H was examined, where leather off-cuts from the production in company H could be used in the production in company B.
C	Cascaded use of textile goods at their usual end-of-life that would extend material life.
D	New product designs as well as a small-scale implementation of a take-back scheme coupled with remanufacturing and resale that extend product life.
E	Cascaded use of redesigned bedding products in new markets to extend product life.
F	A store concept based on a combination of repair, reuse, redesign and recycling services for apparel, and another repair service. Both aimed at extending product life and the former also at extending material life.
G	A combined leasing and refurbishment service for furniture that would extend product life.
H	A redesigned piece of furniture and an associated take-back and remanufacturing service to extend product life. Furthermore, the potential for an industrial symbiosis between company B and H was examined, where leather off-cuts from the production in company H could be used in the production in company B.
I	CBMs in two different business units that would extend the life of fabrics through maintenance services and recycle fabrics, respectively. These CBMs thus aimed at extending material as well as product life. Internal dialogue on relevance of CBMs to clarify the organisation's position on circular economy.
J	Technical solutions primarily to enable recycling, i.e. solutions oriented at material life extension. Internal dialogue on relevance of CBMs to clarify the organisation's position on circular economy.
K	CBM integrating predictive maintenance, resale and recycling. Internal dialogue on relevance of CBMs to clarify the organisation's position.
L	Circular packaging and a CBM based on take-back and resale (i.e. CBMs aimed at both material and product-life extension). Internal dialogue on relevance of CBMs to clarify the organisation's position on circular economy.

Table 3
Cross-case overview of observed barriers.

Size	Start-up		Micro			Small			Large				
Industry[a]	App.	App.	Tex.	Mac.	Fur.	App.	Fur.	Fur.	Tex.	Mac.	Mac.	Mac.	
Customer segment	B2C	B2C	B2B	B2B	B2B	B2C	B2B	B2C	B2B	B2B	B2B	B2B	
Case companies	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	
Market and institutional level													19
Regulatory barriers		x											1
Difficulty securing funding for CBMs	x	x			x		x	x					5
Market demand unclear	x	x			x	x		x	(x)		x		7
Public procurement policies not sustainability oriented			x	x			x						3
Low price of virgin raw materials compared to recycled materials				(x)	x				(x)				3
Value chain level													36
Investments in existing manufacturing facilities and value chain					x			x	x	(x)	x		5
Concerns about quality control of returned goods					x		x		x		(x)		4
Concerns about consistency of flow of return goods		x					x		x		x		4
Dispersed, complex value chains	x								x	x	x		4
Reluctance to involve external stakeholders in CBMI activities			(x)			x	(x)		x		x		5
Takes time to build new partnerships and mutual trust	x	x	x		x	x	(x)	x	x		x		9
Lack of knowledge or competencies in value chain	x	x			x		x	x					5
Organisational level													52
Narrow focus of existing sustainability strategies				x		x			x	x	x	x	6
Difficulty attaining management buy-in		x			x			x	x		x	x	6
ROI and similar requirements for new business ventures	x	x	x		x			x			(x)		6
Cannibalisation concerns				x		x					x		3
Little evidence of financial and environmental benefits		x		x	x			x	x		x	x	7
Lack of resources, knowledge or competencies in-house	x	x	x	x	x	x	x	x	x	x	x	x	12
Uncertainty about legislation in this field		x									x		2
Difficulty establishing cross-organisational collaboration									x	x	x	x	4
Special product design required for maximum profitability			x		x			x	x	x	x		6
Employee level													23
Lack of knowledge about circular economy and CBMs			x	x		x			x	x	x	x	7
Hesitant approach to promoting the circular economy agenda							x		x		x	x	4
Prevailing linear business model structures and thinking				x	x	x	x	x	x	x	x	x	9
Incentive structure supporting linear business models									x	x	x		3
	7	11	7	8	13	8	10	11	18	9	20	8	130

[a]) App. is short for apparel, Tex. is short for textiles, Mac. is short for machinery and mechatronics, Fur. is short for furniture.

