

Emerging Business Models for Circular Economy: A Systematic Literature Review

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Abstract: Business models for circular economy keep products alive and operating for as long as possible during their use and consumption. Business model (BM) innovation in the circular economy (CE) helps firms design their BMs based on CE principles and identify new value-creation opportunities. Since research on the design of circular business models (CBM) is at an early stage, there is a lack of unified terminologies, and the meanings and relationships between the various CBM archetypes are unclear. This study aims to review and analyze existing emerging BMs in CE from peer-reviewed journals and recommend future research directions. The systematic review of 76 research articles resulted in identifying 23 CBM archetypes. This study analyzes the CBM archetypes based on descriptions, examples, similarities in the terminologies, and the frequency of use in the literature. The review identifies the three widely adopted CBM classification frameworks, the ReSOLVE framework (Ellen MacArthur Foundation), Accenture's CBM framework, and the CBM strategies by Bocken et al. Most of the studies in this review combine BMs derived from several classification approaches to categorize suitable BM archetypes for the CE, which illustrates the lack of comprehensive classifications. The key findings show that providing access to a product's functionality, recycling materials that would otherwise be sent to landfills, and restoring the functionality of existing products (re-manufacturing/refurbishing) are the most discussed archetypes in CBM literature, and other types do not get adequate attention. Future studies should examine BMs that have not received enough attention and provide a comprehensive classification of CBMs that clarifies their meaning and relationships. With this study, we contribute to advancing the body of knowledge in CBM and help practitioners in developing new CBMs.

Keywords: circular business model, business models, circular economy, business model innovation, classification

1. Introduction

The transition to the circular economy (CE) has generated interest because of increasing resource consumption and waste generation, as well as limited available natural resources. Efficient use and reuse of resources could reduce resource inputs, energy, emissions, and waste leakage; as a result, negative environmental effects would be reduced without compromising growth and prosperity while maintaining a better balance between the economic, environmental, and societal dimensions (Geissdoerfer et al., 2018b; Manninen et al., 2018). A circular economy helps to reduce waste generation and emission by maintaining components, parts, and products value to their maximum useful life and returning them to the product cycle at their end of life (EMF, 2013). Shifting from a linear economy to a CE model has environmental, social, and economic benefits (Bocken et al., 2016b; Lewandowski, 2016). There has been increased interest in CE among scholars, practitioners, and policymakers, as evidenced by an increase in related publications (Esposito et al., 2018; Urbinati et al., 2017). Innovative and disruptive business models (BM) are needed to transform the linear economy into circular ones by replacing the existing model or taking advantage of new opportunities (Bocken et al., 2016a; Hopkinson et al., 2020; Linder et al., 2017). Different adaptations to transform a firm's BM through CE principles will affect the value creation and delivery (Bocken et al., 2016; Lüdeke-Freund et al., 2018; Planing, 2015). Furthermore, the literature on circular business models (CBM) is emerging (Lüdeke-Freund et al., 2018; Nußholz, 2017; Santa-Maria et al., 2021) in which many aspects need to be explored (Geissdoerfer et al., 2020). Scholars have offered conceptual definitions (Bocken et al., 2016a; Geissdoerfer et al., 2020; Nußholz, 2017), archetypes and taxonomies (Henry et al., 2020; Pieroni et al., 2020; Urbinati et al., 2017), product design strategies (Bocken et al., 2016a; de Kwant et al., 2021; Moreno et al., 2016) and have redefined the BM canvas by incorporating CE and sustainability (Antikainen, 2016; Lewandowski, 2016) and BM patterns (Lüdeke-Freund et al., 2018; Pieroni et al., 2021) towards value creation and capture. The literature of CE with a BM perspective has become popular, igniting a discussion among scholars and practitioners to further study the opportunities for creating, delivering, and capturing the value of a business while following CE principles (Diaz Lopez et al., 2019; Lüdeke-Freund et al., 2018; Nußholz, 2018). However, a unified understanding of the current state of knowledge remains elusive (Salvador et al., 2020) as there is a lack of studies that equates to the different perspectives. Due to the growing trend in scientific production, updating earlier works to include

the most recent contributions is necessary. Therefore, this study provides a systematic literature review of circular business models classification frameworks and archetypes. Section 2 presents the different classification approaches of BMs for the CE, and Section 3 offers an overview of the methodological steps used to draft and conduct the systematic literature review. Section 4 presents the results of our literature review, followed by concluding remarks and recommendations for future research in Section 5.

