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Review

Circular Business Models (CBMs) in Environmental Management—Analysis of Definitions, Typologies and Methods of Creation in Organizations

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Abstract: A circular economy (CE) is an economic model that involves more sustainable management of raw materials and waste. Implementation of CE assumptions is highly recommended in the form of dedicated CE technologies as well as CE business models, so-called circular business models (CBMs), which are an integral part of environmental management in organizations. Depending on the application and the type of sector or enterprise, CBMs are defined differently, focusing on various areas of raw materials and waste management. In general, they should create added value for the given enterprise that meets the CE assumptions or integrate CE principles with the organization's business practices. This paper aims to analyze different approaches to CBMs with the use of comparative analysis and desk research methods. The scope of this paper includes a comparative analysis of CBM definitions and their typologies, as well as the basics for creating CBMs in enterprises. Moreover, good practices of implemented CMBs in various enterprises are presented. The general definition of CBM is developed as "a business model that assumes creating, delivering and capturing added value for the consumer while considering the CE principles". Furthermore, the basics of building CBM using a modified Business Model Canvas are proposed. In general, CBM should consider the key CE assumption, i.e., increased raw material efficiency. In the coming years, a further increase in interest in CBMs dedicated to specific sectors and their areas of activity is expected. Various stakeholders could use them as a benchmark to compare and define the best practices for the successful adoption of CBMs in the future.

Keywords: circular economy; environmental management; business model; circular business model

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1. Introduction

A circular economy (CE) is an economic model that strives to maintain the value of manufactured products for as long as possible [1,2]. It assumes a departure from the linear model, based on the principles of extract, process, use and throw away, to a circular model in which waste is treated as valuable raw materials [3]. The CE implementation is one of the key areas of environmental management in organizations. It enables a reduction of environmental impacts and increases the operating efficiency of the company through solutions that fit into the CE strategies, such as 9R (e.g., Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle or Recover). Currently, there is a growing demand for further development of CE solutions that fully fit into the organization's business [4]. To adequately implement CE into an organization, a circular economy business model (CEBM) must be defined so that all elements of the organization (including CE technologies) work together and are integrated. Due to the CE solution that a given company should offer to its customers having to be identified and assessed for implementation, deep knowledge and understanding of CE definitions and scope are necessary [5]. The literature contains over

200 definitions of CE, referring to various methods of replacing delivered products with services that enable extending their life cycle and preventing waste [6]. Based on the analysis of 114 definitions, Kirchherr et al. [7] proposed a comprehensive definition of CE, indicating that it is an economic system based on business models (BMs) that replace the concept of "end-of-life" with reduction, alternative reuse, recycling and recovery of materials in the processes of production, distribution and consumption. Therefore, it functions at the microeconomic level (products, organizations and consumers), at the mesoeconomic level (eco-industrial parks), and at the macroeconomic level (city, region and country), aiming to achieve sustainable development [8]. It means creating environmental quality, economic prosperity, social justice and benefits for present and future generations [7]. This definition indicates the key role of enterprises and their business activities in the implementation of CE, which was also emphasized by the European Commission (EC) in documents on CE in the European Union (EU) [1].

One of the first countries to introduce CE was China, which in 2002 launched a pilot program for implementing CE in selected regions and cities and, in 2009, adopted CE as the country's official policy [9]. CE was considered an anthropogenic system that reintroduced waste as raw materials for new natural or technological cycles while simultaneously generating environmental, economic and social benefits. Currently, the CE model is recommended by several countries on all continents, such as Canada and Brazil [10], the United States (U.S.) [11], the European Union (EU) member states [12,13], the United Kingdom (U.K.) [14], Norway [15], Switzerland [16], Japan [17], or Singapore [18]. CE can be, therefore, indicated as a global direction for more efficient resource management.

In Europe, the dynamic development of the CE model can be observed after 2014, when the EC published the first document calling on member states to take action to increase resource productivity as a part of the "zero waste for Europe" program [19]. The first CE action plan [1] indicated the need for transformation towards a system in which the value of products, materials and resources should be maintained in the economy for as long as possible, and waste generation should be limited to a minimum. The EC also defines CE as a model of regenerative growth that "gives back to the planet more than it takes" and aims to keep the consumption of resources within the planet's limits; therefore, it should strive to reduce the consumption footprint as well as double the rate of use of all materials in a closed loop. This definition is indicated in the second CE action plan of the EC [2]. It is worth mentioning that the EC emphasizes that CE does not apply only to the EU but should be treated as a global economic model that contributes to achieving the sustainable development goals [20] and the ambitious assumptions of the European Green Deal [21]. Moreover, it is pointed out that it is necessary to involve all sectors of the economy, as well as society, in improving the efficiency of the use of resources [19]. An important role is also assigned to new BMs, as they have been pointed out in planning documents regarding the CE implementation, both at the national and international levels [22].

In recent years, there has been an increasing involvement of various industry sectors and companies in the transformation process towards CE [23]. The adoption of CE practices results from the identification of commercial and economic opportunities [24,25], in particular, potential savings from resource-efficient production processes, increased security of supply chains (resulting from the purchase of recycled or sustainably produced raw materials) [26], or improved reputation [27]. Appropriate initiatives of the production and services sectors, including the development of dedicated BMs, environmental standards and corporate social responsibility (CSR) strategies, are important factors driving the CE transformation in many countries [28].

There are many examples in the literature on the practical implementation of CE in enterprises of various sectors, such as recycling [29,30], reuse [31,32] or recovery options [33,34]. However, these are often examples of individual technologies that do not consider the entire CE business model in the given organization. Therefore, it is very important to expand the debate on building innovative CBMs by enterprises, also referred to as "circular economy business models" (CEBM) [5] and "CE business models" (CEBM) [35,36].

The creation of integrated CBMs with their elements (such as identification of main recipients, target markets, costs and returns) is strongly recommended for organizations to deliver environmental, social and economic benefits.

The increased interest of both researchers and practitioners in issues related to the implementation of CE into the activities of organizations results from the increasing importance of environmental and social issues in the activities of organizations [37], as well as systematically introduced recommendations and changes in legal regulations regarding CE [38], which are dedicated to various sectors of the economy. These, in turn, are a consequence of the pressure caused by the climate crisis, which, according to the World Health Organization (WHO) report, is currently the greatest threat to the planet and the health of the world's population [39]. Depending on the application and the type of sector or enterprise, CBMs are defined differently, focusing on different areas of raw materials and waste management. This may create certain doubts for interested stakeholders who are looking for knowledge about CBMs. Therefore, this work aims to organize knowledge in the field of CBMs, analyzing different approaches to their creation. The work includes a comparative analysis of the CBM definitions, a presentation of the basics of creating CBMs and various typologies of CBMs, as well as examples of good practices implemented by CMBs in various enterprises. The presented results may be helpful for stakeholders in understanding the idea of CBMs. Such organization of knowledge and presentation of different definitions and typologies of CBMs, along with the basis for their creation, may be particularly interesting for enterprises planning to implement CE solutions and thus adopt CBMs in their organization.

