Circular business models: a typology based on actor type, circular strategy and service degree

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Circular Business Models: A Typology Based on Actor Type, Circular Strategy and Service Degree

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Abstract: The circular economy has become a dominant perspective for better integrating firms' value creation activities with sustainable development. In contrast to the linear take-make-waste approach, it is based on closed product, component, and material flows with the aim to maximise material productivity and resource efficiency at the level of the production and consumption system, while reducing waste. Existing business models often hinder organisations to become an integral part of circular value creation. In this paper, we present a new take on circular business models which puts a) an actor's position in the value cycle, b) the actor's dominant circular strategy, and c) the service degree with which circular solutions are provided to the market at the core of business model design. We propose a typology with 22 actor-specific circular business model patterns, each customisable according to three service degrees: product-oriented, use-oriented, and result-oriented product-service system offerings (together leading to 42 business model sub patterns). Each pattern is described in detail regarding how different service degrees enable circular strategies, the role of circular product design, potential partnerships along the value cycle, and practical experiences from case examples. These patterns can be freely combined by organisations to form a custom circular business model.

Introduction

The circular economy (CE) has become a major paradigm for advancing sustainable development. It is meant to overcome the destructive "take-make-waste" value creation paradigm which has developed and strived in the past decades by advancing the restorative use of products, components, and materials in the highest possible qualities over multiple cycles (Morseletto, 2020).

From a product perspective, the CE represents an extension of life cycle-oriented innovation in which products are designed, managed, and evaluated along the entire value chain from resource provisioning to recovery (Hansen, Große-Dunker, & Reichwald, 2009; Ny, 2006). Product circularity is rooted in 4R frameworks (Kirchherr, Reike, & Hekkert, 2017) and can be grouped into slowing (e.g. repair, reuse, remanufacture) and closing (i.e. recycling) strategies (Bocken et al., 2016). It aims at lifetime extension on product, component, and material level, and is facilitated through new product designs (Hopkinson et al., 2018). The result is a self-replenishing system in which losses (i.e. waste) and virgin resource inputs (including energy) are minimized.

To advance the CE, a *systems* innovation approach to sustainability is required (Adams et al., 2012), in which environmental benefits are achieved by interconnecting producers, service providers, users, and recovery organisations (and related infrastructures) through repeated cycles of restoration.

The Ellen MacArthur Foundation (EMF) sees three levers to advance the CE: managing reverse cycles, product design, and business model innovation (EMF, 2013). While all three levers are important and interlinked, we focus on the business model as it is crucial for the commercial introduction of new market offerings. Many typologies have been conceptualised for circular business models (e.g. Lüdeke-Freund et al. 2019), but while they often elaborate different circular strategies and service degrees (Urbinati, Chiaroni, & Chiesa, 2017), they largely remain blind to the different positions of the actor in the value cycle (e.g. material supplier vs. producer). Against this background, our research aim is to develop a

circular business model (CBM) typology which better differentiates business model options across actor positions.

Circular Business Model Literature from the Perspectives of Actors, Circular Strategy, and Service Degree

The business model has become of major interest in sustainability (Schaltegger et al. 2016) and CE research and practice (Bocken et al., 2016; Fraccascia et al., 2019; Guldmann, Bocken, & Brezet, 2019; Hansen et al. 2021). Key to advance circular business models (CBMs) in organisations is to grasp their diversity and complexity. This is facilitated by classifications (e.g., typologies, taxonomies) of generic CBMs (e.g. Kortmann & Piller, 2016; Lüdeke-Freund et al., 2019). What these classifications have in common is that circular strategy (i.e. from recycling to maintenance) and service level (i.e. from product-oriented to result-oriented product-service systems) are key dimensions of CBM designs. What is less explored in research, is how CBMs differ according to the position of the focal actor in the value cycle (Zufall et al., 2020). In the following, we review CBM literature from the perspective of actors in the value cycle, circular strategy, and service level (respectively product-service system type).

A: Actor's Perspective

The actor perspective, though less often tackled in the literature, is crucial to identify suitable CBMs and to understand the actor's specific characteristics as well as the respective enablers and barriers. A key difference often made is whether CBMs are applied in business-to-business (B2B) or business-to-consumer (B2C) settings. So far, B2B settings are more pronounced in the literature and studied in more detail. If the goal is to diffuse CE practices more widely, it is required to advance CBMs in B2C settings as well.

- Beyond distinguishing between B2B and B2C, the adoption of CBMs leads to new roles in the value cycle (Hansen & Revellio, 2020;). For example (Zufall et al., 2020), *a "circular resource company"* may expand its value cycle coverage from mere (non-renewable) virgin resource extraction to resource recovery and related recycling practices.
- *Circular manufacturers*, based on vertical integration, extend from mere transactional sales of products to distribution, use-related services, or end-of-life services.
- *Usage-extending or sufficiency-advocating retailers* may extend from mere retailing to services during use (e.g., repair) and take-back.
- New *third-party refurbishing and recovery service providers* (often gap exploiter; Bakker et al. 2014) collect used devices and, if possible, repurpose and remarket products or, otherwise, forward them to recycling.