2. Theoretical background: Circular Business Models (CBMs)classification approaches

Based on the generally accepted definitions of the traditional BM given by Osterwalder (2010) as well as by Richardson (2008), scholars try to define CBMs in the same terms. Osterwalder (2010) describes a business model as "a rationale of how companies create, deliver, and capture value" Osterwalder (2010).While, Lüdeke-Freund et al. (2018), Nußholz (2017), and Oghazi et al. (2018) define CBMs as "the way an organization creates, delivers, and captures value by incorporating the principles of CE". Studies in CBM literature have used the BM canvas (Osterwalder, 2010) and the three core functions of a BM "value proposition, value creation and delivery, and value capture"(Richardson, 2008) to analyze CBMs and study all or parts of the BM building blocks. For example, to incorporate the sustainability and circularity evaluation of a BM and its sustainability impact at an ecosystem level, Antikainen and Valkokari (2016) try to redefine the BM canvas in terms of CE and sustainability while Nußholz (2017) incorporates circular strategies in to the BM canvas. In the literature, CBM studies have used different classification frameworks developed by practitioners (international organizations and consulting firms). In this study, we present the most commonly used classification approaches: the ReSOLVEframework (EMF 2015), CBM framework (Accenture 2014), CBM strategies (Bocken et al. 2016), business models for CE (BSI 2017), business models archetypes for a CE(ForumForTheFuture, 2018) and CBM scan (Van Renswoude et al., 2015).

2.1 ReSOLVE framework (Ellen MacArthur Foundation)

ReSOLVE is a framework developed by the Ellen MacArthur Foundation (EMF, 2015)under the principles of circularity which are translated into six actions. (i) *Regenerate* entails harnessing renewable energy and secondary materials and returning recovered biological resources to the biosphere. In other words, this goal incorporates reclaiming, retaining, and regenerating the health of an ecosystem.(ii) *Share* focuses on utilizing the under used capacity of products by sharing assets, reusing (second-hand) resources, and extending product life through maintenance, design for upgradability, and durability. (iii) *Optimize* efforts regards improving the performance or efficiency of products and eliminating waste in the manufacturing process and supply chain. (iv) *Loop*prefers to retaining products or components in closed loops through re-manufacturing, recycling, anaerobic digestion of wastes, and biochemical extraction from organic wastes. (v) *Virtualize* focuses on delivering products virtually rather than physically. (vi) *Exchange* focuses on applying new technologies or choosing new products/services (EMF, 2015). Despite providing a comprehensive overview of the six CE-based actions, some categories merge two or more potentially distinct BMs. For instance, the action to share combines BMs such as sharing, product life extension, and product as a service. Furthermore, business models towards providing the access or performance of a product without having the ownership by the customers are not addressed.

2.2 Circular business model framework (Accenture)

By analyzing 120 business cases worldwide that generate resource productivity improvements, Accenture's framework classifies BMs according to their function within the CE and shows the product outcome of such a BM. Accenture (2014) presents five distinct types of CBMs and 11 sub-models: (a) *circular supply chain* that is based on the use of renewable energy, bio-based, or recyclable materials and the 'built to last' approach; (b) *sharing platforms* that encourage collaborative usage, access, or ownership models; (c) the *product as a service* model provides access to products or performance while maintaining product ownership; d) the *product life extension* model refers to extending the life cycle of a product through repairs, maintenance, upgrades, resale, and re-manufacturing; (e) the *resource recovery* model deals with recovering energy or resources from wastes or by-products (Accenture, 2014). Despite the five BMs presented by Accenture (2014), the classification does not address BMs related to improving product performance or efficiency and waste reduction such as narrowing the resource loop or optimization and BMs for delivering products virtually rather than physically, such as virtualization or dematerialization.

