sustainability

Review

Transition to a Circular Economy in Europe through New Business Models: Barriers, Drivers, and Policy Making

Gabi Försterling [1], Ronald Orth [2,*] and Benjamin Gellert [2]

[1] Boozt, 215 37 Malmö, Sweden; foersterling.gabi@gmail.com
[2] Fraunhofer Institute for Production Systems and Design Technology IPK, 10587 Berlin, Germany; benjamin.gellert@ipk.fraunhofer.de
* Correspondence: ronald.orth@ipk.fraunhofer.de; Tel.: +49-30-39006-171

Abstract: In recent years, because of global challenges resulting from increased resource shortages and the climate crisis, interest in and the commitment to transition to a more sustainable economic system, especially a circular economy, has increased among scientists, politicians, and practitioners in Europe. To create a system that maintains the value of products as long as possible and minimizes waste, new business models, so-called circular business models (CBMs), are required. So far, as a result of far-reaching barriers, no breakthrough regarding CBMs has been observed and there are a lack of comprehensive analyses on the barriers and drivers of CBMs. Using a systematic literature analysis, this gap was filled and 637 barriers and 394 drivers were extracted from 76 publications, which were categorized into eight areas and synthesized in a comprehensive framework. The results show that an undifferentiated analysis of CBMs could result in incorrect assumptions, as the barriers between them differ. Overall, however, the most significant effect on all CBMs is from external barriers at a macro level. In this paper, drivers, in the form of success factors and political measures, were assigned to concrete barriers, indicating that policy interventions are needed in Europe in order to overcome these barriers and accelerate systematic change. The article provides research, policy, and practice with a theoretically grounded basis for analyzing these barriers and overcoming them.

Keywords: circular economy; circular business models; framework; barriers and drivers; enablers; interference; systematic literature review; content analysis; circular strategies; Europe

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1. Introduction

Current key challenges, such as growing resource shortages, environmental pollution, and the climate crisis, are directly related to the current linear economy, where products are predominantly produced with non-renewable energy sources and materials, and then used and disposed of as waste [1]. Prosperity and economic growth in the European Union (EU) are mainly based on this system and its effects are obvious [2]. The EU produces more than 2.5 billion tons of waste annually and uses nearly 20% of the Earth's biocapacity, while accounting for only 7% of the world's population [3,4]. The concept of circular economy (CE), which aims to unlink economic growth from resource usage, has been presented as a solution [5]. CE is seen as a way to achieve sustainable development goals, especially in environmental and economic terms [6,7]. It is understood as a regenerative system in which materials and products are shared, leased, reused, repaired, refurbished, and recycled for as long as possible, thus radically minimizing waste [3,8]. With CE and technological innovation, the EU could reduce CO_2 emissions by about 83% by 2050, create two million additional jobs, and increase resource productivity by 3% [2]. As a result of these potential benefits, there has been increased interest in implementing CEs in recent years, such as in policy, research, and corporate practice [9–11].

This paper focuses on new sustainable business models, so-called circular business models (CBMs), which can be a driving force of CE, but whose implementation in the market strongly depends on political conditions [10,12]. CBMs can be seen as a new way in which companies create, deliver, and capture value by slowing down, closing, or narrowing material cycles [13,14]. Although the EU recognizes the importance of CE in its second Circular Economy Action Plan 2020, widespread market implementation of CBMs is yet to occur [15–17]. For CBMs to be implemented and thus achieve systemic change towards a circular economy, it is essential to know and assess which barriers and drivers hinder or encourage sustainable systemic change [18].

2. Theory and Research Context

To achieve the transformation to a resource-efficient and circular economy, several building blocks of change are considered necessary and can be influenced by policy action. This paper focuses on the building blocks of new business models and enabling conditions, and their theoretical foundations and the research context are presented below.

2.1. Defining Circular Economy

Many key societal challenges stem from the currently dominant economic system of the linear economy. A linear economy is often referred to as the "take−make−dispose" model, in which primary raw materials are extracted, converted into products, and disposed of as non-recyclable waste after being used [19]. This is in contrast with the concept of CE. According to Blomsma and Brennan [20], CE is currently in the validation stage, meaning it faces the challenge of establishing itself from a theoretical and narrative perspective [20]. As a result of this stage, new definitions are constantly emerging in scholarly discussions [6,12,20,21]. Thus, there is criticism that the concept lacks viability and the ongoing conceptual debate is a barrier to the establishment of CE [6,12,20]. On the other hand, CE is receiving growing interest and increased relevance in research [21]. Despite the lack of scientific consensus on the term, CE can be defined as follows: "A circular economy describes an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations" [12] (p. 224).

The aspects of CE mentioned above are not entirely new. What is new is, however, is the rate at which CE has become more important in recent years [7], as opposed to other concepts [8,22].

Circular Economy in the Context of Sustainable Development

With the emergence of CE, its position in the sustainability sciences and the extent to which CE can contribute to the concept and guiding principles of sustainable development as well as the balance of the three sustainability dimensions of ecological, economic, and social, has been discussed [23–25]. The current debate is mainly driven by the Agenda 2030, adopted in 2015, with its 17 economic, environmental, and social goals (SDGs—Sustainable Development Goals) [26]. CE has strong correlations with goals such as decent work and economic growth (Goal 8), responsible consumption and production (Goal 12), and ecosystem protection (Goals 14 and 15) [27,28].

Sustainable development overall is a globally defined societal goal, whereas CE focuses more on production and consumption models [7,29]. It is therefore argued that CE can be understood as an operationalization of sustainable development that contributes to achieving sustainability goals [6,7].

The contribution of CE to social sustainability can be considered in terms of environmental improvements in the human habitat (e.g., no further waste export and disposal in the global South), creation of new jobs, and fair taxation [21,30–32]. According to Sauvé et al. [7], CE also contributes to a resource-efficient and -independent economy, increasing the chances of ensuring the energy security of not only current, but also future generations. Nevertheless, some authors reaffirm that the relation of CE to the social sustainability dimension and aspects such as intra- and inter-generational justice and fair wealth distribution are largely unclear [6,7,12].

From an economic perspective, greater independence from limited resources and volatile raw material prices leads to higher competitiveness [5,33]. In Europe, 40–60% of the total costs of manufacturing companies are related to material costs [34,35]. The use of innovative business models and technologies, especially in material-intensive industries, can greatly reduce material consumption and thus costs [2]. The vision of CE is to decouple economic growth from resource consumption [5].

In terms of climate and environmental protection, CE drastically minimizes overall resource consumption, uses natural resources more efficiently, and substitutes non-renewable resources with renewable or recycled ones [33]. The decreased material usage and waste reduction over the entire life cycle significantly reduces greenhouse gas emissions. Initial calculations show that CE could reduce CO_2 emissions in material-intensive industries by as much as 83% by 2050 [2,5]. However, critical voices also emphasize that CE can have undesirable environmental consequences. Potential dangers of rebound effects are noted. A rebound effect means that ecologically positive effects (e.g., resource productivity and technical efficiency improvements) can lead to price decreases as a result of increasing demand, and thus to increased consumption or overuse [24].

In the context of sustainability science, it is clear that CE and sustainability cannot be used interchangeably and that CE cannot replace the previously dominant guiding principle of sustainable development, but instead forms a new important school of thought [6]. A circular economy could contribute to economic and ecological sustainability in the future [21], and should thus become much more of a focus with regard to the pursuit for solutions around sustainable and ecologically viable modes of production and consumption.

2.2. Circular Business Models

Consistent sustainable development cannot be achieved without new business models. A business model is understood as the way in which a company creates, conveys, and captures value [36]. Instead of generating only economic value as in classical linear business models, sustainable business models, which include so-called circular business models (CBMs), are intended to provide additional social and environmental contributions [16,37]. In this context, CBMs can be defined as " [. . .] a new kind of [Business Models], where the value creation is grounded on keeping the economic value embedded into products after their use and exploit it for new types of market offerings" [38]. CBMs are created through an innovation process—either in established companies by changing or adding CBM components to existing business operations, or in start-ups, whose foundation serves the goal of developing a CBM [39].

2.2.1. Strategies and Concepts of a Circular Economy

Various strategies and concepts exist for the design of CBMs. This work refers to the CBM strategies of Bocken et al. [13], as well as the R-strategies.

Bocken et al. [13] developed a classification of strategies for CBMs based on the type of resource flow through a system. The three strategies focus on (1) slowing down, (2) closing, and (3) narrowing cycles [13].

Slowing down cycles aim to significantly extend the lifespan and useful life of products and their value. This can be achieved by reusing products through repair and remanufacturing, designing and creating qualitatively durable goods, or by introducing access and performance models where customers consume services instead of owning the products.

The closure of cycles aims to close the loop between the end-of-use phase and new production by converting waste into usable materials and substances [13]. Here, the focus is not on extending the value of the product, but on capturing the (residual) value of disposed products, waste, or waste byproducts [40].

The third strategy, resource efficiency or narrowing of resource flows, targets the increase in material and energy efficiency [41].

Alongside the three strategies of Bocken et al. [13], R-strategies were established in science and the industry [12,42]. R-strategies (Rs) describe sequential steps leading to circularity and the amount varies in different approaches [43]. However, the most commonly used variant emerged from the EU waste hierarchy, termed the 4R Framework, namely: (1) "reduce" (consumers reduce their consumption and companies eliminate the production of waste), (2) "reuse" (linked to the general reuse strategy of repair, remanufacture and refurbish activities), (3) "recycle" (recycling, recovery, and reuse of waste), and (4) "recover" (energy recovery through the combustion of materials) [16,42,43].

2.2.2. Circular Business Model Typology

CBMs can be understood as a new way in which an organization creates, delivers, and captures value by slowing down, closing, or narrowing resource cycles [13,14]. The typology of CBMs used here is based on Lacy, Long, and Spindler [19]. According to this typology, companies have five business model options available in order to contribute to a resource-conserving and waste-reducing production method. In doing so, they benefit from cost savings, new revenue streams, improved reputation, and reduced dependence on resources and fluctuating resource prices [16,19,44]. These five business model types include (1) circular inputs, (2) resource recovery, (3) life-cycle extension, (4) product service systems (PSS), and (5) collaboration platforms. Each CBM type is discussed in more detail below.

Circular Inputs focus on substituting non-renewable material and energy inputs with more sustainable solutions that can circulate in the resource cycle. This CBM therefore follows a "reduce" strategy [16]. It focuses on inputs, i.e., the components that go into products in the design, procurement, and manufacturing stages. It forms the starting point for all other business models by making strategic and environmental purchasing decisions at the beginning of product development [19,45]. The goal is to use only recyclable, recycled, renewable, or biodegradable materials in the production process, which can partially or fully eliminate waste and pollution [19,46].

Resource Recovery, or reuse and recycling [47], is the most successful model for CE companies so far. If products cannot be reused, remanufactured, or disassembled, recycling offers the last opportunity to take advantage of the end of a value-added product life cycle [48]. Companies pursuing this business model seek to extract value from unused waste streams [16,43], and thus follow a "recycle" or "recover" strategy [13]. Three subtypes of resource recovery are distinguished, as follows [45].

Downcycling, similar to the general term "recycling", refers to the transformation of waste into secondary raw materials, with the difference being that these processes involve some loss of feedstock quality, which limits their scope of application in some cases [19]. For example, the length of cellulose fibers decreases with each successive recycling loop of paper and cardboard [45].

Upcycling, on the other hand, converts waste into secondary raw materials for use in relatively high-value applications, such as the German manufacturer "Freitag", which makes bags from truck tarps and bicycle inner tubes [45].

Industrial Symbiosis goes one step further. Here, unused materials are not simply revalued through recycling, but the waste of one process can be an untreated input for a new product [13]. Companies obtain waste from waste byproducts of internal production processes or transfer the waste to cooperating companies, which then use it in their production process [41]. CBM is most commonly used in the metal, paper, plastics, packaging, construction, agriculture, forestry, and electronic sectors [45,49].

CBM **Life-Cycle Extension** mainly refers to the "reuse" strategy, as the product value is extended through maintenance, repair, renewal, and remanufacturing [13,16]. Four models are available for extending the lifetime and usage period of products, which are relevant in both the pre-use and post-use phases. These are (1) longevity by design, (2) direct reuse of a product, (3) maintenance and repair, and (4) renewal and remanufacturing.

Product Longevity is significantly influenced by *Design* during the development of a product [19]. Design strategies should address goals such as making products easy to repair and maintain, easy to replace (component replacement) and adapt [13,19], easy to disassemble and reassemble, and overall standardization and compatibility [13]. Design decisions such as these are tremendously important for integrating circular principles, because once a product enters its sale phase, changes are typically limited in scope [13].

Direct Reuse is achieved through the redistribution and resale of used products, for example, on online platforms or in traditional second-hand stores, where the operator receives a share of the sale price [45].

However, manufacturers can contribute to product-use extension not only upfront in design decisions, but also in the post-use phase. Maintenance and/or Repair replaces defective components and restores a product's functionality so that its expected lifespan can be achieved [19,45].

The fourth option is to Renew and Remanufacture products, which involves modernizing damaged or worn products through inspection, disassembly, cleaning, remanufacturing, component replacement, and testing [50]. This requires return systems and cooperations, for example with retailers, logistics companies, and collection points [13]. In addition to the original manufacturer, third-party companies are increasingly entering the market and perceive their business model in the repair and remanufacturing activities of goods [45].