2. Materials and Methods

This work was divided into four main stages, which are presented in Figure 1. The first stage of research included an introduction to the topic and identification of the problem and research interest. Here, the focus is on justifying the importance of BMs in the process of transformation towards CE from a holistic perspective. It was pointed out that there are many definitions and typologies of CBMs. A research gap was identified, which was the lack of organization of information on the definitions of CBMs and their analysis, as well as their types and importance in planning documents. This information was presented in Section 1. The second stage contained the organization of data sources about CBM. The analysis of various definitions of the CEBM was presented, considering the chronological order found in the available literature. A definition of CBM is proposed here, which, in the authors' opinion, considers two key elements of implementing CE in an organization—creating value for the consumer and incorporating CE principles in the organization's activities. The results of this stage are presented in Section 3.1. The next stage included an overview of available strategic documents on the CE model to underline the importance of CBMs. Since the EU has declared that it will play a leading role in the transformation process towards CE globally [27], the European documents regarding CE are analyzed here. They are presented in Section 3.2. The fourth stage of research included the revision of different approaches to building CBMs in organizations. Section 3.3 contains information on how the various authors present creating CBM based on the principles of regular BMs. The focus here is on building a BM in the context of organizational management, not CE technology. In the fifth stage of research, various typologies of CBM are presented. They are included in Section 3.4. The last (sixth) stage of research synthesizes how the CE principles are applied to BMs in various organizations, providing revision and analysis of good practices. Additionally, the advantages and disadvantages of building CBM in organizations are outlined. The data obtained were organized and presented according to the productive sector in which the enterprise was located. There are four sectors of the economy, according to generally accepted standards [40]—primary sector, secondary sector, tertiary sector and quaternary sector. The primary sector focuses on the production of raw materials and agricultural goods, mainly in mining, farming, fishing or forestry. The secondary sector involves the manufacturing of products (finished goods), mainly in dedicated factories.

The tertiary sector provides services to customers. The quaternary sector also provides services; however, here, more focus is dedicated to education and expertise than in tertiary workplaces [40]. In the current study, we focus on the secondary sector and tertiary sector, as they are the most representative of the CE concept—manufacturing CE products and providing service to consumers. These results are presented in Section 4, while conclusions are defined in Section 5.

The research methods used in this study were desk research and comparative analysis [41]. The desk research method included searching, collecting and extracting data from existing resources available in various scientific databases. This was conducted from July to October 2023, with a focus on work published after 2014. The primary literature items were searched in full-text scientific databases, databases of legal acts and specialized reports. These included Elsevier Science Direct, Springer Nature, Wiley Online, Google Scholar, BazTech, Multidisciplinary Digital Publishing Institute (MDPI) and legal acts of the European Union (EUR-lex). The following keywords were used to collect appropriate documents: 'circular economy', 'CE', 'business'', 'business model', 'circular business model', 'CBM', 'circular economy business model', and 'CEBM'. Comparative analysis, which included the process of comparing items to one another to define similarities and differences, was used for the comparison of various definitions of CBMs. We used a descriptive statistical analysis in the form of graphs and tables.

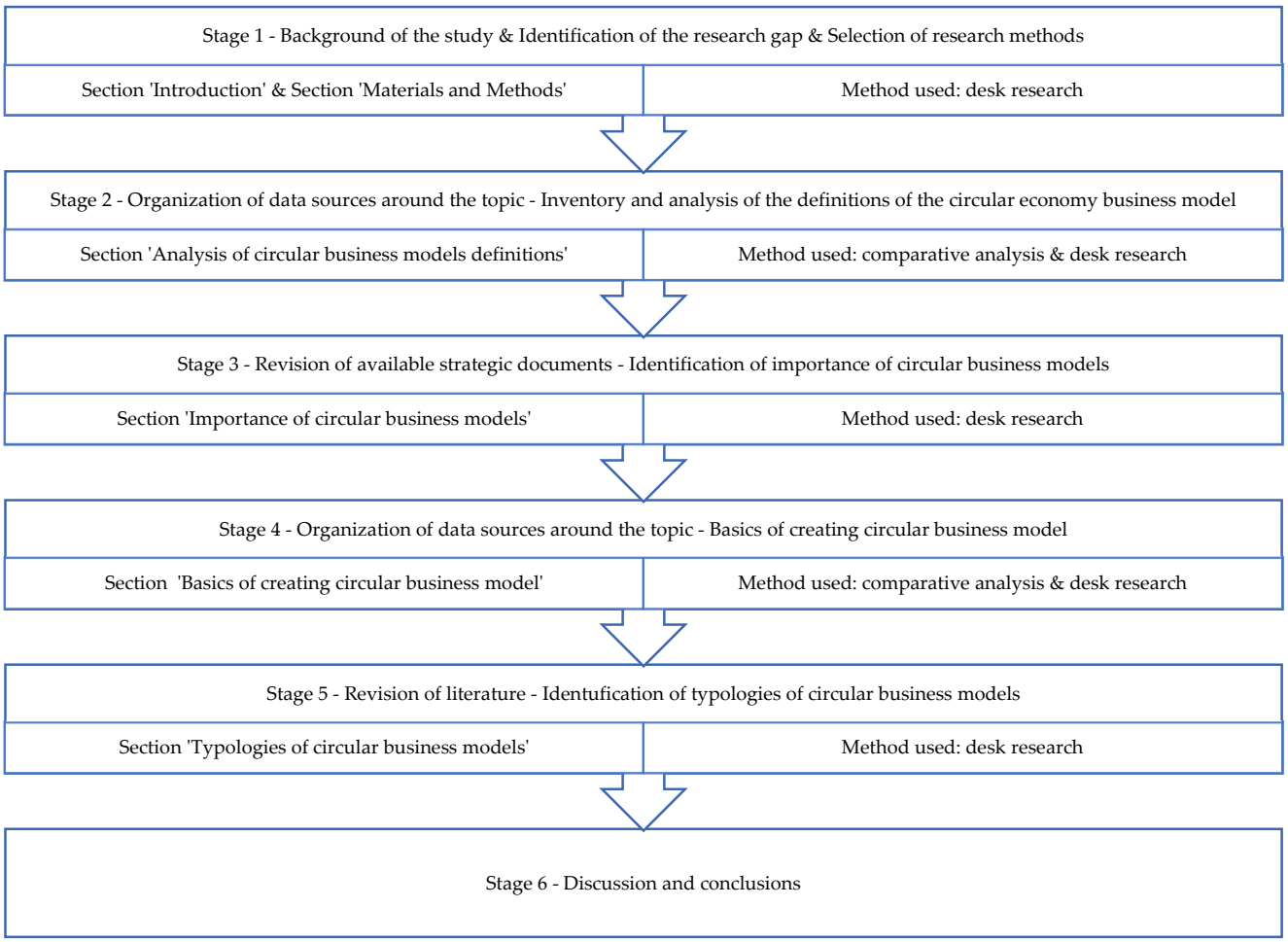

Figure 1. The research stages and methods used in this study (created based on [42,43]).

3. Results

This section presents the results of this study, focusing on the importance of CBMs, their definitions, creation, typologies and good examples in various branches of industry.

3.1. Analysis of Circular

BM is the basis for the operation of the enterprise, while the CBM is one of its types. The BM itself is a certain general operating pattern of a given organization or an adopted tactic of managing an organization that ensures the generation of income. The BM considers the organization's activities using specific methods at a specific time, using resources to create the greatest possible value for the customer, as well as ensuring that part of this value is retained by the organization [44]. In the available literature, we can find many definitions of the CBM. Table 1 presents an inventory of selected definitions of CBMs.

Table 1. Inventory of definitions of the circular economy business model.