The need for trust relates to the fact that in existing value chain setups, the collaboration between partners is typically based on formal agreements following industry standards, but to develop most CBMs, a collaborative approach is needed, which will initially build more on trust than on standards since these are generally not in place yet.

4.2.3. Barriers at the organisational level

At an organisational level, *extant sustainability strategies* with a narrow focus on, for instance, energy efficiency of products, was a barrier to the adoption of the circular economy concept and the development of CBMs because the large companies in particular seemed locked into old sustainability paradigms on multiple occasions. A change of focus in the sustainability strategy and an allocation of resources to CBM development was needed in the case companies, but in some of the companies, the company contacts struggled with how to ensure the needed *management buy-in* to these changes.

The economic profitability of CBMs was a concern for many of the case companies. First, company investments are traditionally based on key figures such as payback time, return on investment (ROI), or similar. Yet, CBMs operate at different timelines, and have different financial structures and risks than linear business models (Linder and Williander, 2017), and often cannot meet the *ROI requirements* that linear business models do, at least not within the same time span. CBMs thus need to be evaluated on different terms, and according to parameters that are yet to be developed. Second, case companies worried about *cannibalisation* from new circular offerings that would prolong the product life and thus decrease sales. Third, fairly *little evidence* is available that clearly demonstrates the financial and environmental benefits of CBMs.

Most of the case companies were new to CBMs and, consequently, had to build *knowledge and skills* within this field and allocate resources to it. One area that posed challenges was lack of knowledge about *regulation* of relevance to CBMs. In the large companies, it was important, but difficult, to establish *cross-organisational collaboration* that would assist internal dialogue to clarify the company's position on CBMs and ensure the necessary coordination between departments and development of circular economy competencies across the company.

Product design requirements for circular products such as avoiding gluing, welding and casting parts together, for example, also constituted a barrier. The redesign process requires new skills, and, while redesign is costly in itself, building new manufacturing lines and supplier networks to implement a new design is particularly so. Furthermore, frequent technological product improvements were highlighted as an issue that rendered it difficult to ensure a stable product design over time to facilitate remanufacturing.

4.2.4. Barriers at the employee level

Some case companies had previous experience with circular economy principles, for example, from experience with products made of recyclable materials or from a return system, although these experiences were typically not articulated as CBMs. These experiences formed a good starting point for the introduction of circular economy and CBMs in those companies, but most of the case companies were unfamiliar with the notions of circular economy and CBM when the research collaboration began, and this *lack of knowledge about circular economy and CBMs* was an initial barrier to the CBMI process.

Possibly because of difficulty of attaining management support

for the CBMI process, particularly in the large companies, we observed that the company contacts were *hesitant about promoting circular economy internally*. The need for a circular economy agenda to fit with other strategic agendas in the company, the perception that the organisation was already stretched for resources, uncertainty regarding the market demand and regarding the solidity of the business case also appeared to be important reasons for the cautious approach.

In some of the large case companies, employees struggled with how to manoeuvre around the extant organisational *structures and values*, which were strongly influenced by linear business model thinking. In general, it seemed employees found it most appealing to work from the familiar linear business setup and approach circular economy in small and safe incremental steps. An *incentive structure* based on linear business model values and business-as-usual operations, for example, rewarding sales volume rather than service contract agreements, was also found to be problematic at the employee level.

4.3. Cross-case analysis

Barriers experienced by the individual case company are mapped out in Table 3 to compare barriers across companies. The table shows that, overall, most barriers were encountered at the organisational level (52), followed by the value chain level (36), the employee level (23) and the market and institutional level (19). One could speculate, whether this distribution has to do with the fact that most case companies worked primarily at the early stages of CBMI, since market and institutional barriers may not be encountered until later stages of the innovation process, closer to implementation. Comparing the companies that implemented CBMs during the research project (i.e. A, B and D) to the rest of the companies nevertheless shows that the companies that implemented CBMs did not experience more market and institutional barriers than those companies that did not. This indicates that the distribution of barriers on the four socio-technical levels does not relate to whether the company was at early or later stages of the innovation process.