2.3 Circular Business Model strategies (Bocken et al.)

Bocken et al. (2016) present the typologies of BM innovations for the CE to slow, narrow, and close resource loops. The typology of slowing resource loops includes (a) *access and performance* models that focus on providing the ability or service to meet users' needs without requiring them to own the product physically, (b) *extending product value* involves circular practices of re-manufacturing or return programs towards exploiting the residual value of a product, (c) *classic long-life* models focus on providing long-lasting and repairable products, and (d) the *encourage sufficiency* model recommends that firms help consumers decrease their consumption by offering durable, upgradeable, serviceable, warrantable, and repairable products as well as by taking a non-consumerist approach (Bocken et al., 2016). In addition, the BM strategy towards closing resource loops comprises (e) *extending resource value* refers to the exploitation of a resource's residual value and (f) *industrial symbiosis* in which leftovers are utilized from one process as feedstock for another Bocken et al. (2016). This classification approach neglects discussing aspects such as circular inputs and collaborative consumption approaches even though it organizes BMs from a slowing and closing resource loops perspective. Aside from the elements presented, other scholars integrate BMs such as "intensifying" and "dematerializing" (Geissdoerfer et al., 2020) and "regenerating" and "informing" (Konietzko et al., 2020) into this approach to fill the gaps in this CBM classification.

2.4 Business models for circular economy (British Standard Institute)

The British Standard Institute (BSI, 2017) proposes potential BMs compatible with a CE in six groupings. (a) *Product as a service* is a BM that combines both products and services and uses results as a basis for innovation such as leasing and pay for success system. (b) *Sharing economy or collaborative consumption* focuses on enabling greater use of unused or under-used assets. (c) The *on-demand* model focuses on providing the product/service only when the customer requests it. (d) *Dematerialization* stresses replacing physical items with virtual ones. (e) The *product life extension* models focus on extending the life cycle of a product by designing it for durability, modularity, reuse, refurbishment, repair, and re-manufacture. (f) *Recovery of secondary materials* focuses on incentivizing customers to return used products as well as recovering and recycling secondary materials/by-products (BSI, 2017). This classification covers most CBMs, but it does not mention BMs that work towards circular inputs such as the use of the residual from one process as in input for other (i.e., industrial symbiosis), renewable energy, and bio-based and recyclable resources.

2.5 Business models archetypes for a circular economy (Forum for the Future)

Forum for the Future (ForumFortheFuture, 2018) conducted a study on fast-moving consumer goods and presented 10 BM archetypes for a CE in two categories. Five of the BMs are categorized as classic CBMs: (a) *closed loop* recycling focuses on using secondary materials as an input source; (b) *downcycling* takes materials and turns them into products of lower quality; (c) *upcycling* involves recycling used products into new ones with better quality; (d) *industrial symbiosis* involves sharing services, utilities, and by-products between companies; and (e) *collection services* allow for the collection of old or used products (ForumFortheFuture, 2018). Five other enabling BMs are not circular by nature, but they can boost the circularity of other models: (f) product-service systems provide a solution rather than the actual product, (g) the *lock-in* model encourages consumers to use a particular product or service regularly, (h) *Local loop* models focus on the closer and more beneficial cluster of industries, (i) the *modular design* divides products into smaller sections which can be utilized and replaced separately, and (j) *personalization* creates opportunities for product personalization through data management (ForumFortheFuture, 2018). While this classification approach places a strong emphasis on recovery and recycling models, it does not consider circular practices that extend product life during the use phase, such as repairing, maintaining, re-manufacturing, upgrading, reusing, and redistributing.