Circular Economy Business Model Definition	Source
a way in which an organization creates, delivers and captures value through and within closed material loops	[45]
a way in which an organization creates, delivers and captures value for a broader range of stakeholders while minimizing environmental and social costs	[46]
creating economic value for the organization by slowing down, closing and narrowing the resource loop	[47]
a business model in which the conceptual logic of value creation is based on the use of the economic value retained in products after their use in the production of new products	[48]
a sustainable business model focused on solutions for the circular economy through a circular value chain and alignment of incentives for interested parties	[49]
a method of introducing circular economy assumptions into the activities of a given organization	[50]
a way in which organizations create and deliver value that can support closing resource flows	[51]
a way in which organizations incorporate circular economy principles into their value propositions across the value chain	[35]
a business model that delivers an environmental value proposition	[35]
the sum of resources and activities that simultaneously serve to delivercustomer value and close the loop	[52]
a way in which the organization creates, delivers and captures value in a mannery that is compatible with and regenerative of finite natural resources; maintaining products, components and materials at their highest value and utility within appropriate system boundaries	[53]
a model based on activities consistent with the hierarchy of reuse, repair, regeneration and recycling, aimed at retaining value for as long as possible	[54]
creating economic value for the organization by slowing down, closing, narrowing the resource loop and sustaining the life of resources	[55]
cycling, extending, intensifying, and/or dematerializing material and energy loops to reduce the resource inputs into and the waste and emission leakage out of an organizational system	[56]
creating value for the customer in a sustainable way	[57]
integration of circular economy principles with the organization's business practices	[58]

Many authors describe CBMs as opposed to traditional or linear BMs. The simplest definition of the CBM indicates that it is based on the integration of CE assumptions with the organization's business practices [58]. In this context, the purpose of the CBM is to introduce the principles of CE into the activities of a given organization, considering each dimension of economic activity: between enterprises, between enterprises and consumers, and between consumers themselves [50].

Referring to the definition of the BM itself, the CBM can be presented as one whose goal is to provide value to the customer while closing material loops [45,51] or "closing the loop" [52]. Moreover, it is worth mentioning that the CBM does not have to independently

close material loops within the internal boundaries of the system but can also be part of a system of other BMs that together ensure the closure of the circulation of a given material or raw material [45]. In turn, another definition indicates that the CBM should determine the way in which the organization introduces CE principles into its value propositions throughout the entire value chain [35]. CBM is, therefore, based on the assumption that organizations should redefine the way they create value while complying with CE principles [59].

The CBM is one that combines creating economic value with slowing down, closing and narrowing the resource loop. The goal of slowing the resource loop is to extend the useful life of products by repurposing, refurbishing and remanufacturing products. Narrowing refers to resource efficiency and dematerialization, while resource loop closing seeks to close the loop between the post-consumer phase and production, i.e., material recycling [47]. A slightly broader definition includes an additional element—maintaining the life of resources through regeneration [55]. The CBM may also represent a way in which the conceptual logic of value creation is based on the use of the economic value retained in products after their use in the production of new products. The term "CBM" coincides with the concept of closed supply chains and always includes recycling, remanufacturing, reusing or renovating/repairing [48].

The CBM can also be defined as the way an organization creates, delivers and captures value for a wider range of stakeholders while minimizing ecological and social costs [46]. In this way, it aims to maintain the value and functionality of products and the materials they contain at the highest possible level [54]. The most extensive definition of the CBM was developed as part of the international project entitled "Transition from linear to circular: Policy and Innovation" (R2π), financed by the EC. It assumes that the CBM is the way in which an organization creates, delivers and captures value in a manner compatible with finite natural resources. It enables their regeneration and maintains products, components and materials at their highest value and utility within appropriate system boundaries [53].

Other authors approach the concept of CBMs from the perspective of eco-innovation, i.e., any innovation that leads to sustainable development. In this understanding, eco-innovations regarding CBMs are inherently networked—they require cooperation, communication and coordination within complex networks of interdependent but independent entities/stakeholders [45]. The CBM concept is a useful instrument in identifying different ways of implementing eco-innovations, i.e., technological innovations, organizational innovations, social innovations and consumer innovations [54].

CBMs are also indicated as sustainable BMs, which is why, in the literature, we can also find definitions based on sustainable development. For example, Frishammar and Parida [57] define the CBM as a way to create value for the customer in a sustainable way. In turn, Geissdoerfer et al. (2020) point out that CBMs are sustainable BMs aiming to implement solutions for sustainable development. They achieve this by creating additional monetary and non-monetary values through the active management of many stakeholder groups and the inclusion of a long-term perspective. This involves considering that these solutions are focused on CE, including circular value chains and alignment of incentives for stakeholders. The assumption of sustainable BMs is the integration of the organization's economic activities with social issues and issues related to environmental protection [56].

CBMs are the opposite of the serial production model, which is based on mass production and mass consumption, the so-called Fordism [60]. According to Manninen et al. (2018), CBMs should provide an environmental value proposition expressed in absolute value. This proposition represents a promise of environmental improvement that the organization provides to the environment through its impact along the entire value chain. The authors propose assumptions for calculating the environmental value propositions table (EVPT), enabling organizations to plan and design new CBMs or verify the intended environmental benefits and analyze their contribution to sustainable development. The need to develop environmental assessment methods dedicated to organizations developing and implementing new CBMs is also emphasized here [35].

However, it should be noted that economic organizations and decision-makers must know how to implement the CBM in practice, regardless of its academic definitions. The priority is, therefore, to identify and understand what they need to do to implement the CE principles smoothly. Many of the currently functioning BMs of organizations that have been successfully implemented in the market are in line with the assumptions of the circular economy, but so far, they have not been called CBMs. Some of them operate based on traditional economic models, such as repairing or renting. Others, in turn, were created with the development of modern technologies, including virtualization and sharing platforms, which would not be able to develop without the generally available Internet. Moreover, for the further development of CBMs, it is important to develop recycling and raw material recovery technologies, which are key issues in the circular economy concept. Undoubtedly, changes in legal regulations and pro-ecological trends force economic organizations to look for new BMs aimed at mitigating the impact of their products and processes on the natural environment. This confirms the need to develop and implement CBMs in various economic sectors, especially those that have the greatest potential to use raw materials and waste in a closed loop. It should be underlined here that each economic sector is characterized using its specificity, requiring the adaptation of circular economy activities to various products or services, which in turn results in the need to develop different CBMs adapted to the specificity of this sector. Based on the revision and comparison of analyzed CBM definitions, we propose to define the CBM as "a business model that assumes creating, delivering and capturing added value for the consumer while considering the CE principles".

3.2. Importance of Circular Business Models

The CBM is a key element of the organization's transition to CE [61]. Information on CBMs can be found in various planning documents and recommendations. The importance of CBMs in the selected European documents is indicated in Table 2.

Table 2. Importance of CEBMs in the selected EU documents on CE.

Document (Source)	Circular Economy Definition	Importance of Business Models
Zero waste programme for Europe (COM no. 398, 2014) [19]	a system that keeps the added value of products for as long as possible and eliminates waste	• The need to introduce systemic changes and technological innovations in organizations, society, financing methods and politics; • The possibility of saving material costs using the EU industry, and by creating new markets and new products and value for business, which may contribute to Gross domestic product (GDP) growth; • The need to implement innovative BMs that may lead to the creation of new relationships between enterprises and consumers.
First CE Action Plan (COM no. 614, 2015) [1]	a system where the value of products, materials and resources in the economy is maintained for as long as possible, and waste generation is reduced to a minimum	• Innovative forms of consumption, such as using the same products or infrastructure (sharing economy), consuming services rather than products, and using information technologies or digital platforms; • Horizon 2020 work program for 2016–2017 includes the important "Industry 2020 in the Circular Economy" initiative, under which a budget of over EUR 650 million was allocated to innovative demonstration projects supporting its objectives—Circular economy and the competitiveness of EU industry in activities in the industrial and service sectors, including the processing and manufacturing industries and new BMs.