All the companies experienced a substantial number of barriers (ranging from seven to 20) and most companies experienced barriers at all four socio-technical levels. A few companies, i.e. micro-company D and large company L, did not experience barriers at the value chain level, and company L did not experience barriers at the market and institutional level either.

The circular start-ups, i.e. companies A and B, did not experience barriers at the employee level, whereas all the incumbents did. It makes sense that the start-ups did not experience barriers at the employee level, since these barriers relate to issues such as a *lack of knowledge about CBMs*, a *hesitant approach to promoting the circular economy agenda* and *prevailing linear business model structures and thinking.* These types of barriers do not apply to circular start-ups, where the founders have actively sought out CBMs as alternatives to linear business models and where no pre-existing organisational lock-in (McGrath, 2010; Chesbrough, 2010) hinders the innovation process.

Large companies are expected to face more internal barriers to innovation that relate to organisational inertia from path dependency and lock-in than small companies (Bessant et al., 2014; D'Estea et al., 2012; Sandberg and Aarikka-Stenroos, 2014). This pattern seems to be reflected in the present study, where the large companies on average experience more internal barriers than the small companies (also if circular start-ups are excluded from the group of small companies, looking only at the categories micro and small companies). Small companies, on the other hand, are expected to face more external barriers relating to a lack of resources and market structures (D'Estea et al., 2012; Sandberg and Aarikka-Stenroos, 2014). Yet, this is not the case in the present study, where the large companies also experience more external barriers *on average* than the small companies (both when including and excluding start-ups in the group of small companies). The large companies thus on average face both more internal and more external barriers than the small companies in this study, although there are sizeable variations between individual companies that mean some small companies experience more barriers than some of the large companies. The small company E for instance experience 13 barriers whereas the large company L experience only eight.

Concerning how the specific industry impacts the experienced barriers, the barriers vary significantly within the same industry. Between large B2B companies in the machinery and mechatronics industry, for instance, the total number of barriers experienced varies between eight and 20, and zooming in on the value chain level barriers are seen to vary from none to six. We can therefore not establish a link between industry and the number or types of barriers experienced.

Whether the customer segment affects the encountered barriers is examined by focusing on companies G and H. These companies are both small incumbents from the furniture industry, but G is a B2B company whereas H is a B2C company. The two companies experienced a similar number of barriers (ten and 11 respectively), but very different specific barriers with only five common barriers. This analysis could lead to the assumption that the customer segment accounts for some of the variation between the experienced barriers. However, returning to an analysis of the large B2B companies in the machinery and mechatronics industry this does not seem to be the case.

Hence, a comparison of company J and K constitutes an appropriate means of examining whether the significant variations in barriers across the case companies can be attributed to company size, industry and customer segment, since the two companies are of the same size (i.e. large), from the same industry (i.e. machinery and mechatronics) and serve the same type of customers (i.e. business customers). If size, industry and customer segment determine the number of barriers and which specific barriers a company experiences, we would expect these two companies to encounter similar barriers.

Comparing the two companies nevertheless reveals that the number of barriers they encountered is different. Company K experienced as many as 20 barriers, corresponding to most of the barriers listed in the value chain, the organisational and the employee categories, whereas J only experienced nine of these barriers. A similar divergence is found when comparing the two start-ups A and B that are also of the same size, from the same industry and serve the same type of customers. These findings indicate that barriers to the CBMI process were influenced by factors other than size, industry and customer segment. This could be factors relating to the ambition level for the CBMI process and/or factors relating to the company-internal settings such as the level of management attention, resources available for the CBMI, what internal and external stakeholders were involved in the innovation process and what were the attitudes of those stakeholders towards CBMI.