We consider the following actors based on their main or dominant role in the value cycle (we speak of roles, because next to the dominant role of an actor, the actor may take additional roles, which then results in fewer actors still covering the entire value cycle):

- *Suppliers (raw materials):* Actors providing raw materials and other substances needed for production processes.
- *Suppliers (machines and equipment):* Actors producing components and machines needed by producers.
- *Producers (OEM):* Actors producing proprietary materials, components, and products.
- *Retailers (and wholesale):* Actors selling products.
- *Repair providers:* Actors offering repair services.
- *Prosumers:* Non-market actors organising DIY and other informal activities.
- *Logistics providers:* Actors providing logistics services and spare parts management.
- *Recovery managers:* Actors recovering, managing, and sorting materials.
- *Intermediaries:* Actors operating platforms for coordinating recycling, used products, or sharing activities.
- *Emerging actors:* This umbrella category contains further actors and actor roles in support of the key actors' business models (e.g. financial service providers) and leaves room for entirely new type of actors yet to be identified.

In principle, all existing actors can extend their businesses towards other stages of the value cycle. Also, new actors can enter the value cycle at any stage. Overall, this leads to a significant dynamic of the actor setting, their positions in the value cycle, and the roles they play. In consequence, in addition to the original,

usually still dominant role a given actor plays in the value circle, additional roles to address circularity may be taken. This can be done either with own resources through vertical integration ("Make"), by partnering with others ("Ally"), or through rather short-term contractual relationships via the market ("Buy"). Changing the positions in the value chain has traditionally been a major competitive force (Porter, 1980). If focal actors refrain from offering any voluntary circular business in the market, they take a "Laissez-faire" approach and leave more room for new entrants (Hansen & Revellio, 2020).
While individual actors are important, circular solutions usually cannot be successfully implemented by a firm alone, even when high degrees of vertical integration are pursued. Still, the traditional business model concept represent the "focal firm's plan" for creating, delivering and capturing value (Adner, 2016). Hence, the focus is on the focal firm, not on the actor constellation participating in the activities (Adner, 2016). We therefore support the call for adopting a circular ecosystem perspective (Konietzko, Bocken, & Hultink, 2020; Takacs, Stechow, & Frankenberger, 2020) which equally considers partners' business models (Adner, 2016, p. 51). According to *Takacs et al. (2020, p.3),* a circular ecosystem

> *"coordinates itself across the business models of different complementors to create sustainable value propositions with closed resource loops that are based on an aligned product design. Based on this, the CE can be seen as the interplay of complementing business models along a circular ecosystem."*

Different actors in the value cycle can pursue the role of an ecosystem orchestrator with remaining actors serving as potential partners (Hansen & Schmitt, 2020; Konietzko et al. 2020). Hence, CBMs by different actors in the value cycle usually have to be aligned.

B: Circular Strategy Perspective

Circular strategies are at the core of CBM development (Lüdeke-Freund et al., 2019). They describe how actors are approaching the concept of circularity through their value creation activities. These activities are in turn derived from different types of cycles. The renown 'butterfly framework' developed by the Ellen MacArthur Foundation (EMF, 2013), for example, distinguishes different cycles according to the separation of technical and biological spheres of the industrial metabolism (this way of defining cycles and corresponding circular strategies has its origins in the original works by Braungart & McDonough 2009, Stahel 2006/2010 and others):

- *Technical cycling:* Includes maintaining, repairing, reusing, remanufacturing (or refurbishing, as a lighter version), and recycling.
- *Biological cycling:* Refers to organic feedstock (i.e. renewable inputs) as a basis to develop biodegradable or compostable products.

Technical cycles are at the core of the CE (because biobased materials/products should optimally also be technically cycled before being biodegraded) and are therefore focused in the present paper. Moreover, we apply an ambitious understanding of technical cycles as closed-loop systems (Braungart, McDonough, & Bollinger, 2007, p. 1343):

> *"A technical nutrient […] may be defined as a material … that has the potential to remain safely in a closed-loop system of manufacture, recovery, and reuse …, maintaining its highest value through many product life cycles"*

Moving from open to closed-loop systems has considerable environmental benefits (Dubreuil et al., 2010; Haupt, Vadenbo, & Hellweg, 2017). This applies not only to open vs. closed-loop *recycling*, but to *all* circular strategies (Hansen & Revellio, 2020). Moreover, closed technical loops also provide strong incentives for individual organisations to fully embrace the CE, because they demand considerable changes to *their own* (circular) value creation activities (e.g., use of secondary next to primary materials, remanufacturing next to primary production, reused next to new goods sales). And because products, components, and materials then ultimately return to the own organisation, it becomes necessary to introduce more circular and higher quality materials, components, and products into the market in the first place. It is particularly these closed-loop changes which demand a more radical business model innovation perspective as applied here.
Based on this understanding of closed technical cycles, we consider the following circular strategies relevant for guiding the development

of CBMs (Lüdeke-Freund et al., 2019; Morseletto, 2020):

- *Repair, maintain, and upgrade*[1]
- *Reuse*
- *Remanufacture*
- *Recycling*

In line with the established waste hierarchy and Stahel's inertia principle, these loops are ordered with environmental and economic benefits principally decreasing from repair to recycling (Stahel, 2010; Kirchherr et al., 2017; EMF, 2012).