Table 2. *Cont.*

Document (Source)	Circular Economy Definition	Importance of Business Models
Second CE Action Plan (COM no. 98, 2020) [2]	a regenerative growth model that gives back to the planet more than it takes away, making progress towards keeping resource consumption within the planet's limits, and therefore must strive to reduce its consumption footprint and double its circular material use rate	• Since manufacturing companies in the EU spend on average around 40% of their funds on materials, CBMs can increase their profitability while protecting them from fluctuations in resource prices; • Innovative BMs, based on closer customer relationships, mass personalization, the sharing and collaboration economy and driven by digital technologies such as the Internet of Things, big data, blockchain and artificial intelligence, will accelerate not only the introduction of circularity but also dematerialize our economy and make Europe less dependent on virgin materials; • Establishing a solid and coherent product policy framework that makes sustainable products, services and BMs the norm and transforms consumption patterns to prevent waste in the first place; • Promoting CBMs by linking design issues with end-of-life processing, developing regulations on mandatory recycled content for certain component materials and improving recycling efficiency.
Leading the way to a global circular economy [27]	less wasteful systems that use resources moreefficiently and sustainably while providing workopportunities and a high quality of life	• CBMs should consider the efficient use of energy and resources, low emission and circular solutions appropriate to local conditions; • Society's involvement in the development of CBMs and the creation of resource-efficient products tailored to the real needs of consumers.

In enterprises, CBMs may concern every stage of a product's life, starting with the extraction of raw materials through production, use and waste management in the form of material or energy recovery [62]. Mainly, the recommendations in analyzed documents regarding CE concern the introduction of innovations [63], not only technological ones but also organizational, legal, and financing methods, as well as social and environmental ones. They can all be included in the CBM proposed by a given organization.

The role of the sharing economy, on which many modern companies are based, is also emphasized, e.g., in the form of sharing transport facilities, including bicycles and cars, office space, food and clothing [64]. The involvement of individual people and their networks in the development of CBMs is, therefore, also important [27]. Innovative forms of consumption require high ecological awareness of society; therefore, CE education can play an important role in the process of CE transformation. A consumer who expects eco-trends in an organization may also set further pro-environmental development directions for the organization [1].

It is worth noticing that CBMs are also indicated in the individual strategies of the EU countries, often called CE roadmaps [13]. These roadmaps are systematically published on the European Circular Economy Stakeholder Platform (ECESP) website, where over 50 such documents have already been made available, including those for regions and companies [65].

3.3. Basics of Creating a Circular Business Model

Most BMs described in the literature have been designed and optimized for a linear "take, make, throw away" model, in which negative externalities in the environment are not included in resource prices. Considering the definition of the BM itself, it can be assumed that the basis of the CBM is to create value for the customer in a sustainable manner, with the actions taken aimed at improving the efficiency of the use of resources in the organization [57]. However, individual companies may approach planning and

implementing BMs consistent with CE assumptions in different ways. Below, we present some of the possibilities of creating CBM in enterprises in a holistic approach applicable to various types of organizations.

Currently, one of the most popular CBMs available in the literature is a modification of the business model canvas (BMC). Osterwalder et al. (2005) defined BMC as "a conceptual tool that contains a set of elements and their relationships and allows for expressing the business logic of a specific firm". It includes nine specific blocks in four pillars of business operation [66], as presented in Figure 2. In the first pillar—product—a value proposition shows a general view of an enterprise's bundle of products or services. In the second pillar—client interface— the target customer presents segments of customers to whom a company wants to offer value; the distribution channel presents different means for the enterprises to get in touch with its customers, while relationship shows the kind of links an enterprise establishes between itself and its different customer segment. In infrastructure management, value configuration contains the arrangement of activities and resources; core competency outlines the competencies necessary to execute the firm's BM, and partner network presents the network of cooperative agreements with other units necessary to efficiently offer and commercialize value. The last pillar—financial aspects—contains cost structure that sums up the monetary consequences of the means employed in the BM, and the revenue model presents the way a company makes money through a variety of revenue flows [66].

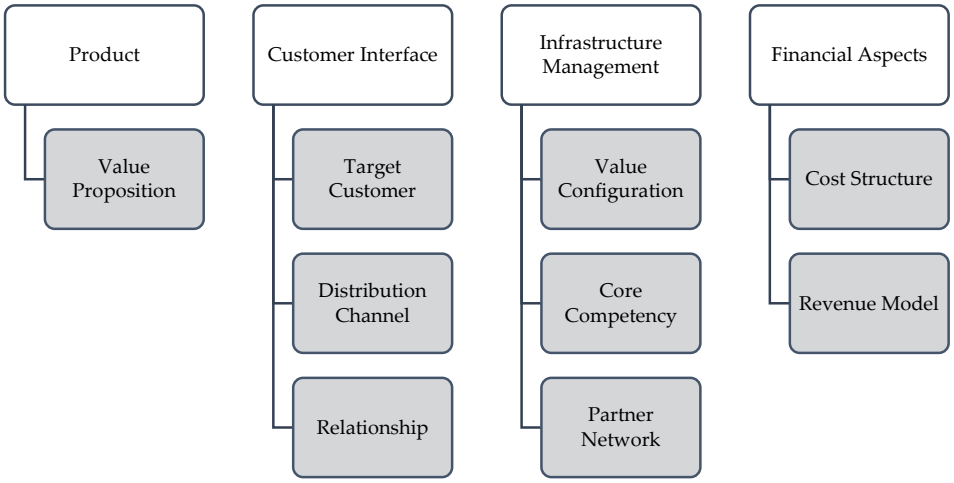

Figure 2. Nine business model creation blocks across four specific pillars of business management. Source: adapted from [66].

In the process of CBM creation, based on BMC, it is important to include these nine blocks [67] in correlation to the following aspects: value proposition, value creation and delivery, and value capture. Therefore, the proposed conceptualization of the CBM adapted from Osterwalder et al. includes the following elements in those areas:

- Value proposition: customer segments, customer relationships, product/service offer and value proposition;
- Value creation and delivery: key partners, channels, key resources and key activities;
- Value capture: cost structure and revenue streams [68].

Another concept of BMC modifications was presented by Lewandowski (2016), who pointed out that the circular business model canvas (CBMC) should integrate principles of the CE into business actions, as well as into BM components and the design process. This approach is more complex than the original BMC and thus more complicated to adapt than the original one. Two additional building blocks were suggested to add to the regular BMC: a "take-back system" defined as the creation of a take-back management system and "adoption factors"—the necessity to support CE implementation by various organizational capabilities as well as external factors [59]. Pollard et al. (2021) also proposed

modification of the regular BMC to implement CE principles. They presented the circular economy business model innovation (CEBMI) Process Framework based on five layers: business strategy, circular economic Business Model Canvas, circular economy business model challenges and opportunities, policy documents relevant to the given sector and circularity indicators. The presented interconnected layers were developed for electrical and electronic equipment manufacturers, providing them with a comprehensive layered process for creating and implementing the CBM tailored to their business offerings [58].

An interesting approach to building the CBM in enterprises was presented by Lacy et al. (2014). It was based on the product life cycle, according to the CE framework. Implementing CE in an organization requires a significant change in business planning and strategy. Instead of focusing on maximizing throughput and sales margin, the organization must participate in continuous product and service cycles to increase revenue. This requires not only focusing on core business but also participating in collaborative networks involving suppliers, manufacturers, retailers, service providers and customers. The key stages of change supporting the adoption of the CBM include the following [69]:

1. Strategy: putting emphasis on core business to manage complex and collaborative circular networks;
2. Innovation and product development: extending lifetime from design—single use to design—multiple use;
3. Sourcing and manufacturing: transforming from a homogenous supply chain to heterogeneous resource flow innovation and cascading;
4. Sales and product use: transforming from never seeing the product again to customer and asset life cycle management;
5. Return chains: moving from compliance to opportunity-driven take-back.

When preparing to build the CBM, it is necessary to consider the possibilities of creating value for the customer throughout the entire cycle of the CE model. First, an organizational strategy should be developed, which should be based not only on the organization's core activities but also on the management of complex and collaborative networks. At the product design stage, possible product innovation and development should be considered, moving from designing single-use products to designing for multiple life cycles and users. In the next stage, i.e., supply and production, it is necessary to consider replacing a homogeneous supply chain with a variety of resource flows and cascading. At this stage, the organization should also ensure whether the raw materials used to produce products are renewable or fully reproducible and consider their environmental footprint and toxicity. It is assumed that production should not only be efficient but also that there will be no loss of resources during the process, and the organization can significantly increase the scale and maintain the acquisition of volumes from return chains. In turn, at the stage of sales and use of the product, product life cycle management is also considered in the use phase. This, in turn, allows for better design of the last phase of the returns chain, in which the possibility of returning the product is offered on specific terms. The inclusion of these five activities stands out as particularly important for the successful implementation of the CBM into an organization [69].