A recent study by Vermunt et al. (2019), among companies that have implemented CBMs, has shown that the experienced barriers differ depending on the type of business model that the company has implemented. Our study focused on companies in the process of developing CBMs or implementing CBMs, which means that the final CBM type was in many cases not known yet. The types of CBM that were explored may nevertheless have influenced the experienced barriers, as the findings of Vermunt et al. (2019) would imply.

This is in line with findings in Guldmann and Huulgaard (2019), where we found that there is a connection between the CBM type and the level of engagement that is required of the company in the CBMI process. In other words, the CBMI process is more demanding and requires a stronger engagement and commitment from the company, if the company is exploring more advanced types of CBMs, i.e. CBMs where all or most business model elements are aligned to close and/or slow resource loops in an optimal way (Guldmann and Huulgaard, 2019). It is reasonable to connect this notion with the prospect of encountering more or different barriers, if exploring advanced types of CBMs as opposed to types that require less internal change and less new processes and collaboration in the value chain. Furthermore, companies have different premises for engaging in the CBMI process. Pre-existing sustainability strategies and practices, for instance, are premises that are linked to the value creation logic of the organisation and are likely to influence the number and types of barriers experienced in the innovation and implementation process (Guldmann and Huulgaard, 2019).

5. Results and discussion of the comparison of Empirical data with the literature

This section presents the results of the literature review. The aim of the literature review is to compile a comprehensive list of CBMI barriers described in CBMI-related streams of literature and compare this with the barriers observed in the 12 case companies to examine differences and similarities between the two lists.

5.1. Barriers to circular business model innovation described in the literature

The barriers derived from the sustainable innovation literature review are presented in Table 4.

The review revealed 31 external and internal barriers reported in the literature. External barriers range from governmental barriers, such as legislation, taxation, funding, infrastructural and procurement barriers, to barriers related to the value chain and other stakeholders. Technological as well as consumer-related barriers, such as fashion trends, are also included. The internal barriers are related to, among others, lack of management support, knowledge, resources and incentive structures and the organisational adaptability, unclear business cases and complexity in product design.

5.2. Comparing observed barriers and barriers from the literature

The barriers identified in the multiple-case study are compared to barriers from the CBMI-related literature in Table 5 to examine differences and similarities between the two lists.

The table shows that CBMI barriers observed in the case companies generally correspond to barriers in the CBMI-related literature (i.e. the sustainable innovation literature), although the observed barriers *reluctance to involve external stakeholders in CBMI activities*; *difficulty establishing cross-organisational collaboration* and *a hesitant approach to promoting the circular economy agenda* do not have a clear equivalent in the reviewed literature. They do, nonetheless, all relate more generally to barrier 28 from the literature, i.e. the fundamental shift in corporate culture and market engagement that is needed and a resistance to this change.

A possible explanation why these collaboration-related barriers were detected in the present study, but not previously in the literature, is that it was up to the individual company contacts to integrate the CBMI process in the broader organisation, as opposed to the more typical situation where CBMI is introduced by management. A lack of management support, combined with the long list of other barriers, meant that promoting CBMs was perceived as a career-wise risk for the company contacts as well as the other employees involved. This situation rendered it difficult to establish the internal and external collaboration needed to advance the CBMI process.

In the smaller companies, in which management was directly involved, career-wise risk and cross-organisational collaboration were not barriers, but the companies still exhibited reluctance to involve external partners. Involving external partners seemed premature to the companies possibly because (most of) the companies were just beginning to understand CBMs and how they might progress in that direction.

The observed barrier *investments in existing manufacturing facilities and value chain* emphasises that incumbent companies are often locked into linear business models due to investments in the existing infrastructure. This barrier did not have a clear equivalent in the CBMI-related literature either, although it arguably relates to barriers from the literature, such as concerns over risk of decreasing sales and the aforementioned fundamental shift in corporate culture, policies and market engagement. As the three barriers described above, it is a relevant addition to the list of previously identified barriers.