2.6 Circular Business Model Scan (Van Renswoude et al.)

The CBM Scan (Van Renswoude et al., 2015) classifies BMs into six cycles and 19 CBMs based on the value flow. The cycles and related CBMs include the following: (i) short cycle contains the CBMs paying per service, repairing, reduction of waste, sharing platform, and progressive purchase; (ii) long cycle includes the performance based contracts, take back system, resale for next-life, and refurbishment BMs; (iii) pure circle includes the CBMs cradle-to-cradle and circular sourcing models; (iv) cascading categorized with upcycling, recycling and collaborative production BMs; (v) dematerialized services contains the shifting of physical products to virtual and rental models on subscription bases; and (vi) produce on-demand includes produce on

order, 3D printing, and customer voting (Van Renswoude et al., 2015). While this classification includes most CBMs, the models related to extending a product's life cycle such as modular design, upgrading, hybrid, or gap exploiter models, are missing. Furthermore, the models of 3D printing and take back management do not reflect a complete BMs they are production methods and enabling mechanisms. Based on the aforementioned information, the goal of this study is to investigate existing CBMs using a systematic literature review.

3. Methodology

The method we used for our study is a systematic literature review. The following research question examines the CBM classifications and identify gap: How are business models classified in a CE?

To perform this systematic literature review, we first identified relevant and adequate literature on the topic under consideration. We used Scopus and Web of Science for retrieving all relevant articles, and the main keywords primarily used for the required publications in this area were "business model" and "circular economy." We reviewed the keywords of prominent authors to expand our search and find other variations in keywords. Furthermore, we used Vosviewer to support our keyword analysis, and three more keywords included "closed-loop," "resource efficiency," and "business strategy." Although keywords such as "sustainability" and "sustainable development" are often used and have strong links, this study did not include these keywords because the scope is limited to CE and related activities. Keywords such as "waste management," "product-service systems," "re-manufacturing," and "industrial symbiosis" were also excluded to prevent biases of focusing on specific actions. For the inclusion criteria, articles had to focus on BM theory or CE or discuss the CBM as the major topic of the study. The document types included journal articles and reviews written in English. As shown in figure 1, step by step filtration was made and finally 76 articles were selected.

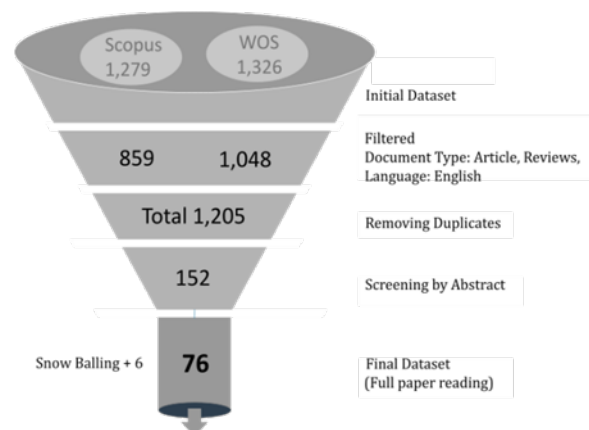


Figure 1: Articles retrieval and selection procedure

4. Circular business model archetypes

The number of articles on circular business models has increased since 2018 as demonstrated on figure 2. Since 84.4% of the reviewed works were published within the last four years, this proposition highlights the topic's relevance in the literature. Furthermore, 32.95% of the articles are from the *Journal of Cleaner Production* and 22% are from the *Journal of Sustainability*. The study also identified 16 other journals with only one publication. Most of the papers (75.8%) were published by research institutes in Europe, and Sweden contributed the most (12.5%), followed by the UK (10%) and the Netherlands (10.8%). Most authors (43.3%) in this research are from Northern Europe (Sweden, Norway, and Denmark). As for the distribution of articles by research approaches as shown in figure 3, most papers from the sample are qualitative (79%), supported by case studies (50%) and exploratory analyses (51%). According to this systematic literature review, researchers used different CBM classification frameworks or approaches developed by practitioners. The CBM classification frameworks developed by EMF (2015), Accenture (2014), and Bocken et al. (2016) are the most widely used, as presented in Table 1. Since there is no clarity on the standard classification of CBMs (as presented in Section 2), most reviewed articles were found to use circular strategies or practices derived from different approaches to determine suitable BM archetypes for the CE. Moreover, other studies use waste hierarchy and R strategies (Bianchini et al., 2019; Bigliardi et al., 2021; Blomsma et al., 2019; Bocken et al., 2016b; Ranta et al., 2021).