The Information Systems Management Institute (ISMA) has developed a procedure for verifying the BM in a given organization in terms of its adaptability to the assumptions of the circular economy. The procedure aims to obtain all the necessary information required to implement circular economy principles into the organization by mapping and verifying the scope of activity. Six stages of the value creation process have been proposed (Figure 3), i.e., value proposition, design, delivery, production, use and reuse (recycling). Revenue streams and costs are also mapped.

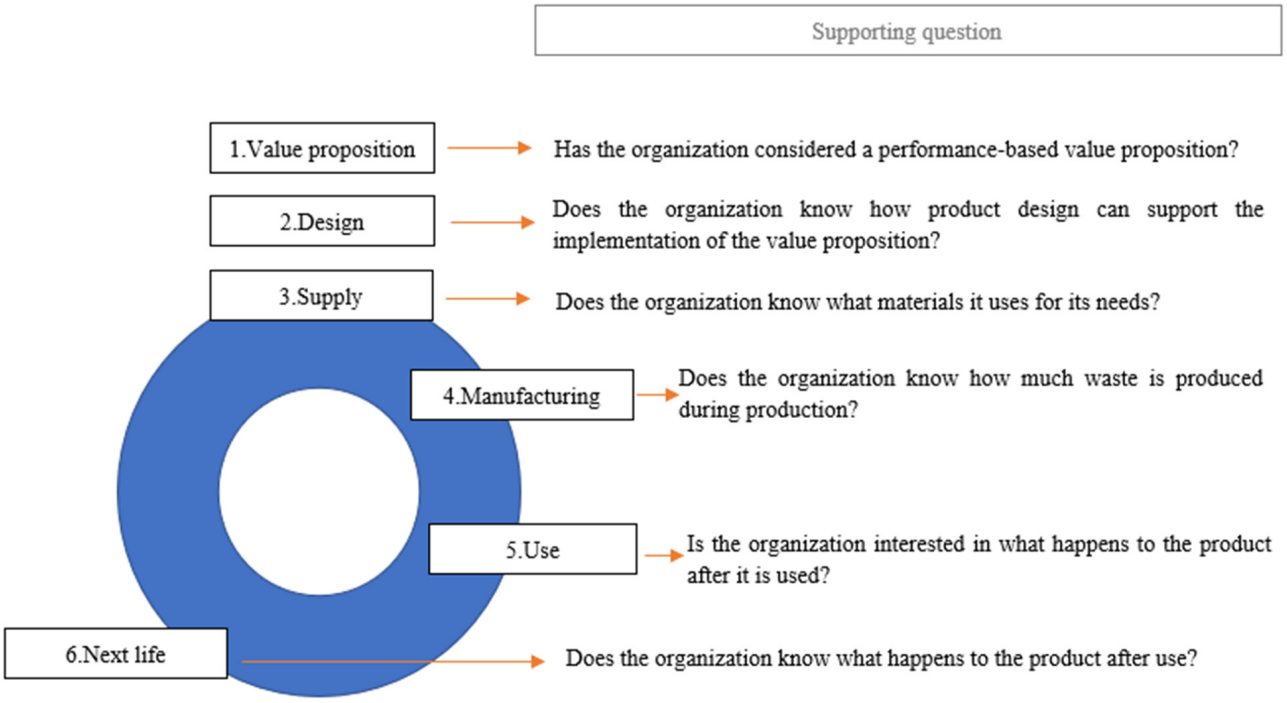

Figure 3. Six stages of the value chain process according to ISMA. Source: own, based on [70].

Based on the initial verification, it is possible to determine the current activity characteristic of the linear model and the CE model, considering the revenue streams from these activities. This allows for the identification of areas where innovations and new CBMs can be proposed. Additionally, this initial verification identifies circular business areas and possible revenue streams, allowing the company to continue building a stronger business case for implementing CE solutions. Identification of the features of the linear model and assumptions of the CE in the activity of a given organization also allows for the identification of obstacles and the selection of appropriate tools to counteract emerging risks.

The next stage is the second verification of the possibility of implementing the CBM into the organization, which is based on three elements:

- Market analysis: identification of dependencies and conditions of the market in which the organization operates, considering the specifications of a given economic sector;
- Review of the organization's vision: desired economic and social achievements that the organization wants to achieve;
- Stakeholder analysis: cooperation with stakeholders throughout the value chain.

The final stage of the procedure is the selection of an appropriate circular economy BM and the development of a roadmap for its implementation in a given organization. The roadmap should address desired changes over time and indicate what action is required [70].

In fact, different companies have different levels of knowledge about CE. Therefore, it is important to propose a CE building framework in which it is possible to determine at what stage of CE implementation a given company is and then select an appropriate CBM. In 2017, the British Standard Institution presented "BS 8001:2017—Framework for implementing the principles of the circular economy in organizations—Guide" as the first official practical framework to implement CE in business operations, based on defined criteria and elements. It is dedicated to any organization, regardless of its size, location, sector or type. It provides a set of recommendations, definitions and clarifications to voluntarily implement CE in enterprises, based on six CE principles—system thinking, innovation, stewardship, collaboration, value optimization and transparency [71]. The company has to identify the level of circularity:

1. Unformed: limited or/and ad-hoc actions;
2. Basic: initial CE framing and scoping—analyzing of opportunities;
3. Improving (process improvement): ways of working that align with CE principles;
4. Engaged (product/service/process innovation): aligning value proposition to CE principles;
5. Optimizing (business model innovation): organizational ways of doing business and creating value fully align with CE principles.

In general, BS 8001 proposed a flexible eight-stage framework, with the possibility for enterprises to enter the CE system at any of the eight stages due to the different levels of CE maturity and activity that currently exist. Applying this standard in an organization is a guide for management and employees who will actively implement CE in operational and business activities [71]. The application of the BS 8001 standard was deeply discussed by [72,73]. The element that connects all the concepts of building CBMs in an organization is the creation of a specific value proposition that will be delivered to the consumer, which will assume CE principles. This is consistent with the proposed definition of CBM in the previous section.

3.4. Typologies of Circular Business Models

The literature contains many different criteria for dividing CBMs, available in both scientific and specialist studies in the field of circular economy and business. One of the first proposals to distinguish BMs that fit into the assumptions of CE was to organize business activities into six different groups aiming to implement circular economy into the activities of various organizations [74], referred to as the ReSOLVE model. It was proposed by the Ellen MacArthur Foundation in 2015 and includes the following activities:

- **R**egeneration: activities considering the transition to renewable materials and energy sources, i.e., returning recovered biological resources to the environment (e.g., energy recovery from waste, energy from renewable sources and energy-efficient construction);
- **S**haring: sharing products or services to maximize their use (e.g., sharing cars, bicycles and workplaces);
- **O**ptimization: increasing product efficiency and effectiveness and removing waste in the production process and supply chain (e.g., automation of production or service systems);
- **L**ooping: keeping components and materials in a closed loop (e.g., reuse of products, recycling and recovering raw materials);
- **V**irtualize: providing the utility of a given product or service virtually instead of materially, i.e., dematerialization (e.g., book readers);
- **E**xchange: replacing old materials with new advanced materials, using modern technologies, and selecting modern products and services (e.g., replacing the traditional production process with 3D printing).