Barrier 16 is the only barrier from the literature that does not have a counterpart in the empirically derived barriers. This barrier pertains challenges encountered by third-party repair companies that work independently of the original equipment manufacturer e.g. to repair or upgrade products. These barriers include no official training available to repair staff, no access to repair tools etc., as well as a more general lack of knowledge experts on circular economy. This barrier did not emerge in the CBMI processes in the case companies, since these were wholesale or manufacturing companies and not third-party repair companies. Moreover, the researchers provided the needed expertise on circular economy in the innovation process, which meant there was no lack of knowledge experts either.

6. Conclusion

In this article, we addressed the research question: *What barriers do companies encounter in CBMI?* The aim was to explore two gaps in the existing literature. The first gap was that the relatively few CBMI studies that deal with barriers tend to focus on the study of individual cases or specific industries, while a broader perspective is generally lacking. To help alleviate this gap in the literature, the article presented an in-depth multiple-case study across start-ups and incumbents and across industries, company sizes and customer segments to ensure a broad and rich empirical foundation for the analysis of barriers and begin to understand similarities and differences between companies in these categories.

The analysis showed that most companies experienced barriers at all four socio-technical levels, i.e. barriers at the market level, the institutional and value chain level, the organisational level and the employee level. Notably, circular start-ups that adopted CBMs when the company was established did not encounter barriers at the employee level, as the only category of companies.

The comparison of companies of the same size, in the same industry and serving the same customer segment showed that these companies experienced different barriers. This implies factors other than size, industry and customer segment influence what barriers a company encounter in the CBMI process. The type of CBM that is explored or implemented by the company and the premises for CBMI were discussed as factors that could potentially be influencing what barriers are encountered.

The second gap addressed in this article was that current

Table 4
Barriers to circular business model innovation in the literature.