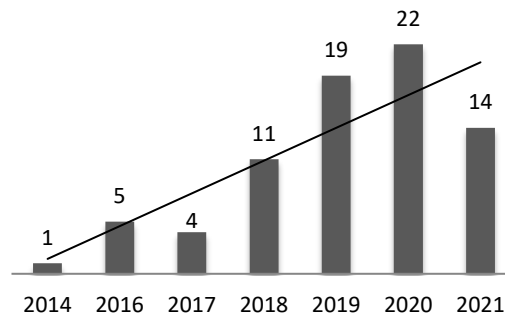


Figure 2: Distribution of articles over time

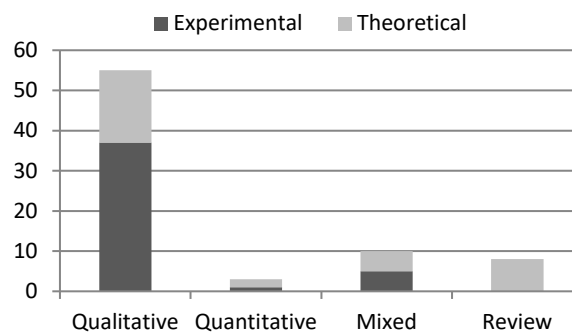


Figure 3: Distribution of articles by research approach

Table 1: BMs for CE classification approaches

Framework	CBMs	Sources	Observations
Approach I ReSOLVE framework Ellen MacArthur Foundation (2015)	Regenerate, Share, Optimise, Loop, Virtualise and Exchange	Ceptureanu et al. (2018); Heyes et al. (2018); Horvath et al. (2019); Lewandowski (2016); Manninen et al. (2018); Marke et al. (2020); Mendoza et al. (2017); Rosa et al. (2019)	Bases on <i>Value flow</i> Merges sharing, product life extension, and PSS under <i>optimization BM</i> While PSS not sufficiently addressed
Approach II Accenture's BM framework Accenture (2014)	Circular Supplychain, Sharing platforms, Product as a service, Product life extension, and Resource Recovery	Chen (2020); Moreno et al. (2016); Guzzo et al. (2019); Pollard et al. (2021); Upadhyay et al. (2019); Vermunt et al. (2019); Whalen et al. (2020)	<i>Focuses on BMs function within the CE</i> Waste reduction, product efficiency improvement, and dematerializing BMs are not sufficiently addressed.
Approach III CBM strategies Bocken et al. (2016)	Slowing, Narrowing & Closing resource loop	Bocken et al. (2016); Bocken and Ritala (2021); Ertz et al. (2019); Geissdoerfer et al. (2018); Geissdoerfer et al. (2020); Guldman et al. (2020) Han et al. (2020) Hansen (2020); Konietzko et al. (2020); Salvador et al. (2020)	BM towards the use of circular inputs (bio-based and recyclable resources, renewable energy) and 'Resource sharing' models not sufficiently discussed.
Combined Approach CE Strategies from multiple approaches	CBMs compiled using different approaches	Brendzel-Skowera (2021); Centobelli et al. (2020); de Kwant et al. (2021); de Mattos et al. (2018); Diaz Lopez et al. (2019); Fehrer et al. (2021); Galvão et al. (2020); Henry et al. (2020); Hofmann (2019); Husain et al. (2021); Lüdeke-Freund et al. (2018); Karman (2020); Nußholz (2017); Pieroni et al. (2020); Planing (2018); (Salvador et al., 2021)	Most of the studies do not provide scientific procedures for their categorization and are not comprehensive.

Our primary objective is to investigate and present a complete and more organized breakdown of circular business model archetypes. To conduct a comparative analysis of classification approaches and to identify suitable BMs for CE in the literature, the study reviewed 76 journal and review articles. Through a detailed comparison analysis of CBM archetypes based on descriptions, examples, similarities in the terminologies, and the frequency of use in the literature, this study identifies 23 consolidated archetypes which are supported by descriptions, examples, and alternative terms as shown in the Table 2.