It is emphasized that the implementation of CE principles as part of the presented activities may contribute to lower consumption of primary materials in favor of recycled materials. This reduces the risk of supply chain disruptions resulting from climate threats or geopolitical destabilization, as the decentralized nature of operations will be able to provide alternative sources of raw materials [74].

The report [69] and the circular economy handbook [75] developed by Accenture (a business consulting organization) distinguished five main CBMs, which were identified based on the analysis of over 120 organizations that stand out for improving resource productivity through introduced innovations. The groups of CBMs include the following:

- Circular supply chain: use of materials that are renewable, recyclable or biodegradable;
- Recovery and recycling: recovery of raw materials and energy from used products or byproducts;
- Extension of product life: extending the life cycle of products and components through repair, modernization and resale;
- Sharing platform: increasing the degree of product use by enabling sharing/access/ownership;

- Product as a service: offering access to products while retaining ownership to enhance the benefits of closed-loop resource efficiency.

The indicated CBMs have their own distinct characteristics and can be used individually or in combination to help organizations achieve increases in resource efficiency, thus increasing differentiation and customer value, reducing operating and ownership costs, generating new revenues and reducing risk [69]. Organizations should start adopting CBMs now to remain competitive in the future [75].

According to the work of the IMSA institute, CBMs can also be classified into six groups of cycles, depending on the method of creating value in a closed loop [70]:

- Short cycle: maintenance, repair and adaptation of existing products and services;
- Long cycle: extending the life of existing products and processes;
- Cascade cycle: creating new combinations of resources and material components and purchasing recycled waste streams;
- Closed loops: 100% reuse of resources and materials;
- Dematerialization: transfer of physical products to virtual services;
- Production to order: production only when there is demand.

Based on the presented cycles, the IMSA institute categorized nineteen existing CBMs, which are presented in Table 3.

Table 3. Typology of CBMs according to IMSA.

No.	Name	Specification
	Short cycle	
1	Pay per use	One-time payment to use product or service
2	Repair	Product life extension through repair services
3	Waste reduction	Waste reduction in the production process
4	Sharing platforms	Products and services are shared among consumers
5	Progressive purchase	Pay periodically small amounts before purchase
	Long cycle	
6	Performance based contracting	Long-term contract and responsibility with the producer
7	Take back management	Incentive to ensure the product returns to producer
8	Next life sales	Product gets a next life
9	Refurbish and resell	Product gets a next life after adjustments
	Cascades	
10	Upcycle	Materials are reused and its value is upgraded
11	Recycling (waste handling & repurpose)	Materials are cascaded and reused, recycled or disposed of
12	Collaborative production	Cooperation in the production value chain leading to closing material loops
	Pure circles	
13	Cradle to cradle	Product redesign for 100% closed material loops
14	Circular sourcing	Only sourcing circular products or materials
	Dematerialized services	
15	Physical to virtual	Shifting physical activity to virtual
16	Subscription based rental	Consumers can use a product or service against a low periodic fee

Table 3. *Cont.*

No.	Name	Specification
	Produce on demand	
17	Produce on order	Only producing when demand is present
18	3D printing	Using 3D printing to produce what is needed
19	Customer vote (design)	Making customers vote on which product to make

Another typology of CBMs was presented by the Circle Economy organization [76], which works to disseminate knowledge in the field of circular economy. A set of eight CBMs was proposed, divided into two main groups—product sale models and service sale models. Product sales methods include the following:

- Sale of reusable parts: sale of parts of modular products that can be refilled;
- Leasing, rental and pay-per-use: providing products in the leasing, rental or pay-per-use model instead of sales;
- Peer-to-peer sharing (P2P): delivering products by sharing between consumers and customers;
- Sale of long-lasting products: sale of high-quality, durable products;
- Sale of spare parts: sale of parts of modular products that can be replaced;
- Products sold in a subscription model: provision of services as part of a subscription with regular payment schemes.

In turn, service sale models include the following:

- Social services: decentralized services that rely on the power of the crowd or community;
- Pay-per-use: the provision of services in which customers are charged only when they use them [77].

The R2π project developed a set of seven CBM patterns, which were assigned to three stages of the circular economy cycle. The proposed CBMs are as follows:

- Closed-loop supply: obtaining recycled or renewable materials that can be returned to the technical or biological cycle;
- Recovery of byproducts: remaining/secondary output products of one process (or value chain) become inputs for another process (or value chain);
- Repair: concerns repairing, refreshing or improving the aesthetics of the product without extending its warranty (repair and renovation);
- Modification: restoring the product to a like-new condition or better performance with an appropriate warranty;
- Access: providing end users with access to the functionality of products/assets instead of ownership;
- Performance (product as a service): providing the end user with access to the functionality of the product or resource itself instead of the product or resource;
- Recovery of raw materials: recovery of raw materials from used materials or products and their use as raw materials in other processes or value chains.

It is emphasized that the CBM should consider the organization's ability to implement circular economy principles while maintaining or increasing profits [53].

In 2017, the British Standards Institution (BSI)—the world's oldest standard-setting body—presented the BS 8001 standard, which provides practical frameworks and guidelines for organizations in the implementation of circular economy principles. The BS 8001 standard has been prepared in a way that allows it to be used anywhere in the world. It is intended for use in any organization, regardless of location, size, sector and type of business. It provides a practical guide for organizations with varying levels of knowledge and understanding of the circular economy to help them rethink the overall way they manage resources to increase financial, environmental and social benefits. The BS 8001 standard distinguishes six CBMs in organizations [71]:

- On-demand: producing a product or providing a service only when consumer demand has been quantified and confirmed;
- Dematerialization: replacing physical infrastructure and resources with digital/virtual services;
- Life cycle extension/reusability: designed so that products last for a long time (durability); facilitating product reuse; modular product design; regeneration, repair and renewal;
- Recovery of byproducts and secondary raw materials: optimizing value by creating products from secondary raw materials/byproducts and recycling, and encouraging customers to return used/unwanted items to the manufacturer using a convenient system;
- Product as a service: leasing access and not selling ownership of the product or service; delivering product performance or specific results rather than the product or service itself;
- Sharing economy: sharing products and services and providing platforms/resources (sharing).

In the scientific literature, we can also find publications presenting various criteria for the division of CBMs. Laubscher and Marinelli [78] identified six key groups of circular economy models, classified depending on the possibility of creating value for customers in the circular economy:

- Sales model: selling product volumes towards maximizing asset productivity through the sale of services and creating incentives for customers to return products after the first life;
- Product design/material selection: consider the assumption that circular economy products must be designed and constructed to maximize high-quality reuse at the product, component and material level;
- Management of information on material flows: concerns the development of IT systems enabling tracking of material flows in supply chain loops;
- Closed supply chains: maximizing the recovery of own assets where it is profitable and maximizing the use of recycled materials/used components;
- Partnership: building long-term relationships based on cooperation and trust with suppliers and customers in the supply chain;
- Human resources management/motivation system: an adaptation of organizational culture and development of employees' abilities and competencies and their motivation system.

Urbinati et al. [79] reviewed CBMs, proposing their division based on the degree of circularity adoption in the organization, i.e.,

- A group of CBMs based on creating value for the customer, i.e., implementing the concept of a closed-loop in offering value to customers;
- A group of CBMs considering value networks, i.e., ways of interacting with suppliers and reorganizing the organization's internal activities to be consistent with the circular economy concept.

This division was then initially tested by the authors using several case studies, showing in practice the possibility of correctly distinguishing different ways of implementing the circular economy in economic organizations in both groups [79].

In the work Potting et al. [80], CBMs were classified based on the EU waste hierarchy, which assumes ordering waste management methods from the most to the least desirable, here according to the so-called circularity levels: refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, and recover. More intelligent production and use of products, for example, through product sharing, are indicated as methods of extending the life cycle of products. Another option is to extend the service life, followed by recycling the materials through recovery. Incineration, which recovers energy, is the least recommended solution because it means that the materials are no longer available for use in other products.