Product Service Systems (PSS) are characterized by companies keeping ownership of a physical product and offering its benefits for rental or lease services, while remaining responsible for the maintenance and refurbishment of the product at the end of its use by the consumer [19,45]. Therefore, this CBM is often combined with elements of other CBMs such as life-cycle extension [47]. It can be used through different revenue models such as monthly leasing, one-time rental, payment per use, or payment per functional outcome [51]. Product service systems, also referred to as product-as-a-service, mainly imply a "reduce" strategy through the rethinking of ownership and overconsumption, as consumers reduce the purchase of new goods, while companies focus on "reuse", by reusing and refurbishing their own products [16,42]. For this CBM, a strong customer relationship and loyalty are the most important factors [16]. The model works particularly well with high-priced goods that are desirable, but not easily affordable, and where product aging plays a major role [19]. Both original equipment manufacturers and third-party companies can implement product service systems. This CBM is currently most widely applied in automotive, chemicals, furniture, and household appliances sectors [45,49].

Through **Collaboration Platforms**, goods owned by private individuals or companies can be used more intensively or often through shared access or ownership [46]. The goal of this CBM is thus to extend the life of infrequently used products and to use them more frequently and intensively through sharing [52]. This CBM, which is often just called "sharing", runs transactions with the temporary transfer of ownership between consumers on online platforms provided by companies for this purpose [45]. Especially for high-priced goods such as vehicles, accommodation, or furniture, this allows consumers convenient and affordable purchases [19]. However, Collaboration Platforms grow primarily for economic reasons and few have emerged from the idea of the circular economy [19,43]. Markets with increasing sharing opportunities include clothing, co-working spaces, accommodation, and mobility and transport [45,49].

The five CE business model types are not always fully distinguishable. Different CBMs combined are called **Hybrid Models** [13], and they have the potential to achieve the greatet impact [19,53]. Urbinati [53] referred to full circularity when upstream and downstream CBM strategies are combined. Ideally, this is the case when companies use secondary raw materials or renewable materials (circular inputs) and, applying cradle-to-cradle design principles, manufacture them into durable products (life-cycle extension) that are then leased or rented to customers (product service systems) and remanufactured for the next customer after the use phase (life-cycle extension) [16,19]. Figure 1 links the previously presented CBM types and the central phases of a circular economy, and illustrates the interaction and synergies of individual CBMs.

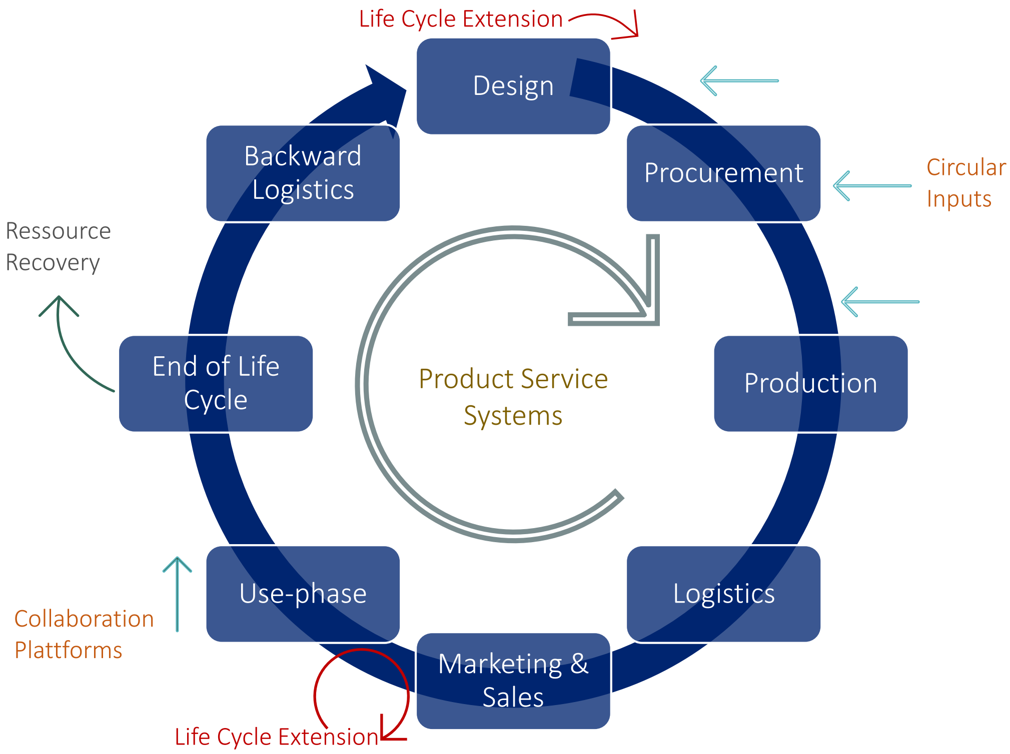

Figure 1. CBM and CE phases (adapted from [19]).

2.3. Enabling Conditions: Political Environment and Instruments

For market mechanisms to unfold in favor of CE, companies rely on the support of policy makers [17]. Over the past 30 years, the public debate around policies to establish CE has been strongly driven from a waste-management perspective [5,49]. Despite progress in waste treatment, total waste generation in the EU increased steadily by approximately 3% between 2010−2016 [54]. Correspondingly, under increasing pressure from pollution and climate change, public calls for new approaches and measures in the EU that go beyond waste-centricity have been growing over the past decade [49,55]. The new CE Action Plan, adopted in March 2020 as part of the "Green Deal", is expected to contribute to this development. It is intended to address the entire life cycle; involve consumers; and make the most resource- and waste-intensive sectors such as plastics, packaging, electronics, food, construction and buildings, batteries, and textiles more circular, while incentivizing new CBMs such as product service systems [15].

Since 2016, many EU states have already developed their own CE roadmaps and policy packages [56]. In general, these packages can be assigned to one or more of the following resource policy instruments, whereby complex transformation to CE can only be realized with "policy mixes", i.e., a combination of different instruments [5,57]:

- **Economic**: negative economic incentives (e.g., taxes and fees) or rewarding economic incentives (e.g., tax reductions and subsidies).
- **Regulatory**, e.g., legal regulations, standards, decrees, and public procurement.
- **Research and Education**, e.g., research funds and the establishment of faculties or research groups.
- **Information Instruments**, e.g., eco-labels, public campaigns for consumers, and advisory services for companies.

Although resource policy instruments cannot always be clearly separated [57], they provide a structured framework that we use later for the systematic literature review.

2.4. Focus on Barriers and Drivers

Despite the rapidly growing attention given to CE, widespread adoption and implementation of CBMs have not yet occurred [11,16,39]. This is a result of numerous barriers that companies face. To facilitate and accelerate the implementation of CBMs, it is necessary to identify the barriers and as drivers as positive counterforces. To date, research on barriers has often focused on single sectors such as textiles [58] or information and communication technology [59]; specific types of businesses such as small- and medium-sized enterprises [60,61]; or a geographic focus, such as China [62], Australia [63], Russia [64], and a variety of European countries such as Denmark, Spain, and Italy [39,50,65], among others. However, there is a lack of systematic and comprehensive studies on the barriers and drivers that focus their attention on comparing different CBMs [16].

The goal is to contribute to a new comparative framework that collects and synthesizes the literature on the barriers and drivers of CBMs within Europe. Especially in young and fast-growing research fields, such as CE, systematic literature reviews are useful because the literature is often still poorly structured. The method thus offers the potential to place studies and articles on the barriers and drivers of CBMs into a broader context and to identify the trends, tendencies, and correlations of these barriers and drivers. For this goal, it is important to decide beforehand on an author's category system to which the identified barriers and drivers can be assigned. Initially, the framework of Vermunt et al. [16] with six categories was adopted, as it considers the internal and external company levels, and their research objective is equally to identify and compare the barriers of different CBMs.

Internal barriers are areas and factors inside the company that hinder CBM implementation. They include the three categories, namely (1) financial, (2) organizational, and (3) technology and knowledge [16].

External barriers lie outside of the company and are more difficult to influence [5]. They include the categories of (4) supply chain, (5) market, and (6) institutional.

Institutional barriers are divided into hard factors (laws and political system) and soft factors (societal values and habits) [16]. Barriers are predominantly referred to as barriers or inhibiting factors that hinder the transition to the circular economy or CBM [66]. However, definitions of drivers differ somewhat. Salim et al. [67] (p. 544) referred to "key opportunities which motivate stakeholders [...]", while Jesus and Mendonça [66] (p. 77) defined drivers as "factors that enable and encourage the transition to a CE". The systematic literature review will show to what extent these definitions are confirmed or if drivers need to be newly categorized.

3. Research Design

The following chapter describes the research approach and procedure for the systematic literature analysis. Furthermore, the development of criteria for the content analysis, as well as a category system, lays the foundation for the analysis of the results.

3.1. Research Approach and Systematic Procedure

This work is exploratory in nature and uses quantitative and qualitative methods to gain new insights. It is exploratory because, first, it is a new research field [11,68] and, second, there is a lack of theoretical elaboration and evaluation on the topic. There is no theory or hypothesis testing in the exploratory research approach. The goal is to inductively derive findings and develop new theoretical knowledge or concepts [69,70]. To do so, the systematic literature review methodology is chosen to identify quantitative and qualitative findings in order to answer the research questions in the context of barriers and drivers to CBMs.

Three Step Procedure

The analysis follows a three-step procedure: (1) planning, (2) execution, and (3) reporting (analysis of the results) [71,72]. Figure 2 outlines the three phases and the steps performed. Based on this structure, the most important steps and their results are explained in the following chapters. They serve as a basis for the subsequent development of the framework.

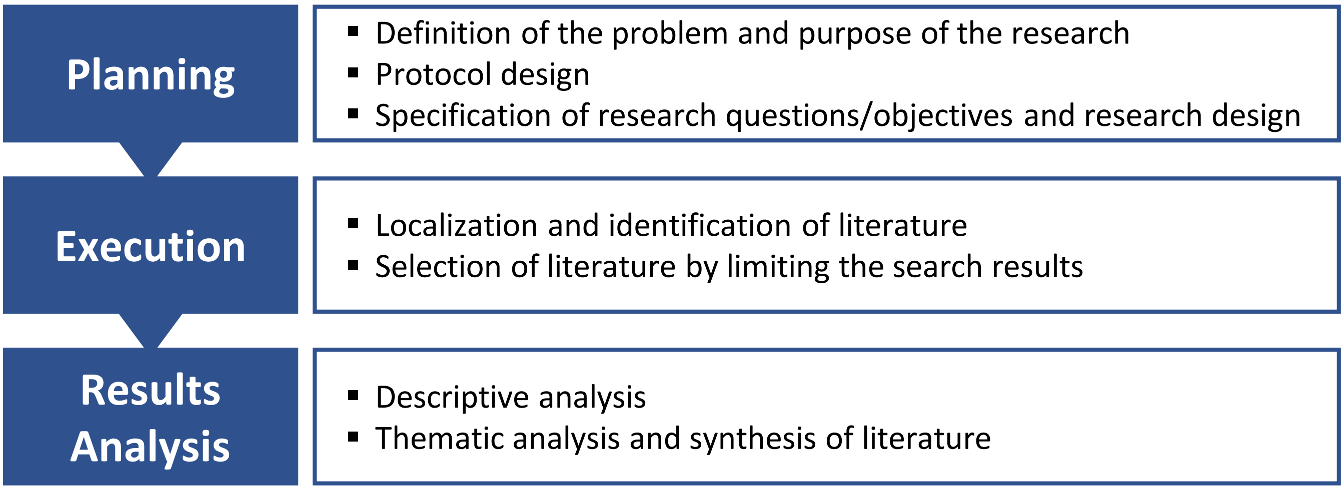

Figure 2. Phases of the systematic literature review as a basis for framework development (adapted from [71,72]).

Initially, basic assumptions and framework conditions were documented in a protocol. This helped to maintain objectivity and enable reproducibility by explicitly describing key steps [72]. The protocol defined the problem statement, the object of the study, the research questions and objectives, and the strategies for gathering and selecting the literature. The key aspects for deriving the research questions and research objectives are summarized below.

3.2. Research Objectives and Questions

The barriers and drivers of circular business models are that it is new and recently growing research field [11,39]. Previous studies have focused on different areas, investigating the barriers of a sector [59] or a type of business [73]; a specific category such as financial, political, or consumer barriers [74,75]; a geographic area; or a specific CBM type [11,16].

Methodologically, most articles captured barriers through a limited empirical survey, mainly through interviews with company representatives [16,76,77]. Empirical contributions continue to be strongly desired [11], but their limited sample size makes them impossible to generalize and highly context-dependent [16]. There is a lack of comprehensive and systematized frameworks with extensive data to identify the strongest barriers or barrier categories of CBMs. Although many articles have already examined the barriers of CBMs from different perspectives, besides the paper by Vermunt et al. [16], only one study exists so far that empirically evaluates whether barriers differ between different CBMs or whether they can be generalized. Most importantly, there is a lack of contributions that link barriers to drivers of CBMs as a positive attribute, identify concrete ways to overcome them, and address responsibilities between companies and policymakers in the process [11,78]. This paper intends to fill this research gap. Because of the particular relevance of CE in Europe, empirical studies with barriers and drivers of another geographical area have not been addressed.