Table 2: CBM archetypes, alternative terms used, descriptions, case examples and the frequency of use in the reviewed literature

CBM Archetypes	Alternative Terms Used	Description	Example	#. Use
Access Model	Availability/Usage based services; Hire and leasing; Leasing/renting; Pay-per-service/use; Product as a Service; Product service system; Service instead of product; Servitization	Providing access to a product's functionality for a specific use or cycle through leasing, renting, or pooling while retaining the ownership.	Clothing rental and subscription - Vigga, Mud Jeans Heavy Machinery Rental - AMECO Compressed air as a service - Tamturbo	48
Recycling	Closed/Open-loop recycling; Upcycling or Downcycling; Extending resource value; Product recycling/Recycling 2.0; Resource Recovery; Cascades and Repurposing	Exploiting the residual value of materials considered to be waste through Recycling, Upcycling, Downcycling, or Biodegradation.	Playground from recycled athletic shoes - Nike Roofing felts into asphalt material - Tarpaper recycling Repurposing of containers to housing purposes - Mærsk	44
Repair and Maintenance	Product life extension	Extending product lifecycle through improved maintenance and repair services.	Condition-based maintenance service - ABB Free repairing service for jeans - Nudie Jeans, Patagonia	32
Remanufacturing/Refurbishing	Reconditioning; Remaking; Product Transformation	Restoring product or part functionality to a "like new" or better performance through remanufacturing, refurbishing, or reconditioning.	Remanufacturing automotive parts - Renault; Bosch; Refurbishes and sell IT equipments - Refurb electronics - Gazelle, HP	31
Bio-/Secondary materials	Bio-based resources; Circular Supplies/sourcing; Closed-loop; Environmentally friendly material usage; Use of recycled materials; Renewable, Recyclable materials	Use of bio based or fully recyclable or renewable resource inputs that can be returned to the biological cycle.	Recycled fabrics in furniture production - Flokk, Pure Waste Circular Supplies for Packaging - Ecovative	28
Sharing or pooling systems/platforms	Co-access; Co-ownership; Collaborative consumption; Pooling systems/models; Sharing economy; Sharing platform	Facilitate the sharing of under-utilized products through shared use, access or ownership.	Car sharing services - Zipcar, car2go, Blablacar Apartment sharing - airbnb Underused resources sharing platforms - Rheaply	27
Incentivized return	No alternative terms found	Incentivizing customers financially or in an alternative way to return used products	Clothing return initiatives - H&M, M&S' Shwopping Used electronic gadgets - Gazelle	25
Collection/ Take back of used products	Collection services; Reverse logistics/Supply Chain; Take-back system	Facilitate sales, return or collection of used units of functional products or components	Take back cartridges for reuse or recycling: Lexmark Takes back reusable crates and pallets for reprocessing and reuse - Svenska Retursystem	18