	External barriers	Selected references
1	Lack of concrete, coherent, strict legislation	Rizos et al. (2016)
2	No government support in the form of training, funding, legislation. No clear place to go for help and long procedures to obtain certifications etc.	Kuo et al. (2010); Rizos et al. (2016)
3	Lack of supportive public procurement policies	Rizos et al. (2016)
4	Taxation of labour rather than raw materials renders labour-intensive reuse and recycling activities expensive	Stahel (2010); Kissling et al. (2013)
5	Legislation hinder CBMs, e.g. legislation on sales of waste materials and on cross-border movement of products for reuse	Singh and Ordoñes (2016); Milovantseva and Fitzpatrick (2015); Mont (2002); King et al. (2006)
6	Warranty legislation hinders the use of reused spare parts	Riisgaard et al. (2016)
7	Lack of external funding opportunities	Rizos et al. (2016)
8	Financial, legal and operational risk increase in CBMs compared to linear business models, and tools to assess and manage risks are lacking	Kuo et al. (2010); Linder and Williander (2017); Prendeville and Bocken (2017); Sauvé et al. (2016); Mont (2002); Rizos et al. (2016); Besch (2005)
9	Lack of interest and understanding from value chain and a need for training and education	Rizos et al. (2016); Adams et al. (2017); Ravi and Shankar (2005); Kuo et al. (2010); Mont et al. (2006)
10	Network collaboration challenges, e.g. difficulty of creating the needed networks for circularity and supply chain dependencies that prevent circularity	Pearce (2009); Seitz (2007); Besch (2005); Mont et al. (2006); Wise and Baumgartner (1999); Rizos et al. (2016); Kissling et al. (2013); Boons and Lüdeke-Freund (2013); Prendeville and Bocken (2017); Mont (2002); Kuo et al. (2010)
11	Original spare parts are difficult or impossible to attain or have to be transported over long distances	Riisgaard et al. (2016); Sabbaghi et al. (2017); Mont et al. (2006); Seitz (2007)
12	Rate of technological change may demand frequent design changes that hinders product reuse and remanufacturing	Besch (2005); King et al. (2006)
13	Fragmented supply chains, lack of green suppliers and long distances to customers	Adams et al. (2017); Rizos et al. (2016); Besch (2005)
14	Unpredictable or decreased quality of returned or recycled products and materials	Bocken et al. (2015); Singh and Ordoñes (2016); Kissling et al. (2013); Kuo et al. (2010); Ravi and Shankar (2005)
15	Unpredictable flow of reused goods or recycled materials resulting in e.g. conflict with demand and planning difficulty. Lack of information systems to mediate this	Singh and Ordoñes (2016); Linder and Williander (2017); Östlin et al. (2008, 2009); Ravi and Shankar (2005); Besch (2005)
16	No official training available to repair staff, no access to repair tools and repair guidelines for third party repair companies. General lack of knowledge experts on circular economy	Riisgaard et al. (2016); Sabbaghi et al. (2017); Rizos et al. (2016)
17	CBMs only relevant to some customers and product types and customer benefits from, and acceptance of, new CBMs are uncertain	Pearce (2009); Sundin et al. (2009); Mont (2002); Rizos et al. (2016); Edbring et al. (2016); Besch (2005); Kuo et al. (2010)
18	Low status of products from recycled materials and repaired, reused, refurbished or remanufactured products. Uncertainty about residual value of products. Low status of products may damage company image, if it engages in CBMs	Singh and Ordoñes (2016); Ylä-Mella et al. (2015); van Weelden et al. (2016); Rizos et al. (2016); Edbring et al. (2016); Mont et al. (2006); Besch (2005)
19	Changing fashion trends can be a challenge for long-life products	Mont et al. (2006); Besch (2005)
	Internal barriers	**Selected references**
20	Unclear business case for CBMs. Integrating environmental considerations in product and business model design is also perceived as lengthening time to market	Adams et al. (2017); Mont (2002); King et al. (2006)
21	Concerns over risk of decreasing sales due to increased sales of repaired, reconditioned and remanufactured products	Guiltinan (2009); Michaud and Llerena (2011); Besch (2005)
22	Product design should follow certain guidelines to enable circularity, and redesign of old products may thus be needed	Berchicci and Bodewes (2005); Sundin et al. (2009); Östlin et al. (2008)
23	Lack of top management commitment	Ravi and Shankar (2005); Kuo et al. (2010)
24	Lack of in-house knowledge about circular economy including remanufacturing, recycling etc. and its benefits	Rizos et al. (2016); Ravi and Shankar (2005)
25	Not possessing the necessary technical and technological know-how to engage in new business models. Difficulty of designing new business models including a lack of tools for this	Rizos et al. (2016); Kindström and Kowalkowski (2014); Mont (2002); Bakker et al. (2014b); Urbinati et al. (2017); Ravi and Shankar (2005); Kuo et al. (2010)
26	Companies' supply chain position may limit opportunities to adopt CBMs. Required expertise and knowledge about the products, makes CBMs most suitable for OEMs	Mont et al. (2006); Pearce (2009); Rizos et al. (2016)
27	Lack of internal resources, i.e. capital, time and staff to investigate opportunities	Rizos et al. (2016); Kindström and Kowalkowski (2014)
28	Fundamental shift in corporate culture, policies and market engagement is needed and demand internal reorganisation. Resistance to change	Mont (2002); Mont et al. (2006); Rizos et al. (2016); Kuo et al. (2010); Besch (2005); Ravi and Shankar (2005)
29	Traditional incentive structures and performance metrics are inappropriate to support new business models	Mont (2002); Ravi and Shankar (2005)
30	Repairs impaired by proprietary product designs, parts glued together and other physical product attributes	Riisgaard et al. (2016); Krystofik et al. (2015)
31	Products and buildings are complex and not designed with end-of-life reuse or recycling in mind resulting in a low value at end-of-life	Singh and Ordoñes (2016); Adams et al. (2017)

literature on CBMI barriers draws not only on the emerging literature on CBMI barriers, but more so on related streams of literature within the field of sustainable innovation (e.g. product-service systems and green supply chain management) that may not represent CBMI barriers comprehensively.