With this background, the objectives of the paper are to (a) identify barriers and drivers of CBMs extensively, (b) systematize them in a category system and developed framework, to note any differences in CBMs, and finally (c) to evaluate drivers and specific measures of policymakers and companies to overcome these barriers. For this purpose, the research questions (RQ, research question) presented in Table 1 and a respective objective were developed.

Table 1. Research questions and objectives.

RQ	Research Question	Objective
1	What is the current state of research on the barriers and drivers of circular business models and how do the contributions differ?	Evaluation of state-of-the-art on the barriers and drivers of circular business models and the identification of future research needs.
2	Which barrier category, regardless of the type of circular business model, is the most common in the literature?	Quantitative identification across the literature of the general trend in the largest barrier categories for CBMs, providing an initial indication of the role of various stakeholders.
3	Do the barriers differ between different circular business models, and if so, how?	Proportion comparison of the barrier categories between CBMs. If they differ, this is a basis for the development of a framework that shows the most relevant barriers for each CBM.
4	What drivers are accelerating the spread of CBMs and what actions can policy makers and businesses take to overcome these barriers?	Differentiation of the term driver and the assignment of possible measures to overcome the barriers, thus revealing indications for the role of politics and companies.

3.3. Research Process and Selection of Literature

Three search methods were defined to identify relevant literature. Figure 3 summarizes the literature selection process and results, which are explained in the following section.

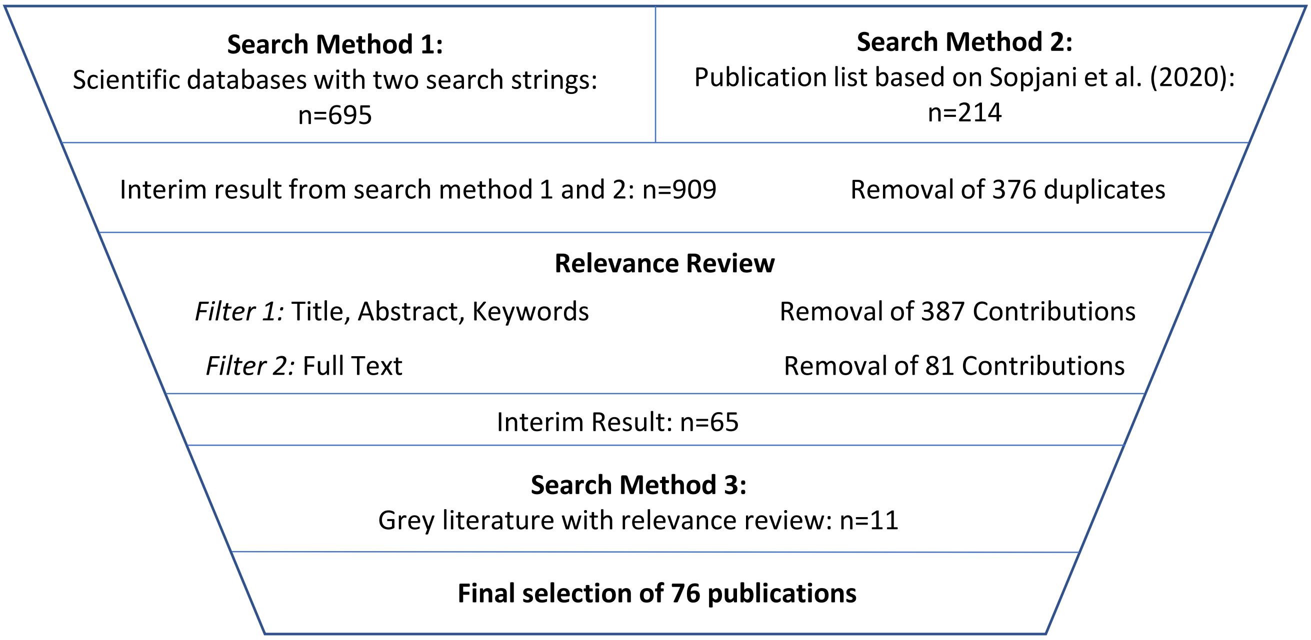

Figure 3. Research strategy and results (data from [79]).

The first search method used search strings in scientific databases. The second method accessed an open-source database of publications with barriers to CE, and the third search method used grey literature and reports.

For search method one, the selection of research databases and the definition of search terms played a critical role [80]. Two of the largest scientific databases, Scopus and Web of Science, were chosen, covering peer-reviewed literature worldwide, major journal publishers (e.g., Elsevier, Taylor and Francis, Wiley, and Emerald), and conferences [81,82]. A restriction on publication years was not set, as this is has become an emerging research field in recent years and a complete mapping of its development should be possible. The scientific databases resulted in 695 search hits.

Search method two used an open-source database of CE barrier publications developed by Sopjani, Arekrans, and Ritzén [79]. Through a systematic literature review, they classified 527 publications. From the database, 214 articles with the applied filters of "barrier(s) are the focus" and "status done' were added to the sample, resulting in 909 articles. After removing 376 duplicates, the number of publications to be screened was reduced to 533. In the next step, criteria were defined as a result of the limitation from the high number of search hits. The selection was divided into general inclusion and exclusion criteria and content-related relevance criteria. Literature should not be evaluated solely by the quality of the publication, but primarily by its content [80,83]. Content relevance was evaluated first and thus prioritized. Only when a publication actually contained barriers or drivers of CBMs was the scientific quality of the publication is assessed. The following criteria were developed to determine the relevance of the publication to the research purpose:

1. The publication includes barriers and/or drivers related to CBMs—either in general or specific (for one or more CBMs).
2. If this is the case, studies that focus on a sector or a certain type of company (SME, large company/startup, and established company) are also included.
3. Publications that analyze barriers and drivers from the macro and micro levels are excluded.
4. Empirical studies focusing on countries or regions outside of Europe are excluded.

Two filters were applied to determine the relevance [84]. Filter one sought to determine if barriers or drivers of CBMs from an entrepreneurial perspective were identified in the publication by reading the title, abstract, and keywords. This was done for the 533 publications; through this process, 387 clearly irrelevant articles were excluded from the sample, leaving 146. In filter two, a second screening was performed in the full text, which allowed for relevance assumptions to be tested in more detail [84]. An additional 81 articles were considered irrelevant in this process, including 30 articles with a geographic focus outside of Europe. The sample thus contained 65 articles.

Lastly, in search method three, the so-called grey literature was added to the data set. In addition to journal and conference articles, studies from research projects and relevant institutions were reviewed for possible sources [72,80]. In this way, institutional and industry practices, which often operate one step ahead of academic contributions, were also considered [66]. In addition, prominent actors such as the OECD and European Commission served as relevant sources [66]. Furthermore, contributions from research institutes, accounting and consulting firms, and non-profit organizations such as the Ellen McArthur Foundation or Circle Economy were included in the shortlist [84]. After conducting a relevance review, 11 additional papers were added to the sample. Table A1 in the Appendix A contains the search results for each search string and search method.

3.4. Analytical Method: Data Extraction Procedure

This phase prepared the analysis of the results, which was then divided into the descriptive and thematic analysis of the literature. This section outlined the data extraction procedure and the categories through which the literature was classified.

A content analysis inspired the process, which used both qualitative and quantitative techniques to answer the research questions. Content analyses took a mixed-method approach: Text passages were documented and assigned to categories (qualitative step) or counted based on the frequencies of categories (quantitative step) [85].

Deductive and inductive approaches were used in the qualitative content analysis by assigning text units to existing categories or to new developed categories. Deductive categories emerged from the literature and thus built on existing research, while the inductive approach identified and summarized new codes and categories that emerged from the analyzed material [85].

This paper choses a mixed approach of deductive category assignment and inductive category formation [85]. Deductive category formation was achieved through prior knowledge of the literature, especially the work of Sopjani et al. [79]. From their classification scheme for barrier analysis, numerous categories were adopted before starting the extraction process. However, some categories and their characteristics also emerged during the literature analysis and thus inductively.

In a descriptive analysis, the research design and research field, in which the publications were located, were explored. This included extracting the year, geographic context and country, research approach, document type, and journal or publisher name of the publication [72,79]. Here, the following categories were established in order to systematically capture the articles and then evaluate them thematically:

1. Geographic context (continent/country): Does the paper have a geographic focus?
2. Barriers/drivers emergence: How were the barriers/drivers identified?
3. Ranking: Is there a prioritization/weighting of the barriers/drivers?
4. Framework/visualization: Is there a framework in place to visualize the barriers/drivers?
5. CBM strategy: Is it about slowing down or closing resource cycles?
6. CBM type: Does the paper analyze a specific Circular Business Model?
7. Business type: Do the barriers/drivers relate to a business type?
8. Sector: Is the paper sector-specific?

The following analysis step served primarily in developing the framework and focused on extracting the barriers and drivers from all 76 publications. In addition to the categories used in the thematic analysis, the focus here was on assigning each barrier and each driver to a category regarding the research question. From this, the frequencies in which category most barriers or drivers originated could subsequently be determined.

Deductively, the six barrier categories from Vermunt et al. [16] were adopted for the time being, namely: financial, technology and knowledge, organizational, supply chain, market, and institutional. Where a publication assigned barriers or drivers to a different category, it was added. As a result, 15 different categories existed at the end of the transfer phase. In order to determine the final categories and combine different ones if necessary, all barriers and drivers were reviewed and their categories were adjusted.

The categorization of Vermunt et al. [16] was ultimately expanded by two categories. It turned out that consumer behavior and societal norms were mentioned so frequently that the category "institutional" was split into soft and hard factors, namely: consumer and societal, and political and regulatory. The three internal barriers were retained. For the supply chain category, the focus was expanded to include networks, as the importance of collaboration as a barrier and driver was frequently mentioned in the literature. Finally, the ecological barriers category was added entirely. The final eight categories with brief explanations are shown in Table 2.

Table 2. Category system of barriers and drivers (adapted from [67,86]).

Level	Category	Definition
Internal	Organizational	Companies as social systems, influenced by goals, routines, organizational structures, lack of time, and personnel, etc.
	Financial	Financial aspects such as financing of CBM, special features in costs, and revenue model.
	Technology and Knowledge	Availability of technology and knowledge that positively or negatively influences the production processes or business activities.
External	Consumer and Societal	Behavioral and attitude-related factors of consumers and society.
	Political and Regulatory	Barriers/drivers triggered by actions of political institutions and current laws, standards, tax systems, etc.
	Supply Chain and Network	Procurement, transport, and logistics aspects, as well as barriers and drivers in network collaboration.
	Market	Market conditions, competitor relationships, market demand-related barriers, and drivers.
	Ecological	Positive or negative environmental impacts associated with CBMs.

4. Results

In the descriptive analysis, the 76 publications as well as the research field were characterized with criteria such as publication year, document types, journal title, relevance of the journals, and research approach. Based on the criteria defined above, the context of the publications, as well as the categories of extracted barriers and drivers were analyzed thematically. In particular, the quantitative part of the evaluation was found to be relevant, as the proportions of the barrier categories were counted comprehensively for the three CBMs of resource recovery, life-cycle extension, and product service systems, and could thus be compared. The results analysis formed the basis for the development of the frameworks.

4.1. Descriptive Analysis

The 76 publications were evaluated regarding the year of publication, document type, research approach, quality level of the journals, and geographical context of the researchers.

Figure 4 illustrates the number of publications per year and highlights the low proportion of publications in the years 2005 to 2014. All of the publications before 2013 were only related to the product service systems business model, showing that this was the first area of research interest to develop. publications (75% of the survey) have been published in the last years of 2016–2020. Since 2015, there has been a steady, annual increase in the number of publications. The recency of the literature analyzed was also evident when considering the proportion of 2019 and 2020 in the survey scope. The research was completed in May 2020. Nevertheless, 42% of the publications were published in the 1.5 years before. This trend will likely continue in the coming years.

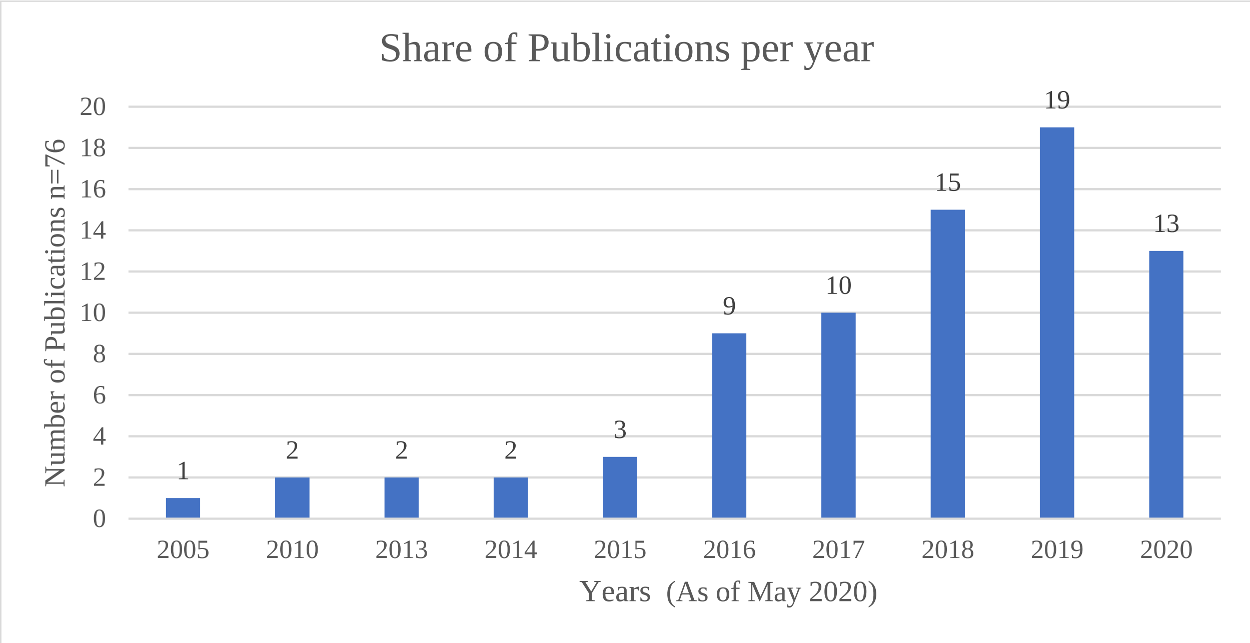

Figure 4. Number of publications per year.