CBM Archetypes	Alternative Terms Used	Description	Example	#. Use
Resource and energy efficiency	Cleaner production Eco-efficiency; Fewer resources; Optimize; Waste reduction	Reduce/minimize energy consumption and waste both in the production process and before.	No example found	18
Performance model	Deliver functionality than ownership; Functional sales; Product as a Service; Result-based models	Delivering product's performance or results rather than the product itself.	Pay per Lux - Philips Power by the Hour - Rolls Royce Pay per print - Xerox	17
Industrial Symbiosis	No alternative terms found	Process-oriented solution to use by products of one process as input to another process, taking advantage of geographical closeness.	Eco-Industrial Park - Kalundborg AB sugar and other sugar refiners	16
Dematerialized services	Dematerialization; Digitization; Software instead of hardware; Virtualise	A BM based on shifting physical activities and assets to digital/virtual services.	Online film and music services - Spotify, Netflix, Amazon	13
Upgrading	No alternative terms found	Extending the use cycle of a product by enhancing the performance or functionality through replacing modules or components with better quality ones.	Repurpose old furniture to new trends and workspace needs - Gispen; Phoneblocks Modular phone - Google Ara Project	13
Classic long life model	Build to last; Durable products; Lifetime products; Long-lasting; Product longevity	Delivering long lasting products through design for durability and reparability.	Phantom car - Rolls Royce; Washing machines - Miele; Luxury watches - Rolex or Patek Philippe	13
Renewable Energy	Circular supplies Regenerate	Use of renewable energy sources for products and components manufacturing and functioning.	Renewable electricity - Gabriel Holding AS	10
Encourage sufficiency	Demand reduction services; Slowing down consumption; Enable and incentivize users to consume less	Encourage customers to moderate consumption of products through warranties, upgradability, and maintenance services.	Premium, high service and quality brands - Patagonia and Vitsoe	10
Modular design and Design for x	Design for circularity Modularity	A design that divides products into smaller sections which can be utilized and replaced separately	Modularity into the design of smart phones - Fairphone	10
Product oriented PSS	Extended producer responsibility; Premium products with life extension services ; Provide an unconditional lifetime warranty;	Besides the product, this BM provides additional services (finance, consultancy, maintenance, take-back programs) during the use phase.	Life cycle care program for heavy machinery - Konecranes	8
Redistribute/ Reuse	Resell, Next-life sales; Second hand Direct reuse; Facilitated reuse;	Product resale to the second and third-hand market or reuse them with or without repairs or upgrades and provide them either free of charge or for sale	Reselling of used medical equipments - Agito Medical; Reuse of automotive components - Tata Motors; Godsintlösen	7
Energy recovery	Waste to energy Energy from waste	Recover energy out of waste materials	Unwanted biological material into sustainable biofuel - Celtic Renewable	7
Hybrid model	No alternative terms found	A BM relies on combination of durable product and short-lived consumables.	Printers and copiers - Océ Canon; Coffee machines and branded capsules - Nespresso	6
Gap-exploiter model	No alternative terms found	Exploit lifetime value gaps in company's products or	Printer cartridges outlasting the ink they contain	5

CBM Archetypes	Alternative Terms Used	Description	Example	#. Use
		services.		
Produce on demand	Made to order	Producing only when its products or services are demanded	Furniture designs to order - Made	5

5. Discussion and conclusion

This systematic literature review explores the research context of business models in the circular economy. We identified the most commonly used CBM classification frameworks and archetypes adopted in the literature. These results offer valuable insights into the current understanding of BMs for circular economies. Since CBM research is still in its infancy, there is a lack of unified understandings and classifications. This review identifies the three most commonly adopted CBM classification frameworks: the ReSOLVE framework (Ellen MacArthur Foundation), Accenture's CBM framework, and the CBM strategies by Bocken et al. Most of the studies in this review combine BMs derived from several approaches to categorize CBMs, which illustrates the lack of comprehensive classifications. In most of the reviewed articles, identified CBM archetypes are not based on explicit criteria and detailed scientific methodologies to identify and systematize the circular strategies. Furthermore, the studies did not fully provide descriptions and related examples for each archetype.

This study conducted a systematic review on 76 scientific articles and identified 23 circular business model archetypes with descriptions and related examples to address the need for a complete and more organized classification of existing CBMs. This study highlights that most studies in the CBM literature concentrate on the three BM archetypes, the access model, recycling and re-manufacturing/refurbishing but, BMs related to product design (such as modular design, hybrid/gap-exploiter model, and the classic long life model), next-life sales, and product-oriented services are not addressed sufficiently. Future studies should focus on BMs that have received limited attention and should provide a comprehensive classification of CBMs that clarifies their meaning and relationships.