This gap was examined by comparing barriers from the CBMI-related streams of literature with the empirically derived barriers from the specialised CBMI cases in our multiple-case study. The comparison showed that the barriers generally corresponded well and the broader literature on sustainable innovation barriers thus seems relevant to the specific field of CBMI. The mapping of empirically derived barriers from the 12 case companies nevertheless revealed four barriers not previously reported in the literature. These four barriers, i.e. *investments in existing manufacturing facilities and value chain*; *reluctance to involve external stakeholders in CBMI activities*; *difficulty establishing cross-organisational collaboration*; and *a hesitant approach to promoting the circular economy agenda*, provide useful additions to the list of barriers from the literature.

In sum, this article contributes to the research field by offering

Table 5
Observed CBMI barriers and their link with barriers from the literature.

Barriers in the multiple-case study	Barriers in the literature
Market and institutional level	
Regulatory barriers	4, 5, 6
Low price of virgin raw materials compared to recycled materials	1
Difficulty securing funding for CBMs	2, 7, 8
Market demand unclear	17, 18, 19
Public procurement policies not sustainability oriented	2, 3
Value chain level	
Investments in existing manufacturing facilities and value chain	-
Concerns about quality control of returned goods	14
Concerns about consistency of flow of returned goods	15
Dispersed, complex value chains	13, 26
Reluctance to involve external stakeholders in CBMI activities	-
Takes time to build new partnerships and mutual trust	10, 11
Lack of knowledge or competencies in value chain	9, 10
Organisational level	
Narrow focus of existing sustainability strategies	28
Difficulty attaining management buy-in	23
ROI and similar requirements for new business ventures	8, 9, 19, 20
Cannibalisation concerns	21
Little evidence of financial and/or environmental benefits	8, 20
Lack of resources, knowledge or competencies in-house	8, 24, 25, 27
Uncertainty about legislation in this field	1, 27
Difficulty establishing cross-organisational collaboration	-
Special product design requirements	12, 22, 30, 31
Employee level	
Lack of knowledge about circular economy and CBMs	24, 25
Hesitant approach to promoting the circular economy agenda	-
Prevailing linear business model structures and thinking	28, 29
Incentive structure supporting linear business models	29

an analysis of barriers across multiple case companies that represent circular start-ups and linear incumbents as well as different company sizes, industries and customer segments. It also contributes by compiling barriers previously described in the literature, and by pointing out new empirically founded CBMI barriers not previously reported in the literature. The research provides managers and other practitioners with a more complete and substantiated list of barriers that can support a proactive and efficient circumvention of barriers to CBMI and potentially accelerate the uptake of CBMs.

6.1. Limitations and further research

The empirically derived barriers reported in this article were based on a longitudinal multiple-case study of 12 diverse wholesale and manufacturing companies in Denmark. This is a large number of companies for an in-depth case study (Yin, 2014; Eisenhardt, 1989), and the total list of empirically derived barriers (cf. Table 3) is expected to encompass the barriers other wholesale and manufacturing companies in Denmark and other comparable countries could encounter. The list of barriers may also be relevant outside this specific context, and the correspondence between the empirically derived list of barriers and the list of barriers based on the literature (which is compiled from studies jointly entailing companies from different European countries, of different sizes, from different industries and with different customer segments, etc.) supports this notion.

However, although 12 is a large number of companies for an in-depth case study, the results of the cross-case analysis would benefit from the inclusion of more start-ups and of companies of every size from each industry and more companies from each industry having customers in both the consumer and business segment. As such the cross-case analysis can only be thought of as an exploratory study into the patterns of barriers, which have to be examined further in studies of a larger scale.

The special context of the research, in which CBMI was initiated in most of the case companies, as a result of the interaction with the researchers, may have resulted in the observation of empirical barriers different from those experienced by companies that begin CBMI on their own initiative. Similarly, our empirical research differs from retrospective studies of CBMI barriers since barriers were observed *as* the CBMI and/or CBM implementation took place. This particular research design may explain why the present study adds to the list of barriers from the literature, particularly at the employee level.

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