In total, 89% of the articles were published in European countries. British research institutions or researchers were involved in 16 different publications, followed by Sweden (14), Italy (12), Germany (11), and the Netherlands (7). These were the five countries with the most published articles.

Regarding the types of documents, Figure 5 shows that at 63%, well over half of the publications came from journals (n = 48). This was followed by conference articles with a share of 20%. The reports identified in search method three of "grey literature" made up 13% and 4% of all publications come from books (monographs and contributions in collective works).

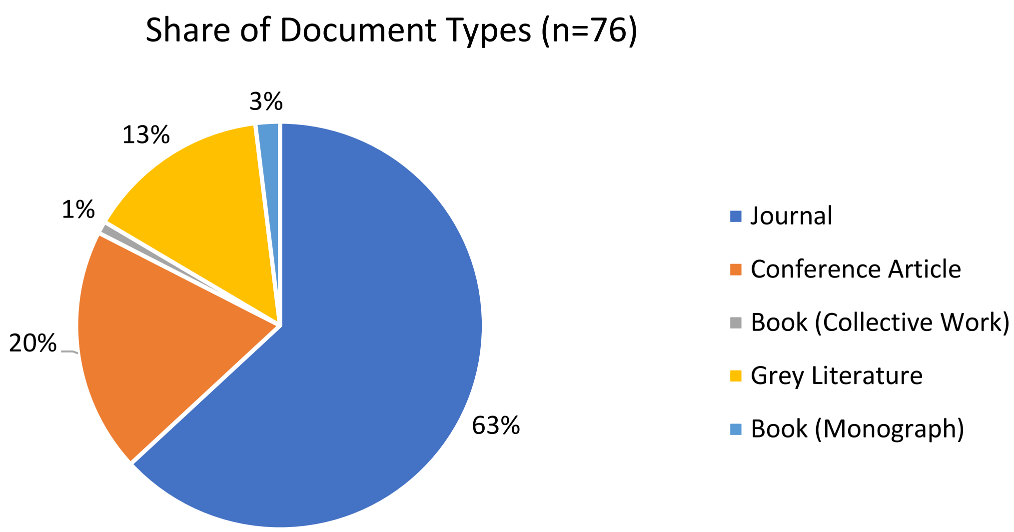

Figure 5. Share of document types.

The average journal impact factor (JIF) of the 48 journals reviewed was 4.3, with two journals in particular standing out in the discussion around CBMs. The journal *Resources, Conversation, and Recycling* and the *Journal of Cleaner Production* had the two highest JIF values (8.1 and 7.2) and the largest number of articles (n = 6 and n = 16). These two relevant journals consequently accounted for 46% of all journal articles and 29% of the total database. This highlights that CBMs are a trending topic in significantly relevant journals.

A large proportion of the journals focused on the ecological dimension of sustainability and environmentally friendly production management. At the same time, it is evident that the topic has hardly been represented in traditional management research. In the context of the criticism expressed in academia regarding the lack of attention to social and ethical aspects of CE, this was confirmed by the fact that no article in the sample came from relevant business ethics journals (e.g., *Journal of Business Ethics* or *Business and Society*). Finally, it was noted that the research field was predominantly explored in a qualitative manner. Over the overall publications, 75% had a qualitative research approach, 22% had mixed methodology, and only 3% had a quantitative approach. Regardless of the research approach, most authors used more than one method to collect data. The qualitative papers identified barriers and drivers using qualitative interviews (22%), often in combination with case studies and hosted focus groups or workshops. Among the mixed approaches, either systematic literature reviews (7%) or a combination of quantitative surveys and qualitative interviews (9%) were used. Only two articles quantitatively used a regression analysis and a Delphi study.

4.2. Thematic Analysis

4.2.1. Context and Analysis of Publications

An evaluation of the publications (n = 76) was performed using the categories defined in Section 3.4. In this process, 637 barriers and 394 drivers were identified from the 76 publications, showing that barriers were more prominently investigated and present so far. The two main forms of extracting and deriving barriers and drivers were empirical or through literature analysis. Of the publications, 56% gained new insights through their own data collection, followed by 33% that identified barriers and drivers through existing literature.

A look at the CBM types in the evaluation of the 637 barriers in Figure 6 shows that the three dominant business models were product service systems (31%), life-cycle extension (26%), and resource recovery (21%).

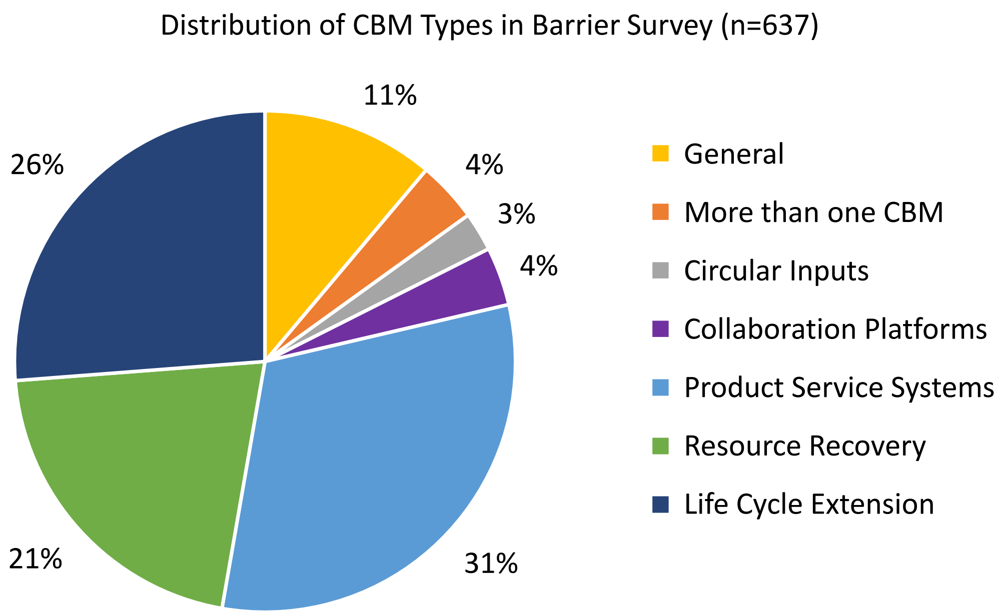

Figure 6. Distribution of CBM types in the barrier survey.

For life-cycle extension, the majority of the companies performed the repair and remanufacturing of used products. For resource recovery, about 20% of the barriers were related to the industrial symbiosis subtype. The least barriers and drivers were related to the CBMs circular inputs and collaboration platforms. The systematic literature review showed that the discussion on the barriers and drivers of CBMs was driven by product service systems, resource recovery, and life-cycle extension.

4.2.2. Barrier and Driver Categories

Figure 7 shows the percentages of the categories of all of the barriers that were assessed, regardless of the focus on specific CBM types (n = 637). A differentiation was made between the internal and external barriers. The internal barriers, consisting of the three subcategories of technology and knowledge, organizational, and financial barriers, accounted for 37% of the barriers. External barriers to CBM implementation dominated the discussion (63%).

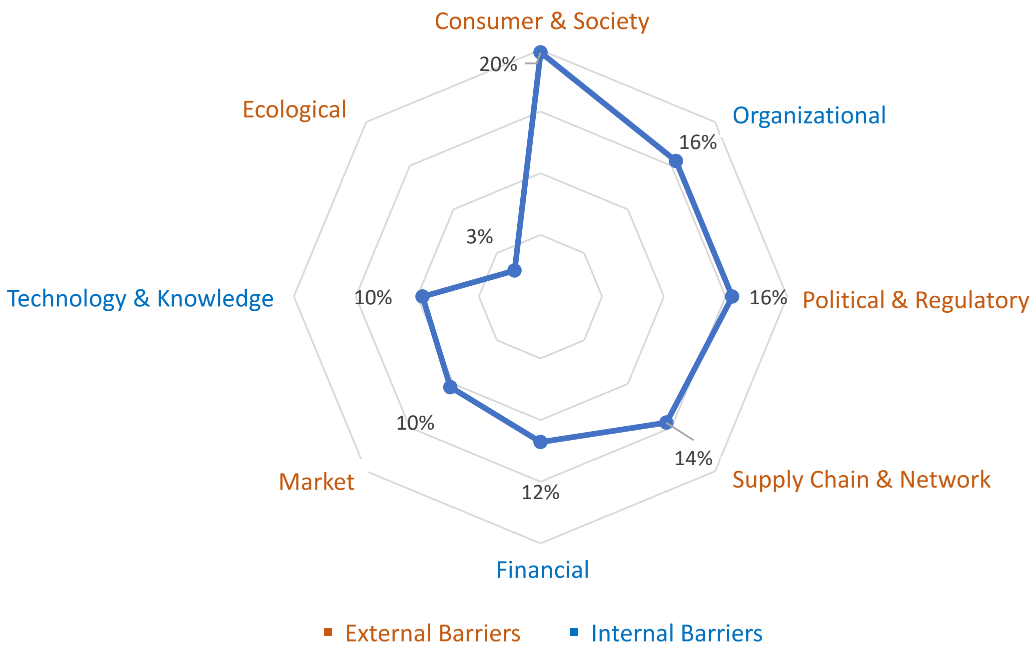

Figure 7. Barrier categories (internal and external)—total without CBM differentiation.

The most frequently mentioned barrier category in the literature was consumers and society with 20%; 16% of the barriers were stated in relation to political institutions and decision makers. Similarly, internal organizational barriers contributed to 16% of the difficult implementation of new business models. Complexity in the supply chain and in collaboration with partners and suppliers was the fourth most common reason for barriers to CBMs (14%).

Barriers According to CBM Type

What does a differentiated look at the categories of barriers reveal with respect to the different types of CBMs? As a result of the limited availability of data on the circular inputs and collaboration platform CBMs, the remainder of the comparison and subsequent discussion will focus on the three dominant CBMs, namely product service systems (n = 200), life-cycle extension (n = 167), and resource recovery (n = 134). With respect to research question three, whether the barriers differed between CBMs, Figure 8 shows the proportions of categories per CBM. For each of the three CBM types, the diagram shows the distribution of the eight categories and thus the main barrier areas.

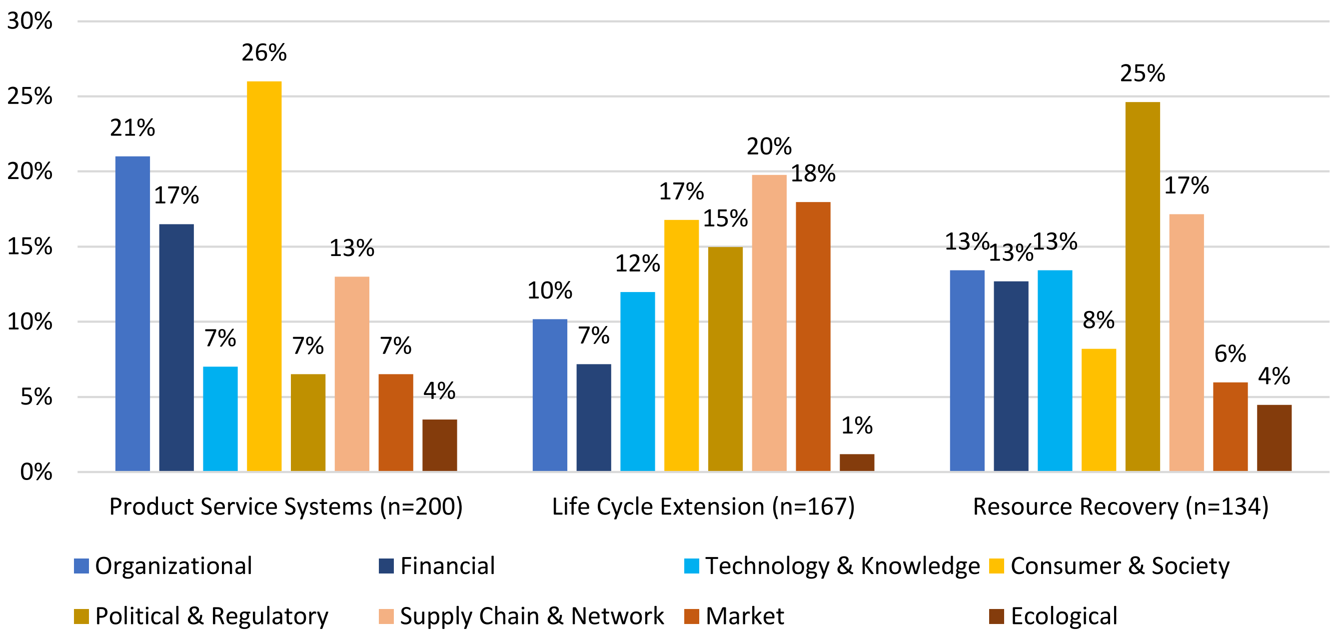

Figure 8. Share of barrier categories in the CBM comparison.