Lüdeke-Freund et al. [51] analyzed 26 CBMs, focusing on specific features of identified groups of models. Based on this analysis, the authors identified a wide range of CBM design options that define how organizations create value by adhering to circular economy principles. Six main groups were proposed that can support the closing of resource flows:

- Repair and maintenance: extending the life of the product at the point of use through inspection and service that maintains or restores its functionality;
- Reuse and redistribution: reusing a product for the purpose for which it was originally designed and manufactured, with minor improvement or change;
- Renovation and regeneration: a more comprehensive review of products by replacing parts that have failed or are likely to do so soon;
- Recycling: synthetic and mineral materials collected, separated, processed and introduced into the production process (new products); the material may, therefore, be of lower quality (downcycling) or higher quality and functionality (upcycling) than the original material;
- Cascading and repurposing: refer to many applications of biological materials, first using the functions of these materials as components and finally recovering energy in the process of increased entropy;
- Organic feedstock BM patterns: extraction of biochemical feedstock through conversion processes that transform biomass simultaneously into chemical products and one or more forms of energy.

4. Discussion and Future Research Directions

Currently, we are in an irreversible process of transitioning to a circular economy, which is the recommended direction for all sectors of the economy. An important opportunity to deepen CE transformation is the fact that more and more enterprises are implementing circular solutions [27], and interest in CBMs has been developing dynamically in recent years. A significant increase in the number of papers in this area can be observed after 2014, which could be partly associated with the fact that this year, the EC declared that the EU should adopt the CE model and started the transformation process [19], indicating the first CE Action Plan in 2015 [1], which was updated in 2020 [2,81]. An increase in the number of CBM-related journal articles and reviews is presented in Figure 4. Most of these works were published in journals focusing on environmental issues, such as the *Journal of Cleaner Production*, *Resources, Conservation and Recycling*, *Technological Forecasting and Social Change*, *Procedia CIRP* and *Journal of Environmental Management*. Most of these works are original research works (13,419), with a smaller number being literature reviews (2166) and book chapters (2021). In turn, in the Springer Nature database, most papers were published as book chapters (22,111), books (11,283) and research and review articles (8869), in business and management, engineering and environment-related journals. This confirms that CBM considers issues related to sustainable business, which includes elements of the CE model.

The CBM should be an extension of the BM currently used in the organization or be a completely new idea for the business or area of activity of a given enterprise [82]. It is very important to consider the CE solutions (technology/product/service) proposed by the company when building or updating the entire BM [83]. Implementing the CE model in an organization requires rethinking the logic of value creation [84].

The analyzed CBM definitions confirm that CE-related business requires rethinking the three dimensions of value in an organization: what value is proposed, how value is created and delivered, and how value is captured, to provide a more systematic approach to aligning an organization's value-creation logic with CE principles. Changes in the functioning of the organization resulting from the implementation of circular assumptions can be built into the value creation logic to support its implementation. Aligning the three dimensions of value and adjusting the configuration of BM elements can facilitate its implementation and subsequent functioning in the organization. As previously mentioned, the BMC is one of the most popular BMs currently used by enterprises and scientists. Our

proposal for implementing CE principles to this model can be seen in Figure 5. The strength of this way of presenting CMB is its simplicity, i.e., presentation in the form of nine blocks, giving a full view of the operation of the enterprise to its various members. Moreover, this model is adequate to reality by adapting CE solutions to the conditions of organizational structure in a given company, and it is understandable and orderly.

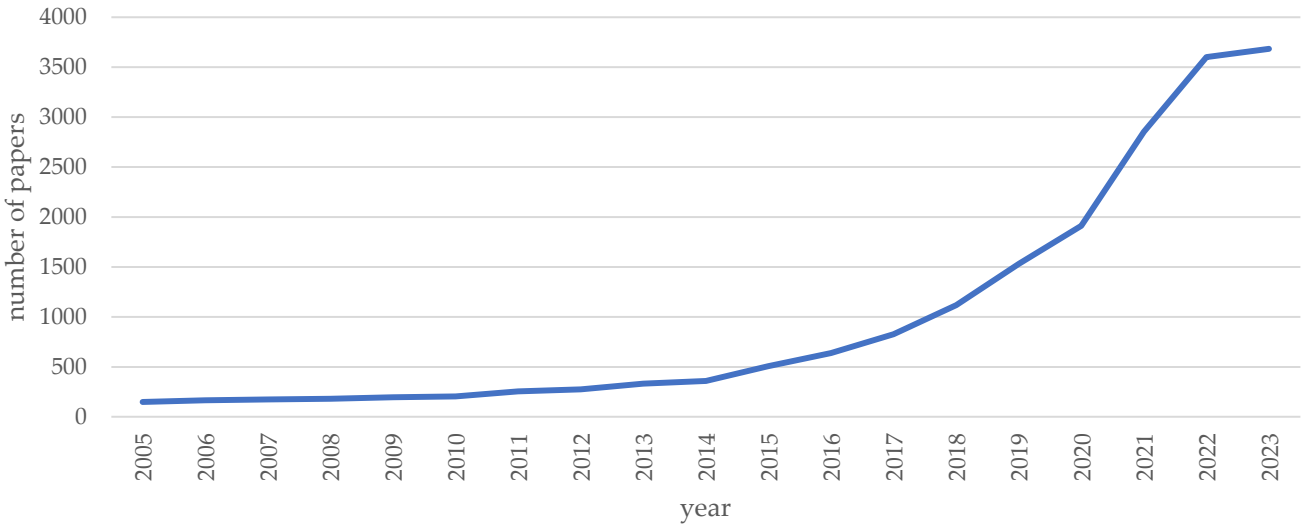

Figure 4. Number of CBM-related journal articles and reviews. Source: Elsevier ScienceDirect database.

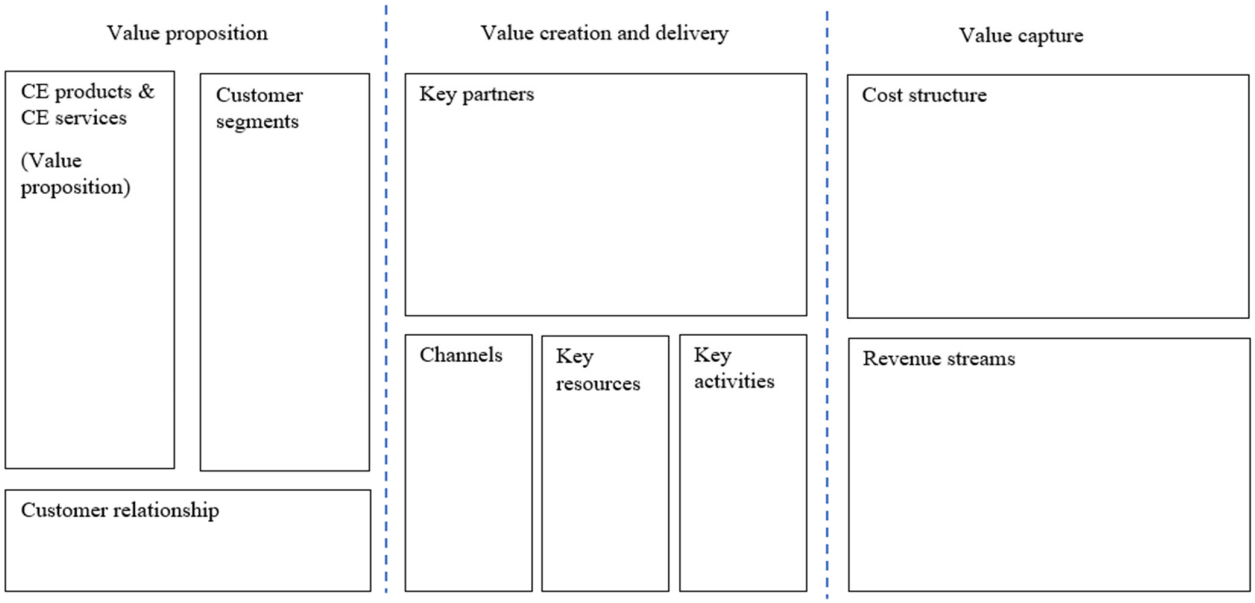

Figure 5. Conceptualization of the CBM, adapted from [66,68].