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References

*The full list of references can be obtained from the authors

- Accenture. (2014). Circular Advantage Innovative Business Models Technologies Value Growth.
- Bocken, de Pauw, I., Bakker, C., & van der Grinten, B. (2016). Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering*, 33(5), 308-320.
- BSI. (2017). Framework for Implementing the Principles of the Circular Economy.
- Centobelli, P., Cerchione, R., Chiaroni, D., Del Vecchio, P., & Urbinati, A. (2020). Designing business models in circular economy: A systematic literature review and research agenda. *Business Strategy and the Environment*, 29(4), 1734-1749.
- Diaz Lopez, F. J., Bastein, T., & Tukker, A. (2019). Business Model Innovation for Resource-efficiency, Circularity and Cleaner Production: What 143 Cases Tell Us. *Ecological Economics*, 155, 20-35.
- EMF. (2013). Towards the Circular Economy: Economic and Business Rational for an Accelerated Transition.
- EMF. (2015). Towards A Circular Economy: Economic and Business Rational for an Accelerated Transition.
- ForumForTheFuture. (2018). The Circular Economy Business Model Toolkit. Retrieved from <https://www.forumforthefuture.org/the-circular-economy-business-model-toolkit>
- Geissdoerfer, M., Pieroni, M. P. P., Pigosso, D. C. A., & Soufani, K. (2020). Circular business models: A review. *Journal of Cleaner Production*, 277.
- Guldmann, E., & Huulgaard, R. D. (2020). Barriers to circular business model innovation: A multiple-case study. *Journal of Cleaner Production*, 243.
- Husain, Z., Maqbool, A., Haleem, A., Pathak, R. D., & Samson, D. (2021). Analyzing the business models for circular economy implementation: a fuzzy TOPSIS approach. *Operations Management Research*.
- Konietzko, J., Bocken, N., & Hultink, E. J. (2020). A Tool to Analyze, Ideate and Develop Circular Innovation Ecosystems. *Sustainability*, 12(1).
- Lewandowski, M. (2016). Designing the Business Models for Circular Economy—Towards the Conceptual Framework. *Sustainability*, 8(1).

- Lüdeke-Freund, F., Gold, S., & Bocken, N. M. P. (2018). A Review and Typology of Circular Economy Business Model Patterns. *Journal of Industrial Ecology*, 23(1), 36-61.
- Mendoza, J. M. F., Sharmina, M., Gallego-Schmid, A., Heyes, G., & Azapagic, A. (2017). Integrating Backcasting and Eco-Design for the Circular Economy: The BECE Framework. *Journal of Industrial Ecology*, 21(3), 526-544.
- Moreno, M., De los Rios, C., Rowe, Z., & Charnley, F. (2016). A Conceptual Framework for Circular Design. *Sustainability*, 8(9).
- Nußholz. (2017). Circular Business Models: Defining a Concept and Framing an Emerging Research Field. *Sustainability*, 9(10).
- Oghazi, P., & Mostaghel, R. (2018). Circular Business Model Challenges and Lessons Learned—An Industrial Perspective. *Sustainability*, 10(3).
- Osterwalder, P. a. (2010). *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. Wiley.
- Pieroni, M. P. P., McAloone, T. C., & Pigosso, D. C. A. (2020). From theory to practice: systematising and testing business model archetypes for circular economy. *Resources, Conservation and Recycling*, 162.
- Planing, P. (2015). Business Model Innovation in a Circular: Economy Reasons for Non-Acceptance of Circular Business Models. *JOURNAL OF BUSINESS MODEL INNOVATION*.
- Pollard, J., Osmani, M., Cole, C., Grubnic, S., & Colwill, J. (2021). A circular economy business model innovation process for the electrical and electronic equipment sector. *Journal of Cleaner Production*, 305.
- Richardson, J. (2008). The business model: an integrative framework for strategy execution. *Strategic Change*, 17(5-6), 133-144.
- Rosa, P., Sassanelli, C., & Terzi, S. (2019). Towards Circular Business Models: A systematic literature review on classification frameworks and archetypes. *Journal of Cleaner Production*, 236.
- Salvador, R., Barros, M. V., Luz, L. M. d., Piekarski, C. M., & de Francisco, A. C. (2020). Circular business models: Current aspects that influence implementation and unaddressed subjects. *Journal of Cleaner Production*, 250.
- Van Renswoude, Arthur ten Wolde, & Joustra, D. J. (2015). Circular Business Models – Part 1: An introduction to IMSA's circular business model scan.
- Vermunt, D. A., Negro, S. O., Verweij, P. A., Kuppens, D. V., & Hekkert, M. P. (2019). Exploring barriers to implementing different circular business models. *Journal of Cleaner Production*, 222, 891-902.
- Whalen, C. J., & Whalen, K. A. (2020). Circular Economy Business Models: A Critical Examination. *Journal of Economic Issues*, 54(3), 628-643.