The results of the systematic literature analysis showed that there were differences in the nature and extent of the barriers between CBMs. Companies with the product service systems business model faced the most barriers externally from consumers and society (26%), especially lack of consumer acceptance, and from the supply chain and network (13%). Internal barriers were the highest in the PSS model, especially because of organizational problems (21%) and financial hurdles (17%). For companies with a life-cycle-extending business model, external barriers dominated, namely: supply chain (20%), market (18%), and consumer and society (17%). For CBM resource recovery, political and regulatory barriers were identified the most (25%), followed by the supply chain and network (17%). The three internal barriers were tied at 13% each.

Drivers of Circular Business Models

Similar to the analysis of barriers, the discussion about drivers referred especially to the three CBMs of resource recovery (23%), product service systems (28%), and life-cycle extension (18%). Thus, the understanding of the term driver in the literature varied widely, which is why a new division and definition of drivers was developed for the data extraction, as well as for the development of the framework. According to this new definition, drivers are understood as an umbrella term, and were thus divided into three groups and dimensions: (1) accelerators and motivators, (2) policies, and (3) success factors and core capabilities.

Acceleration and motivational factors are drivers that accelerate the development and implementation of CBMs, as they are associated with the need for and benefits of CE, and thus provide motivation for companies to change their business model [67]. The drivers assigned here represented the reasons and general development trends, which could lead to the greater implementation of CBMs in the long term. However, they were not directly related to the barriers. Accelerating and motivating factors, such as barriers, were assigned to the eight internal and external categories, according to their types.

The driver groups "success factors and core capabilities", as well as "policies ", were defined as overcoming measures because they were directly related to barriers. Success factors and core capabilities are focused on opportunities for companies, because they are related to capabilities and measures that have a positive or mitigating effect on barriers. Political institutions and actors can use various policy instruments and activities to help companies overcome barriers and create favorable policy conditions. In contrast with barriers and motivators, the two forms of overcoming were not assigned to categories according to their type, but rather based on results, where they were expected to show their consequences and positive impact.

The identified numbers of the three types of drivers were approximately equal: 117 success factors, 138 accelerators and motivators, and 139 policies (n = 394). Most policy actions were related to overcoming market barriers, regulatory barriers, and consumer barriers. For companies, most success factors were identified for supply chain, consumer, and organizational and financial barriers.

5. Framework: Barriers and Drivers of Circular Business Models

5.1. Framework Overview

Based on the previous chapters, a framework is now developed and presented. The central elements of the framework are (1) the CBM types, (2) internal and external barriers that prevent the implementation of CBMs, and (3) drivers and measures that help to overcome the barriers (Figure 9). The framework focuses in particular on the three main CBM types investigated, namely: life-cycle extension, product service systems, and resource recovery.

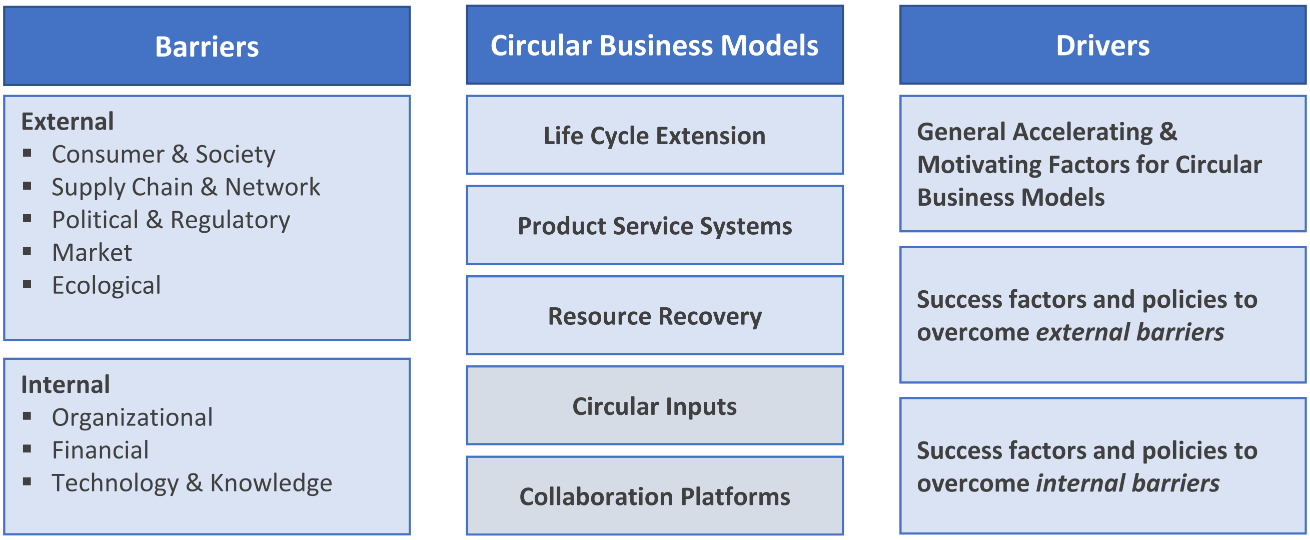

Figure 9. Framework: barriers and drivers of circular business models.

5.2. Barriers of Circular Business Models

5.2.1. External Barriers

Consumer and Society: In comparison with resource recovery companies, the CBMs of product service systems and life-cycle extension have to contend with a lack of acceptance on the part of consumers and society. For product service systems, the biggest problem is the cultural dominance of ownership in society. The desire for ownership and the reluctance to give it up through rentals comes from cultural status, as well as independence from ownership [45,87,88]. In life-cycle-extending CBMs, where products are mainly repaired or sold remanufactured, consumers may acquire ownership, but fail to recognize the value and quality of used or remanufactured products [9,89,90]. Concerns include that the products will not function properly [91].

The three consumer barriers to life-cycle extension are strongly connected. Instead of used products, consumers prefer new ones. This may be due to habits [91] or a desire for modernity and timeliness [16]. In turn, the lower valuation of remanufactured products results in a low willingness to pay and the expectation of low prices, which negatively affects company profit margins [92]. However, there is also a low willingness to pay for new and durable designed products with a high price point, as well as rental models [78,93]. Consumers are reluctant to disclose their personal data or let the provider into their privacy, e.g., for maintenance, in the course of the necessary commitment to a company and the rental contract [94]. In particular, the use of digital technologies (e.g., sensors on the product used for traceability) raises concerns among consumers [76]. Finally, a lack of consumer awareness and understanding hinders the expansion of CBMs, as many consumers are unfamiliar with the concept and notion of CE, or do not associate certain company offerings with CE [91,95]. This barrier is particularly relevant for product service systems. This is because an insufficient understanding of the benefits and functioning of the business concept creates uncertainty and leads to non-acceptance [87,88]. Because of the lack of consumer acceptance, it is argued that the two CBMs could be implemented more successfully in the B2B context [45,96].

Supply Chain and Network: In all three CBMs, relevant barriers from the supply chain and network are present. For resource recovery and product service systems, the biggest barrier was in collaborating with partners. The high customer demands for services also require a higher level of cooperation and exchange in the network, especially with the partners that support the product service systems company in additional services [97]. However, many product service systems companies are reluctant to closely involve external stakeholders [39], as sharing sensitive operational information and creating win-win scenarios between all parties is considered questionable [14,88]. For resource recovering companies, the lack of trust towards external actors and the time required to establish close partnerships also complicates supply chain management [39,98].

The lack of availability of used products, materials, spare parts, and design information significantly impacts CBM life-cycle extension with its "reuse" or "remanufacture" activity and increasing business growth [9,99]. In addition, insufficient amounts and quality of waste or secondary materials for further processing are the third largest barrier to CBM resource recovery [100,101]. For both CBMs, this problem is related to a general lack of suitable suppliers or an overdependence on one of them [16]. for product service systems, on the other hand, it is not the upstream but downstream value chain stage that is critical, as the quantity, quality, time, and location of the products returned by the customer are uncertain [78]. Setting up reverse logistics, e.g., collection of used products and increased transportation activities, is challenging for CBMs of product service systems and life-cycle extension [78]. This, combined with the limited logistical capacity to adequately store the products or materials, leads to high logistical challenges for the two CBMs [16,90].

Political and Regulatory: In general, a lack of political support has been mentioned for each CBM [59,87,102]. The reasons for inhibiting political conditions differed across CBMs. The comparison of CBMs already showed that political barriers account for only a small share of all product service systems barriers. For resource recovery, especially for industrial symbiosis, current waste legislation plays a crucial role. In several empirical studies, companies have indicated that declared waste (especially from other industries) may be disposed of and not reused unless costly and time-consuming licenses and permits are in place [16,43,103]. Particularly, the interconnections and differences in European and national legislation make internationalization in the market difficult [96,104].

In many EU member states, landfilling and burning of waste is still the cheapest option [52]. Additionally, illegal waste trade and disposal complicates the previously mentioned lack of access to waste [65]. Furthermore, the volatility and short-termism in political decisions and legislation create risk and contribute to hesitant decisions by businesses [11,103]. The high taxation of labor makes life-cycle extension activities such as "reuse" and "remanufacture" costly for companied that are already implementing and unattractive for those considering this CBM [9,105]. In product service models, as products returned by customers must also be maintained and refurbished for the next lease, high taxes on labor are also detrimental [88]. There is also a lack of commonly accepted definitions, standards, and labels for remanufactured and repaired products and their quality, leading to difficulties in importing and exporting, as well as a lack of consumer confidence [59,92,106]. Finally, the current application and unsustainable orientation of public procurement have also been criticized [39]. The criteria in public procurement only refer to new products and exclude remanufactured or renewed ones [59,105]. Lack of standards and unsustainable procurement policies in public institutions are also mentioned for the CBMs of resource recovery and product service systems.

Market: Market-related barriers are most relevant to the CBM of life-cycle extension. The biggest barrier and concern for original equipment manufacturers is cannibalization, i.e., the replacement of demand for new products by the sale of used ones [89,107]. On the one hand, this influences the original manufacturer's own decisions regarding a remanufacturing or repair service, and, on the other hand, the entry of third-party companies selling its remanufactured products [45]. Long-life designed products and life-cycle extending measures are in conflict with traditional business models, whose overall goal is to generate as much sales and revenue as possible [78,93]. However, product service systems are also concerned about the potentially negative effect of the new business model on existing sales and revenue [76]. The cannibalization risk is perceived, especially by established companies, before implementing a CBM.

Other market barriers for the resource recovery and life-cycle extension CBMs are the low prices of primary raw materials and new products compared with secondary materials [59,101]. This price difference also likely contributes to the missing market demand reported in both CBMs [100,108]. Finally, the conflicts and competition between original equipment manufacturers and third-party companies due to product remanufacturing weigh on the market environment [59]. Concerns regarding a negative brand image from poor third-party remanufacturing, the cannibalization effect, and access to intellectual property and know-how, result in resistant behavior among original manufacturers [78]. Therefore, some companies try to protect their business through patents and high prices for their components [9,16].

Ecology: The only environmental barrier with more than three citations is the risk of rebound effects in the product service model, especially through increased demand and resource use, as the leasing option gives some consumers access to previously unaffordable products [33,109]. It cannot be assumed that product service systems are environmentally and economically sustainable per se; rather, this depends on numerous factors such as transport distances between the user and company as well as environmentally conscious handling of the products by the user [51,88,110].

5.2.2. Internal Barriers

Organizational Barriers: These are most relevant to product service systems, as their implementation involves complex changes in the organization's processes and structures [16]. The largest barriers are the new management challenges and strategic decisions that arise as a result of the service model. Among others, the redesign of the revenue model with the determination of adequate leasing fees and the strategic focus on appropriate product groups are critical factors [93,111]. In addition, for product service systems, there is the complexity of transformation and the additional administrative and legal workload, e.g., due to sophisticated customer services (setting up customer contracts, handling monthly customer invoices, etc.), as well as the acquisition of the mission-critical skills required for it [16,51,109]. These changes may conflict with the traditionally prevailing corporate culture and lead to resistance and organizational persistence. This may be reflected in management's lack of commitment or staff reluctance [87,97].

In all three CBMs, but especially in resource recovery and life-cycle extension, barriers come from lack of resources (human and time) and a lack of awareness and knowledge of the circular economy [39,102]. For life-cycle-extending CBMs, the first is mainly as a result of the high amount of time required to remanufacture products [59]. The incompatibility and conflicts with a prevailing linear business model structure hinder the implementation of the resource recovery model [11]. This is consistent with the study of Svenssons and Funcks [112], who saw changes in formal and cultural corporate governance as challenging for CBMs [112]. According to them, formal corporate management control includes a lack of new tools and techniques for assessing internal capabilities, high costs and investments, and setting new metrics and strategic goals [112]. Within cultural management control, a lack of commitment and internalization of circular principles within the organization have proven to be problematic [112].