Currently, there are many different typologies of CBMs in the literature, as described in the previous section. These divisions are determined via various criteria for differentiating BMs, such as stages of the CE cycle [53] or the method of creating value in a closed loop [70]. Undoubtedly, an important criterion is what value a given organization provides to the consumer—whether it is a product or a service [85]. Therefore, the selection of an appropriate BM depends on the specifications and sector in which a given organization operates. An overview of the CBMs used depending on the sector of the economy is presented in Table 4.

Table 4. CBM used in various economic sectors.

Sector of Economy	Example of CBM Usage
Secondary Sector (finished goods)	
manufacturing	electrical and electronic items [58,86–89]
	batteries [90]
	furniture [87,89]
	cloths [87–89,91–95]
	medical items [87]
	agricultural/food products [96,97]
utilities—electricity, gas	wind power [98]
Tertiary Sector (service sector)	
sharing platforms	books [99]
	cloths [99]
	cars [100]
	mobility [99]
	sundry [99]
hospitality and leisure	health care [101]

As seen in Table 4, the secondary sector primarily involves the manufacturing of various products, such as cloths [87–89,91–95], electrical and electronic items [58,86–89], agricultural/food products [96,97] and others. In the service sector, the most popular area is the sharing economy, e.g., clothes [99], books [99] or cars [100]. It should be noted here that the cited literature only concerns CBMs created from a management perspective. There are several examples of CE products and services in the literature, but they are often cited as good CE practices without presenting a fully developed and implemented BM with its elements (in terms of management sciences). This means that CMB-building skills should be developed in both production and service enterprises. This is extremely important for companies operating in strategic areas of the economy, such as water and sewage management and the operation of municipal wastewater treatment plants or municipal waste companies. These entities present interesting examples of companies that can implement CE in various areas, including water recovery, raw materials recovery and energy recovery. However, so far, no developed CBM for municipal entities has been presented in the available literature. Further research in this area is required.

There are different driving forces for adopting CBM in organizations. The introduction of CE solutions into business activities creates opportunities for further development of the company [102], diversification of its activities [103] and reaching new markets [104] or recipients (e.g., people with pro-environmental attitudes). The adaptation of CBM could bring many benefits to the organization. Alongside the positive impact on the reputation and eco-image of the company, it could create potential savings coming from resource—efficient production processes [105], as well as enhance the security of supply chains [106] resulting from the procurement of recycled/sustainably produced resources [27]. An important opportunity for CE business development is the possibility of cooperation with other entities involved in the green transformation through building an industrial symbiosis (IS)—voluntary cooperation of various enterprises, where the waste of one becomes the raw materials of the other [107]. This is one of the possibilities for building CE on a local or regional scale [108]. It is worth adding here that in IS, there is cooperation between organizations, while CBMs apply to every dimension of the organization's activity, i.e., between enterprises (B2B), between enterprises and consumers (B2C), and between consumers (C2C) [109]. Integrating closed loops of material flows and industrial symbiosis as part of the global strategy to support the further development of regions and individual

companies is required. This should focus on building SI and new BMs consistent with the CE idea.

The availability of the market and recipients of CE products or services is a significant barrier to implementing CE solutions. For example, when fertilizers are produced from waste such as sewage sludge or sewage sludge ash [110], they are still more expensive than commercial fertilizers on the market. This reduces interest in them. Moreover, the availability and quality of waste (as a raw material for the production of fertilizers) varies over time, e.g., depending on the season, which means that such waste fertilizers may not be available consistently, further reducing the interest of recipients. Therefore, it is necessary to support the creation of a sustainable market for the secondary raw materials [2], a point repeatedly emphasized by the EC in its communications regarding CE. This is important because a significant amount of waste in our economy contains raw materials (such as nutrients) that could be used in commercial products, but at the moment, their potential is lost through unsustainable waste management (e.g., directing nutrient-rich sewage into rivers). This also contributes to environmental deterioration by extracting further raw materials from the Earth's interior instead of using those contained in waste. There are also other limitations to the application of CBMs in organizations, such as the lack of an established holistic structure for individual elements of CBM or decision-support tools. Moreover, most of the examples focus on single innovation stages with insufficient interdependencies with other business processes [87].

Institutional policies play a significant role in the further development of CBMs play by supporting the fostering of demand from consumers for CE products. Moreover, dedicated consumption policies, as tools that can be used by governments to foster CBMs, are recommended [111]. There is also strong importance of the management board of a given organization, which should set the direction of changes within the company to adapt to the changing environment, including considering environmental issues in business activities [89].

Another driving force for the implementation of CBMs is financial incentives, mainly in the form of subsidies for investments in the implementation of CE in enterprises, both technological and nontechnological [112]. The largest support instrument currently in the EU is the Horizon Europe program [113,114]. There are also a number of national support instruments, such as fiscal and tax incentives and financing for companies that exist or are being created that are in line with the demands of sustainable development goals [113,115] and the circular economy idea [116].

The economic and social role of implementing CBMs in organizations should also be emphasized. On the one hand, the implementation of the CE model should bring economic benefits [117] in the form of income from managing waste that has been lost so far, and the CE model can be recycled and treated as raw materials for production [84]. This may bring savings for entrepreneurs. On the other hand, it is worth highlighting social issues. Companies that operate in accordance with the CE idea are better perceived by society as socially responsible [118], in line with the idea of corporate social responsibility [37]. This will ultimately lead to an increase in sales as well as the building of a base of loyal and ecologically aware customers.

Most of the analyzed literature items focus on the methodological foundations of creating CBMs or a compilation of their typologies. However, much fewer works present real constructed CBM for a given example (product or service). Such models are very limited, especially in the bioeconomy sector (e.g., waste management companies or water utilities), which must adapt to global changes and adapt CBMs. It is recommended that future case study research be conducted in those sectors, which could be used as a benchmark to compare and define best practices for the successful adoption of CBMs. Therefore, in the coming years, further development of CBMs is expected to adapt them to specific sectors and their areas of activity.

5. Conclusions

The development of CBMs is an ongoing and increasingly interesting issue for both practitioners and theoreticians. There are many definitions of CBM in the literature, which are usually adapted to the context of presented CE examples, such as the manufacturing of products or the provision of services by organizations to consumers. Due to each economic sector being characterized by its specificity, it is required to adapt CE activities to various products or services, which in turn results in the need to develop different CBMs adapted to the specificity of a given enterprise. In general, CBM should consider the key CE assumption, i.e., increased raw material efficiency. In the current work, we propose to define the CBM as a BM that assumes creating, delivering and capturing added value for the consumer while considering the CE principles. This can be used by any organization, both production and services. There are many CBMs that contain good examples of companies operating in various areas of CE. However, there is limited information on municipal entities that also practice CE in the form of water, raw materials or energy recovery, but so far, no developed CBM. Therefore, further research in this area is required.

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Abbreviations

BM	business models
BMC	business model canvas
CBMC	circular business model canvas
CBMs	circular business models
CE	circular economy
CEBMI	circular economy business model innovation
CEBMs	circular economy business models
CSR	corporate social responsibility
EC	the European Commission
EU	the European Union
U.K.	the United Kingdom
U.S.	the United States

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