Financial Barriers: Financial barriers were identified extensively for the CBM product service systems. They differ greatly from those of other CBMs. For resource recovery and life-cycle extension, only high process costs were identified by relevance. They occur in life-cycle extension because of the high proportion of manual labor as opposed to automated production, and in the resource recovery CBM, collection, sorting, and processing make recycling costly [43,89,101,111]. Here, the negative impact of high labor taxation is evident again. For product service systems, significantly high upfront investment costs must first be made in order to be able to provide enough products for renting to a large number of customers [74,107]. However, the main problem here is the long payback period before the initial costs can be recovered by the service model [109]. The uncertain and changing cash flow is responsible for this, as rental income is lower on a monthly basis and is spread over a long period of time, in contrast with traditional product sales [76,113].

All three business model types face difficulties in their financing. In particular, providers of product service systems encounter challenges here [110,114]. By retaining ownership of the products throughout their life cycle, the total cost of ownership (e.g., through continuous maintenance of the products) and financial risk increase [19,51]. The large asset base from the high number of assets owned in operations lengthens the balance sheet, which is expected to lead to lower asset liquidity and thus higher capital costs [115]. In terms of the high capital expenditure requirements for product service systems, this is problematic because higher capital costs cause interest rates to rise on potentially necessary loans from the bank [115]. Overall, this results in the highest financial risk for product service systems among the three CBMs [74].

From a business-type perspective, this barrier was more often cited for startups and small- and medium-sized enterprises (SMEs), which is due to a lack of financial resources, but also difficult external financing from EU and government grants [39,74,94].

Technology and Knowledge: Barriers in this category are most relevant to the resource recovery and life-cycle extension CBMs. Both face various technical challenges in their processes. For recycling companies, problems arise mainly in the handling of waste and material streams because of low stream homogeneity, data gaps on waste composition, and thus difficult material identification and separation [11,116,117]. The processes to extend the life cycle of products such as repair, remanufacturing, and renewal are technically difficult to implement. This is caused by a lack of product and assembly information, the varying quality of incoming products, and the increasing complexity, especially as products become more customized rather than standardized [59,78]. There is also a lack of usability and commercialization of technical solutions for resource recovery, which would reduce process costs and make CBMs more profitable [102,117]. In contrast is the speed at which innovative and technologically improved products are coming to the market. The high level of technology and innovation can lead to the rapid obsolescence of products that can no longer satisfy customer needs [111]. Finally, a lack of circular design of used products complicates technical processes such as disassembly and remanufacturing [9,16]. A barrier found in all three CBMs is the lack of technical expertise and experience to produce the output [92,103,110].

As has already been shown, the data basis for barriers to which a company type is assigned is small. Nevertheless, trends are emerging in terms of internal barriers to which the three company types—startups, large companies, and SMEs—are most exposed. It is clear that large companies face the most organizational barriers. In particular, resistance to change and challenges in cross-organizational collaboration emerge, as large companies seem stuck in old structures [39,103]. Financial barriers are less present in large companies. For startups, the opposite is true. In this type of company, financial barriers are most prominent and organizational ones are mostly minor.

Summary: Barrier Framework

The barrier framework (Table 3) distinguishes between an internal and external company level. A maximum of three barriers are presented per CBM type. Furthermore, only barriers that are mentioned in at least three different publications were selected. Empty fields in the table reveal the areas in which the respective CBM was exposed to the least or apparently no barriers.

Table 3. Framework: circular business model—comparison of external and internal barriers.

Barrier Category	**Circular Business Models**		
External	**Product Service Systems**	**Life-Cycle Extension**	**Resource Recovery**
Consumer and Society	- Cultural dominance and preference of ownership - Consumer concerns about access to personal data and privacy - Lack of consumer awareness and understanding	- Failure to recognize the quality and value of used/remanufactured products - Consumers prefer new/current products - Consumers' low willingness to pay	*No barrier identified with more than three citations*
Supply Chain and Network	- Difficulties in building partnerships and interactions - Required logistical infrastructure (reverse logistics, transport intensity, and product storage) - Uncertainties about quantity, quality, time, and place of returned products	- Lack of access to and availability of products, spare parts, or materials - Required logistics infrastructure (reverse logistics, transportation, storage practices, and capacity) - Lack of suitable suppliers/partners or a high dependence on them	- Lack of or difficult cooperation in the network - Dependence on other partners and the available amount of waste - Lack of access and availability of materials
Political and Regulatory	*No barrier identified with more than three citations*	- Alignment and criteria of public procurement - High labor taxation - Lack of standards/certifications	- Waste legislation prevents the processing of waste - Illegal waste trading and disposal - Uncertain, fluctuating, and short-sighted policies
Market	- Cannibalization effects	- Cannibalization effects - Too low price for primary raw materials/new products - Resistance by original equipment manufacturers to third-party companies	- Insufficient price of primary raw materials and new products - Lack of or unclear demand from the market
Ecological	- Risk of rebound effects	*No barrier identified with more than three citations*	*No barrier identified with more than three citations*

Table 3. *Cont.*

Barrier Category	**Circular Business Models**		
Internal	**Product Service Systems**	**Life-Cycle Extension**	**Resource Recovery**
Organizational	- Management challenges and strategic decisions - Resistance to change in the company - Complexity and effort of CBM	- Lack of resources, knowledge, or skills in the company - High time investment to remanufacture products	- Lack of resources, knowledge, or competencies in the company - Incompatibility with existing (linear) activities and corporate culture
Financial	- High upfront investments and long payback periods - Changing and uncertain cash flow - Disadvantages of high capital lock-up and cost responsibility	- High costs due to the high proportion of manual work	- High process costs (e.g., for collecting and sorting)
Technology and Knowledge	*No barrier identified with more than three citations*	- Technical challenges in the design of production processes and remanufacturing - Improved and current product technology conflicts with long-lasting products - Lack of circular product design	- Technical challenges in handling material flows - Technical solutions not available on a commercial scale

5.3. Drivers of Circular Business Models

The systematization of drivers developed in Section 4.2.2 provided the basis for the framework content presented here. In this context, general drivers were introduced that accelerated the development of CBMs and motivated companies to implement them. In addition, policies and success factors were then considered together as measures for overcoming barriers. In this part of the framework, possible political and operational measures were assigned to the described barriers. The proposed measures offered well-founded indications and showed possibilities for overcoming them.

5.3.1. Accelerating and Motivating Factors

Acceleration and motivation factors describe reasons that will lead to the greater implementation of CBMs in the long term. Figure 10 shows the 10 most frequently cited acceleration and motivation factors that influenced the future spread of CBMs.

The literature analysis identified a total of 138 factors in the area of general acceleration and motivation factors. Of these, 77 mentions could be grouped into the top 10. They thus accounted for approximately 56% of the factors mentioned:

- Economic: 33 (within the top 10: 33 of 77 = 43%); otherwise 33/138 = 24%.
- Social: 25 (within the top 10: 25 out of 77 = 32%); otherwise 35/138 = 18%.
- Environmental: 19 (within top 10: 19 of 77 = 25%); otherwise 33/138 = 14%.

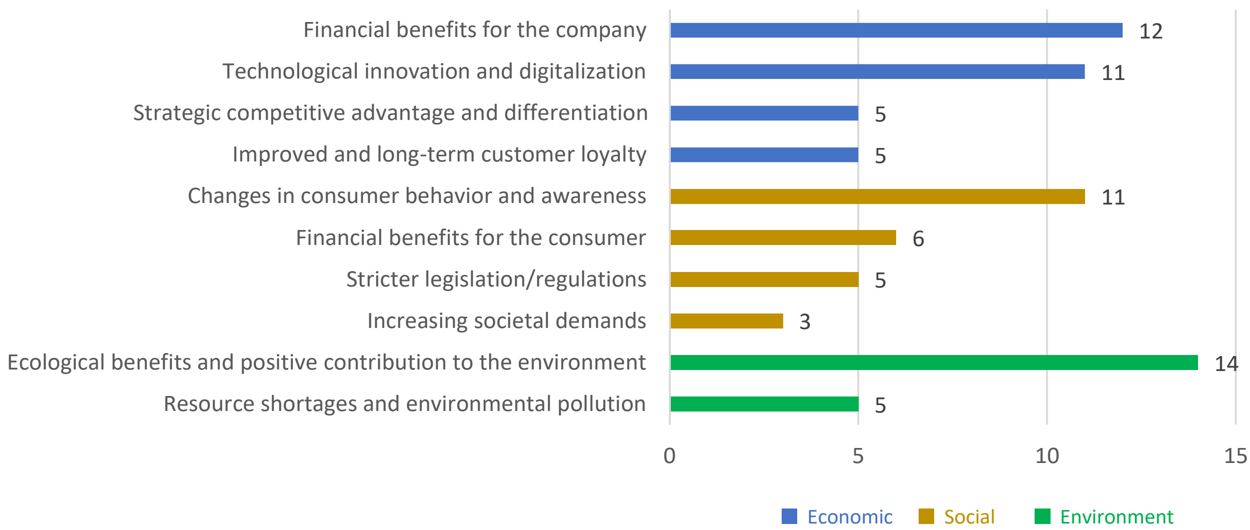

Figure 10. Acceleration and motivation factors for CBMs according to sustainability dimensions.

Economic Factors

Economic drivers account for 43% of the acceleration factors in the top 10, and can be seen as advantages of CE from a traditional business perspective. CBMs allow companies to differentiate in competitive markets and lead to strategic competitive advantages [93,110]. They can be used to address, attract, and retain new customer groups in the long term [118,119]. Finally, new revenue streams can be generated and waste and disposal costs can be drastically reduced [33,44]. Furthermore, technological innovations and digitalization also play a crucial role in the economic benefits. For example, additive manufacturing, 3D scanning, automated-guided vehicles, inspection drones, and other process technologies, can make CBMs more feasible and cost effective [11,92].

Social Factors

Social drivers account for 32% of the top 10 and are associated with institutional changes in society and policy, as well as benefits for consumers and their changing consumer awareness. For example, consumers can save money by leasing or buying second-hand products [95,120]. In addition, for a growing number of consumers, there is an increasing awareness as well as a desire for more sustainable consumption and lifestyles, especially among younger people [11,104]. Furthermore, stricter laws and regulations are forcing companies to be more environmentally responsible [19,45].

Environmental Factors

According to this survey, ecological motives were the third most important (25%)—with the ecological necessity for CE because of increasing resource shortages on the one hand, and the ecological benefits and the positive contribution to the environment and climate protection on the other hand [33].

5.3.2. Success Factors and Policies to Overcome External Barriers

Overcoming consumer-related barriers: To educate consumers about the value and quality of remanufactured products, standards and product labels (e.g., with information on durability, functionality, or expected lifespan) can be used. This can positively influence consumers, increase trust, and distinguish products in the market [9,56,121]. The development of such standards should be encouraged by policymakers, and verified and issued by independent bodies through certifications. Furthermore, additional benefits, such as warranties or free technical support from the company, can reduce quality concerns [78]. Moreover, public relations campaigns and other behavioral approaches such as nudging have been repeatedly mentioned as policy actions to inform and educate consumers about the benefits of CBMs [5,121]. This can primarily increase the lack of consumer awareness and understanding, as well as trigger questions regarding current consumption habits. In addition, companies should communicate both positively about the benefits of their offer and transparently about potential difficulties [122]. Digital product upgrades (e.g., through software updates) and aesthetic product upgrades (e.g., component replacement through modularity) help to better satisfy the need for current products [51,76].

Policymakers can directly provide financial incentives to counter consumers' low willingness to pay, e.g., through reduced VAT rates on remanufactured products [52]. Furthermore, companies should transparently communicate the expected costs as well as offer flexible cancellations in the product service model [107,122]. If applicable, willingness to pay would increase as a result of greater consumer confidence in the wake of certifications and standards. No countermeasures could be identified against data concerns; only fears about privacy invasion could be bypassed through automatically identified maintenance needs [94].

Overcoming supply-chain and network barriers: Policymakers can play an initiating role against lacking or difficult partnerships by providing financial support for CE projects between companies, universities, and communities [5]. Collaboration is particularly successful when it is characterized by shared values and trust and transparency in knowledge sharing [123]. Engagement and leadership from an influential actor in the value chain who can act as the main contact and bring stakeholders together is equally helpful [103,115].

External logistics providers can be involved to perform logistical tasks, especially in the collection and return of used products [78]. In the context of distributed manufacturing, geographically spread factories can reduce the long distances to collect products [94]. Technologies such as sensors and RFID chips, in combination with Internet of Things platforms, collect information on product location, condition, and usage, and can thereby reduce operational risk in product service models as well as simplify reverse logistics [51,78,124]. Regarding the lack of availability of suppliers, materials, products, and spare parts, government policies can be supportive, e.g., by establishing platforms and databases to coordinate the supply of products and suppliers [59,108]. Requiring original equipment manufacturers to make their spare parts available to third-party companies or consumers for a certain number of years can also be supported by policymakers [56].

Overcoming political and regulatory barriers: The implementation of sustainable public procurement policies is often regarded as a possible solution. For this purpose, targets and criteria for purchasing guidelines can be set at European and national levels, creating a higher demand for the products and services of CBMs [52,56,100]. Competence centers and their information services can, for instance, support cities and municipalities in implementing sustainable procurement [5]. Standards and labels with CE principles and quality certification systems for refurbishment and repair work do not yet exist sufficiently and would facilitate market access and trade, especially in the European region [56,59,125]. However, for them to be relevant and effective, they must be based on common practices and understanding [125].

In particular, for the labor-intensive CBMs of life-cycle extension and product service systems, the high taxes on labor should be reduced or shifted to pollution and resource use [9,32,33]. Of Germany's government revenues in 2017, for example, about 63% were generated by taxes on labor, 13% were from capital taxes, and environmental taxes had only a small share, with just under 5% [126].

Furthermore, legal definitions of waste and its regulations should be harmonized to allow companies to use waste (and byproducts) from other industries [98,127]. Addressing the illegal nature of waste trade and disposal can be helped by a higher landfill tax and stronger enforcement of landfill bans [52,127]. A long-term policy agenda gives companies planning certainty in their projects [117]. It is therefore up to policymakers to remove regulatory barriers. Companies can make them aware of their problems and needs through political participation and willingness to cooperate [78,110].

Overcoming market-related barriers: Procurement policies that include and promote CBMs in their guidelines can act as leverage against the lack of demand in the market [56,87]. Reduced VAT rates, which have been highlighted, also have the effect of increasing demand. Additionally, artificial intelligence for demand forecasting and dynamic pricing algorithms can help companies better deal with uncertain demand [1]. Conflicts between original producers and third-party companies could be mitigated by clarifying the rights and obligations of both parties [52]. Higher prices for primary raw materials would not only incentivize companies to change their material inputs, but also increase the demand for CBMs by equalizing prices between recycled or used and new products [9,32]. Higher taxes on primary raw materials or the internalization of negative external effects, i.e., including and pricing the environmental and social costs of a product, can be tools to increase the prices of new raw materials [45,128].

Summary on Overcoming External Barriers

Table 4 summarizes the results on external barriers in the five defined dimensions. The barriers mentioned were assigned to success factors and/or policy measures that contribute to their reduction. Only barriers that were mentioned in the literature by at least three different sources were included. Column 2 identifies the CBM types in which these barriers occur. Column 3 identifies success factors that can help overcome the barriers. Furthermore, the fourth column adds policy measures that can help reduce the barriers. These policy measures are additionally classified according to their instrumental character (column 5). Here, the following legend applies to column 2 with regard to the following abbreviations: LCE = life-cycle extension; PSS = product service systems; RR = resource recovery.

Table 4. Success factors and political measures to overcome external barriers.

Consumer and Society				
Barriers	**CBM**	**Success Factors**	**Political Measures**	**Instruments**
Consumer concerns about access to personal data and privacy	LCE, PSS, and RR	Digital technologies automatically determine maintenance needs without invading customer privacy		
Failure to recognize the quality and value of used and remanufactured products	LCE and PSS	Provision of additional services such as warranties on the products, which includes a free technical support service	Label and standards for remanufactured products Quality certification system for repair and remanufacturing work	Information
Lack of consumer awareness and understanding	LCE, PSS, and RR	Transparent communication of advantages and possible difficulties to customers	Public relations campaigns to educate consumers about benefits	Information
Cultural dominance and preference of ownership	PSS	Communicate transparency about costs of owning rather than renting	Public relations campaigns to educate consumers about benefits Behavioral economic incentives	Information
Consumers prefer new/current products	LCE and PSS	Digital, technical, and aesthetic product upgrades		
Low readiness of consumers to pay for used products	LCE, PSS, and RR	Transparency over the costs of the entire usage phase Flexible termination options for PSS models	Provide economic incentives, e.g., reduced VAT rates for remanufactured products	Economically incentivized

Table 4. *Cont.*

Supply Chain and Network				
Barriers	**CBM**	**Success Factors**	**Political Measures**	**Instruments**
Lack of or difficult cooperation with partners	LCE, PSS, and RR	Critical success factors of collaborative networking (shared values, commitment, and role model function of an influential actor, etc.)	Grants for CE projects from companies, universities, and communities	Research and education
Required logistic infrastructure (reverse logistics, transport, and storage capacities)	LCE, PSS, and RR	Technologies such as sensors or RFID for product traceability Partnership with external logistics providers for reverse logistics Geographically distributed factories eliminate the need to collect products over long distances		
Uncertainties about quantity, quality, time, and place of returned products	PSS	Reduce operational risk through digital technologies and information collection on product condition and usage, component failure, and aging rates		
Insufficient access to and availability of products, spare parts, or materials	LCE, PSS, and RR	Buffer, stock material, or set up different material sources	Requirement for original equipment manufacturers that spare parts are available and affordable for a certain number of years	Regulatory
Lack of suitable suppliers/partners or too much dependence on them	LCE, PSS, and RR	Stimulation of current or new suppliers to develop materials for CE through collaboration and co-investment	Establish online platforms or databases to coordinate the supply of products and suppliers	Information
Political and Regulatory				
Barriers	**CBM**	**Success Factors**	**Political Measures**	**Instruments**
Orientation and criteria of public procurement	LCE, PSS, and RR		(European) targets and criteria for green public procurement	Regulatory
High taxation of labor	LCE, PSS, and RR		Reducing taxes on the factor labor	Economically incentivized
Lack of standards/certifications	LCE, PSS, and RR		Labels, standards, and quality certification systems with CE principles	Information
Legislation complicates the (further) processing of waste	RR		Harmonizing the legal definition and regulations regarding the use of waste and byproducts	Regulatory
Illegal waste trade and disposal	RR		Higher landfill tax Increase waste tax Enforce landfill bans more strongly	Burdening economic

Table 4. *Cont.*

Uncertain, unsteady, and short-sighted governance	RR	Corporate lobbying and political participation to make decision-makers aware of problems and needs	Long-term political agenda that ensures stability for at least 10 years Increased leadership of political actors on CE	Regulatory
Market				
Barriers	**CBM**	**Success Factors**	**Political Measures**	**Instruments**
Cannibalization effect	LCE and PSS	Evaluation tools for cost−benefit calculation or tools for assessing the profitability and sustainability of CBM vs. LBM		
Underpricing of new raw materials and products	LCE, RR		Regulation of higher prices for primary raw materials (e.g., through the internalization of external effects)	Regulatory
Resistance of original equipment manufacturers to third-party companies	LCE		Clarification of the rights and obligations of third-party suppliers and remanufacturers	Regulatory
Lack of or unclear demand from the market	LCE, RR	Demand forecasting through AI	Green public procurement as a driver to increase demand for CBM	Regulatory
Ecological				
Barriers	**CBM**	**Success Factors**	**Political Measures**	**Instruments**
Risk of rebound effects	PSS	Provide financial incentives for low-impact use Apply life-cycle assessment (LCA) Capture user behavior through digital technologies	Research to quantify environmental benefits and greenhouse gas emissions	Research and education

5.3.3. Success Factors and Policies to Overcome Internal Barriers

Overcoming organizational barriers: Policymakers can assist with management challenges by funding research on CE performance indicators and working with product service systems companies to identify product classes that are best suited for CBMs [5,52]. In this context, some criteria for the applicability of a product group have already been mentioned, which can guide product service systems companies in their strategic orientation. In particular, expensive, technically advanced products, that may not require maintenance or repair, as well as products that are easy to transport and less influenced by trends, are suitable here [93]. Furthermore, formal and cultural management control must adapt to the business model [112]. Both valuation and risk models, as well as performance indicators, must be able to evaluate and measure a new CBM, in contrast with the traditional linear method of doing business [88,112]. Strategic goals must be adjusted and communicated throughout the organization as part of formal management control [112]. As a result of linear and persistent corporate cultures, it is important to consider cultural management control as fundamental by turning CE principles into corporate values and communicating them to all employees through internal documents, environmental policies, etc. [112]. Without management commitment to drive these changes and shape the organization, internal transformation will be nearly impossible [116]. Because of the complexity and time involved in CBMs, such as the remanufacturing process or managing customer contracts and services, companies may consider outsourcing these activities [16]. With political support and consulting services, as well as successful operational use cases and methods, knowledge among companies about CBMs and their implementation should also spread [5,88].

Overcoming financial barriers: Low taxation of labor also reduces the high costs involved, especially in CBM life-cycle extension, but also product service systems, due to labor-intensive maintenance and remanufacturing activities. However, for the necessary financing needs, there is no financing instrument that can be recommended in a generalized way for all CBMs, as the financing structure depends on the risk profile of the CBM and the maturity of the company [74,115]. Because of the high financial risk, which is particularly present in the CBM product service systems in the early stages of product development, it is difficult to obtain traditional financing from credit institutions at favorable conditions. Therefore, government funding is important for CBMs in the early and transition phases [115]. This is in line with frequently mentioned policy measures, such as more affordable financing to cover upfront costs for product service systems, or bridge funding for traditional manufacturing companies that want to innovate their business model into a service business [52,87]. Alternative forms of financing such as crowdfunding have also proven to be successful in some cases [78]. In the product service model, the high investment requirement could also be reduced by partnering with the original manufacturer and sharing revenues and costs [107]. There are equally calls for financial institutions to adjust or expand their definition of risk to include resource dependence and environmental damage as risk in linear models [115]. Against the financial risk caused by uncertain cash flow for product service systems, a subscription model with fixed monthly revenues, a deposit for the customer at the beginning of the contract, and/or a minimum lease period would increase security [78,93,113]. However, this is in conflict with the already existing lack of consumer acceptance and low willingness to pay.

Overcoming technology and knowledge barriers: Technology and knowledge barriers can be reduced through policy guidance, such as requiring or mandating original equipment manufacturers to publish information on how to disassemble and repair their products [56]. Essential information on spare parts and manufacturing as well as assembly instructions in a central database would also simplify repair decisions and make the remanufacturing process more efficient [92]. The contradiction between the CE principle of product longevity and the rapid advancement of product technologies can be countered by technical and digital product upgrades. Products should be designed intelligently and networked so that it is possible to upgrade their digital component to the latest software and program versions, which will lead, among others, to functional and performance improvements [51,76].

Mandatory minimum requirements of circular design aspects such as durability or repairability would simplify the recovery processes of used products in the future, especially by third-party companies [56]. To mitigate the challenges of managing material and waste flows for the CBM of resource recovery, policy measures such as the opening of a resource management office have been proposed. Among other things, this will allow relevant data on waste and material streams, as well as their classification, composition, and quantity to be collected, controlled, and published for recyclers [98,117]. Finally, government investment into the research and development of waste separation and treatment technologies can drive the availability and commercialization of technical solutions [100]. Partner companies that exchange waste and waste byproducts and work together to create an industrial symbiosis can use co-funding to make technical solutions operational for their waste treatment [103].

Summary on Overcoming Internal Barriers

Table 5 summarizes the results on the internal barriers of the five dimensions defined initially. Only the barriers with at least three mentions per category in the evaluated literature were included here. Column 2 mentions the CBM types in which these barriers occur. Column 3 identifies success factors that can help overcome the barriers. Column 4 adds policy measures that help to reduce the barriers and column 5 classifies the corresponding policy instruments. For column 2, the following legend applies regarding abbreviations: LCE = life-cycle extension; PSS = product service systems; RR = resource recovery.

Table 5. Success factors and political measures to overcome internal barriers.

Organization				
Barriers	**CBM**	**Success Factors**	**Political Measures**	**Instruments**
Management challenges and strategic decisions	LCE, PSS,	Review criteria for the value proposition's adequacy as a PSS; Adapt assessment principles and indicators for management decisions	Research on performance indicators related to product circularity Systematic identification of products that are suited for PSS	Research and education
Resistance to change in the company and predominance of linear thinking and corporate culture	LCE, PSS, RR	Spread and communicate sustainability values to employees; Set strategic goals and communicate them to all employees; Commitment of employees and management		
Complexity and effort of CBM	LCE, PSS	Outsourcing of various activities (e.g., legal aspects of customer contracts or technical maintenance)		
Lack of resources, knowledge, and competencies in the company	LCE, PSS, RR		Support information and knowledge distribution to companies (e.g., best practices, consulting services, and assessment tools)	Information
Financial				
Barriers	**CBM**	**Success Factors**	**Political Measures**	**Instruments**
High upfront investment and long payback period	PSS	Alternative forms of financing such as crowdfunding Contracts between product manufacturers and service providers for shared revenues can reduce large upfront investments Financing via third parties, e.g., real estate investors (e.g., for integrated washing machines for each apartment in the PSS model)	Economic incentives, especially more favorable financing to cover the initial costs of PSS projects Bridge funding for traditional manufacturing companies to operate as service providers during the transition period Government subsidies	Economically incentivized
Changed and uncertain cash flow	LCE, PSS	Manufacturers looking to move to a PSS model need significant cash reserves to deal with longer cash-to-cash cycles Deposits from customers and minimum-lease terms lower financial risk		

Table 5. *Cont.*

Disadvantages of high capital commitment and cost responsibility over the entire product life cycle	PSS	Demand and order-driven production prevents companies from accruing costs in connection with unsold goods	Credit institutions need to adapt their mindset and risk definitions	Information
High costs due to the high proportion of manual work	LCE, PSS		Lowering taxes on labor	Economically incentivized
High process costs (e.g., for collection and sorting)	RR			
Technology and Knowledge				
Barriers	**CBM**	**Success Factors**	**Political Measures**	**Instruments**
Technical challenges in the design of production processes and remanufacturing	LCE, PSS	Experimenting with technologies and developing knowledge; knowledge research and exchange in (other) sectors.	Engage original equipment manufacturers to publish product information for improved third-party reparability Create a comprehensive data management platform with product-relevant information for remanufacturers	Regulatory and information
Improved and current product technology stays in conflict with durable products	LCE, PSS	Technical and digital product upgrades		
Poor circular product design leads to technical challenges in remanufacturing	LCE	Standards and labels	Set mandatory minimum requirements for product lifetime, reparability, and recyclability	Regulatory
Technical challenges in handling material flows	RR		Share relevant data on waste streams, as well as their classification, composition and quantities through platforms Establish a resource management office that monitors environmental performance and collects data on primary and secondary material flows to support decision-making and investment	Information
Technical solutions are not available on a commercial scale	RR	Co-financing of innovative technologies within a network for the creation of industrial symbiosis	Investment into the research and development of waste separation and treatment technologies	Research and cooperation

6. Discussion and Conclusions

The following chapter presents how this article could contribute to answering the research questions from Section 3.3. Based on this, the implications, limitations, and future research needs are outlined.

6.1. Key Results

A central goal of the analysis was to identify the barriers and drivers of CBMs from the current scientific discourse and to consider them in an integrative way. A system of categories was first developed, which was used as the basis for designing the framework. To make the approach systematic, four research questions (RQ) were defined. By answering the research questions and thus achieving the research objectives, this paper produced the following results:

RQ 1: *What is the current state of research on barriers and drivers of circular business models and how do the contributions differ?*

Using various searching and selection methods, the paper was able to identify a total of 76 papers on the barriers or drivers of CBMs from more than 500 results, and systematized and evaluated them according to various criteria. Furthermore, 42% of the publications were written in the last 1.5 years, which illustrates that CBM was a new and rapidly growing research field. It was also a trending topic in relevant journals (using the journal impact factor (JIF) as a quality criterion), as 46% of all papers came from journals with above-average JIFs. The research topic was mainly published in ecological journals rather than in classical management journals or social ethical journals, indicating that the social sustainability dimension in the context of CBMs had not yet been considered.

The literature was focused on the three CBMs of product service systems, resource recovery, and life-cycle extension. However, the research field lacked both comparisons of barriers between CBMs and studies that identified specific measures for overcoming barriers. Further research on both of these aspects is needed, as well as an assessment and quantification of the environmental and market potential of CBMs, trade-offs between barriers and drivers, and the prioritization of barriers for a better ability to act.

RQ 2: *Which barrier categories, regardless of the type of circular business model, is most common in the literature?*

For the evaluation of barriers and drivers, they were assigned to the developed category system of external barriers (market, political, and regulatory; supply chain and network; consumer and society; and environmental) and internal barriers (organizational, technology and knowledge, and financial). Across the total set of 637 barriers, consumers and society accounted for the largest number of barriers at just under 20%, followed by political and regulatory (16%), and internal and organizational (16%). Overall, 63% of the barriers cited were at the external level of the corporate environment and 37% were caused by internal barrier categories.

RQ 3: *Do the barriers differ between different circular business models and if so, how?*

Because of the limited data available on the CBMs of collaboration platforms and circular inputs, these were not considered for more in-depth analysis. Therefore, only the three CBMs of resource recovery, product service systems, and life-cycle extension were considered in the evaluation based on the barrier categories and in the development of the framework. This showed that it was not only the barrier categories that varied, but also the barriers assigned within CBMs.

As a result of their rental or service model, product service systems faced the following barriers:

(1) Consumer and societal barriers, including cultural dominance and status of ownership, consumer concerns about access to personal data, and invasion of privacy;
(2) Internal organizational barriers, including management challenges associated with renting rather than selling and complexity, and expenses of CBM;
(3) Financial barriers, including high upfront investments and long payback periods, as well as high operating costs over the entire product life-cycle.

In contrast, external barriers were most prominent in life-cycle-extending CBMs. In particular:

(1) Supply chain barriers, including insufficient access and availability of products and spare parts, high logistics requirements due to storage capacities, and reverse logistics;
(2) Market and consumer-related barriers, including underpricing of primary raw materials, consumers misjudging quality, and value of used products;
(3) Political and regulatory barriers, including high taxation of labor and lack of standards and certifications.

For the CBM of resource recovery, i.e., companies that recycled waste or even used it as a direct material input in a process, were the most commonly cited barriers:

(1) Policies and regulations, including illegal waste trade and disposal, as well as waste legislation, impedes waste processing;
(2) Supply chain and network barriers, e.g., difficult cooperation, dependency on partners, and available waste volume;
(3) Technology and knowledge including technically difficult handling of material and waste streams.

RQ 4: *What drivers are accelerating the spread of CBMs and what actions can policymakers and businesses take to overcome the barriers?*

The literature review revealed that the term driver was often used in very general terms. Therefore, the 394 identified drivers were first categorized into groups, namely: 138 acceleration and motivation factors, 117 success factors, and 139 policy measures. Acceleration and motivation factors were not directly related to barriers and could rather be understood as development trends (including resource scarcity and technological innovation) or motivating factors (financial benefits of CBMs) for companies. In order to overcome the identified barriers, success factors and policy measures were assigned to specific barriers in the developed framework. Barriers between the CBMs differed, calling for a differentiated analysis of CBMs by recognizing the different urgency and relevance of the specific success factors and policy measures for CBMs. The need for policy influence across all barrier categories was equally evident.

Overall, this is the first systematic literature review to address the diversity of barriers faced by CBMs and link them to possible overcoming measures in order to overcome them in an action-oriented manner.

6.2. Implications, Limitations, and Outlooks

In this article, a framework was developed based on a systematic literature review. For this purpose, the main barriers to CBMs were identified, elaborated on in terms of content, and then compared. The work shows that the barriers for CBMs differed not only quantitatively in their shares of the barrier categories, but also qualitatively. Therefore, differentiated research and views on CBMs are necessary. The majority of identified barriers to drivers also implied that the implementation and market penetration of CBMs is currently still difficult and challenging. Nevertheless, 394 drivers could be identified and structured in a newly developed systematization based on policy measures and success factors. The developed framework links the main barriers with the success factors and policy measures, and thus shows options for action to overcome the identified barriers.

However, the framework implies, above all, that barriers and drivers for companies and policymakers still need to be analyzed and evaluated on a context-dependent basis. Companies must consider the influence of sector- and company-specific circumstances when analyzing barriers. For policymakers, the decision regarding measures to promote CBMs depends on the preconditions and political level (EU, national, and regional). In particular, for companies aspiring to develop a CBM, addressing potential barriers can reduce risks and provide guidance. The list of success factors and policy measures is not complete, but can be understood as a collection of action-oriented approaches. A target−performance comparison can be carried out from both a political and a corporate perspective, which helps to identify the largest gaps and potentials, and to define future measures for implementing CBMs.

Regarding limitations, it should first be noted that the selected research design had an exploratory character and as such does not claim to be statistically representative. Furthermore, the chosen search method did not include an additional forward and backward search in which the selected literature was checked for potentially relevant cross-references, which might have increased the sample size. Furthermore, a validation of the framework, as well as a prioritization of barriers through an expert survey, could have complemented or strengthened the relevance of the results.

This article concludes with an outlook on the need for future research on CBMs, as well as their barriers and drivers in order to support the implementation of circular principles in business models, and thus the shift to a more sustainable way of doing business. The systematic analysis of the 76 publications on the barriers and drivers of CBMs shows that this is a new and rapidly growing research field, in which knowledge and research gaps still exist. Specifically, the following research needs to be further derived.

Measurement and Key Figures: In the theory section as well as in the barrier survey, potential negative environmental effects of CBMs were pointed out. To increase the legitimacy of CBMs, more studies should address the measurement of sustainability performance, e.g., through comprehensive life-cycle analyses of CBMs, so that the potentially negative effects become quantified and more calculable. In terms of measurement and control, research is needed on the indicators that can assess the circularity of a CBM or product, as well as new models that can more accurately compare the changing cost and financial structure of CBMs and their profitability. An assessment of the market and environmental potential would provide guidance to policymakers or companies with an interest in CBMs regarding which CBMs should be most focused on. This should also be done regarding the realization that the CBMs of collaboration platforms and circular inputs, representing only 4% and 3% of all barriers, respectively, have been poorly investigated in the barriers and drivers research field, and the question should be clarified whether this is associated with a low relevance to CE, lower market and environmental potential, or lower barriers present.

Action orientation: From the literature that was analyzed, there was a lack of studies dealing with overcoming barriers and thus little action orientation. Only 7% of the publications directly contrasted identified barriers with countermeasures. To better address internal and external company-level barriers, further research is necessary. A collection of best practices within case studies would be helpful at this point. Only one study was identified that specifically addressed the various barriers in CBM comparison. The paper by Vermunt et al. [16] provided solid evidence of the diversity in CBMs, and thus the necessary differentiated view of barriers and the development of overcoming mechanisms. Additional theoretical and empirical papers could further develop and solidify this knowledge.

Interdependencies and interrelationships: There is a lack of discussion in the papers about possible interdependencies between barriers, as well as conflicting goals between the applied overcoming measures and barriers. In this paper, because of a different focus, this was pointed out selectively (e.g., in the conflict between the measure to increase the financial security of the product service systems model through deposits in the lease and the already low willingness of users to pay). Deeper analyses could explore the extent to which success factors and policy measures help or harm barriers.

Prioritization: Because of a shortage of time and resources, many companies find it difficult to decide which barriers they should prioritize and address first, given the large amount and variety of barriers. In this context, it was found that only 7% of publications prioritized barriers. Future studies of barriers should focus more strongly on approaches to assess barriers and their impact in collaboration with experts and companies.

Social aspects of CBMs: At last, in line with the criticism of the missing social sustainability dimension, the descriptive analysis also showed that in the future, research should more strongly investigate ethical issues in connection with companies and CBMs. It could be considered to what extent CBMs contribute to facilitating the socio-ecological transformation and thus make a (further) contribution to sustainable development. Here, aspects such as social responsibility, working conditions, or the consideration of human rights in value chains and circular processes should be increasingly taken into account. In addition to internal stakeholders, this could also give greater consideration to the external stakeholder perspective in particular.

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Appendix A

Table A1. Search results from the three rounds.

Search Round	Search Method	Search String	Date	Number of Search Results
1	Database: Scopus	TITLE-ABS-KEY (“circular business model*” OR (“Circular Economy” AND “business model*”)) AND TITLE-ABS-KEY (“driver*” OR “levers” OR “enablers” OR “enabling factors” OR “enabling conditions” OR “facilitators” OR “opportunities” OR “success factors”)	18 May 2020	163
1	Database: Scopus	TITLE-ABS-KEY (“circular business model*” OR (“Circular Economy” AND “business model*”)) AND TITLE-ABS-KEY (“Barrier*” OR “Challenges” OR “obstacles” OR “hurdles” OR “limitations”)	18 May 2020	192
1	Database: Web of Science	TS = (“circular business model*” OR (“Circular economy” AND “business model*”)) AND TS = (“driver*” OR “levers” OR “enablers” OR “enabling factors” OR “enabling conditions” OR “facilitators” OR “opportunities” OR “success factors”)	18 May 2020	145
1	Database: Web of Science	TS = (“circular business model*” OR (“Circular economy” AND “business model*”)) AND TS = (“Barrier*” OR “Challenges” OR “obstacles” OR “hurdles” OR “limitations”)	18 May 2020	172
1	Online library search of the Technical University Berlin	German key words: (“zirkuläre geschäftsmodelle” OR (“kreislaufwirtschaft” AND “geschäftsmodell”)) AND (“Barrieren” OR “herausforderungen” OR “hürden” OR “hindernisse” OR “einschränkungen”)	18 May 2020	11
1	Online library search of the Technical university Berlin	German key words: (“zirkuläre geschäftsmodelle” OR (“kreislaufwirtschaft” AND “geschäftsmodell”)) AND (“treiber” OR “hebel” OR “befähiger” OR “günstige rahmenbedingungen” OR “erfolgsfaktoren” OR “möglichkeiten” OR “unterstützer” OR “wegbereiter”)	18 May 2020	13

Table A1. *Cont.*

Search Round	Search Method	Search String	Date	Number of Search Results
2	Database by Sopjani et al. (2020)	The data base contains 527 publications. The filters "Status = Done" and "Barrier_Focus = Barrier(s) are the focus" were applied, resulting in 214 publications that were added to the sample.	18 May 2020	214
3	OECD	"Circular Business Model"	5 July 2020	4
3	Publications Office of the European Union	"Circular Business Model", Filter: EU Publications	5 July 2020	53
3	Fraunhofer Publica	"Circular Business Model"	5 July 2020	5
3	Fraunhofer Publica	barriers circular economy	6 July 2020	1
3	Fraunhofer Publica	drivers circular economy	6 July 2020	2
3	Acatech	"circular economy"	7 July 2020	2
3	Ellen McArthur Foundation	Publication page (no search window available)	5 July 2020	25
3	Accenture	Circular Economy	7 July 2020	19
3	Circle Economy	Publication page (no search window available)	7 July 2020	16

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