According to the resources states framework by Blomsma & Tennant (2020) The way how circular strategies can be applied also depends on the state of the resources in question. Whether these resources occur as particles, parts, or products has an influence on the circular strategy and, as a consequence, on the CBM. For instance, chemical leasing (UNIDO 2020) is a CBM on the level of the molecule, while car rental is on the product level. Usually, organisations have to choose a core circular strategy and complement it with supporting strategies, which together represent a circular strategy configuration (Blomsma & Tennant, 2020) or loop configuration (Hansen & Revellio, 2020).

C: Product-Service System Perspective

Several CBM designs propose to put product-service systems (PSS) at the core of the business model (Alcayaga et al., 2019; Urbinati, et al., 2017; Yang et al., 2018). Urbinati et al. (2017) propose that regarding downstream side of the offering, customer value proposition and interface is strongly influenced by product-service system considerations. Stahel has also emphasised a servitisation approach based on the levels of molecules, materials, and goods (Stahel 2019, p.67). In their seminal paper, Braungart et al. (2007) highlight "material pooling" and "material banks" as new material-oriented business model.

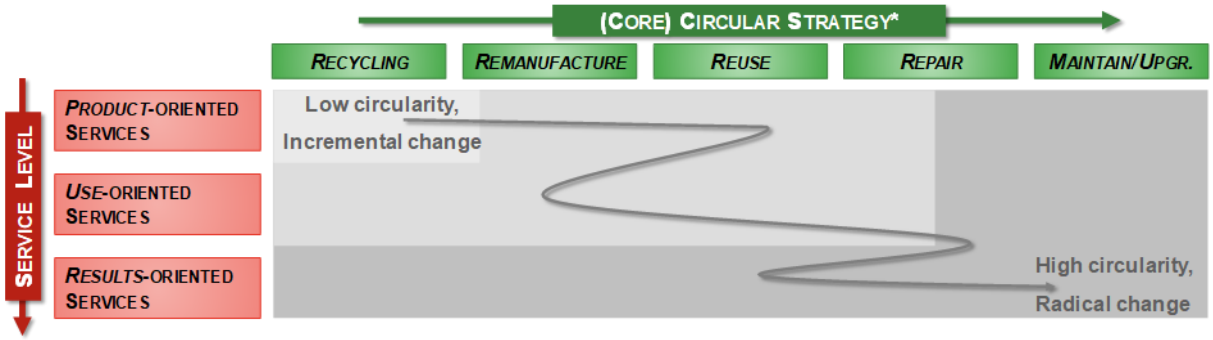
Product-service systems has been used to promote sustainability for several decades (Tukker, 2004) and has recently also been reframed as business model types for the CE (Tukker, 2015). The scope of PSS can probably be best understood by using Tukker's (2004) continuum of eight types of PSS, classifying them into three main categories of product, use, and results-oriented PSS. Result-oriented PSS are seen as those with greatest potential for the CE, but also require the most radical change of the business model (Tukker, 2015).

Combining the aforementioned circular strategies and the three main types of PSS allows constructing a maturity matrix (Figure 1) that can be used to estimate the maturity of CBMs. It is assumed that the circular potentials of a CBM increase both with more ambitious (core) circular strategies and more ambitious service levels.

An Actor-Centric Circular Business Model Typology

A Pattern Approach

The identified patterns in the typology are generalised and ordered to create a systematic classification. 'Patterns' are commonly used to generalise and order the various business models that are available. Some of these classifications (e.g., Abdelkafi, Makhotin, & Posselt, 2013; Remane et al., 2017) follow



Notes: *Higher-level strategies include the possibility to pursue lower-level strategies simultaneously, increasing the synergistic potential for circularity

Figure 1. CBM Maturity Grid Consisting of the Choice of a Core Circular Strategy and the PSS Level. (Source : Hansen et al. 2020, p.12)

[1] It should be borne in mind that maintenance, repair, and upgrading strategies are not always fully distinct in practice. The typology presented here may therefore combine them where appropriate.

Alexander's (1977) understanding of the notion of pattern:

> *"Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice."*

The advantage of following a pattern approach lies in the fact that is allows identifying and generalising domain-specific business models, in our case circular business models, and that these can serve as a source of inspiration for various types of organisation, across industries and geographical contexts. CBM developers can use these patterns to come up with their own interpretations and solutions adapted to their specific cases and contexts.

Typology

By combining actor's main role (A) and circular strategies (B), Table 1 provides an overview of the 22 main CBMs (plus the emerging actor class). These patterns are not exhaustive. We focus on those patterns which:

- Indeed, require business model changes
- and go sufficiently beyond compliance and other mainstream practices.

Adding different service levels (C) to these patterns allows distinguishing three subpatterns each. Each (sub)pattern can be further characterised, which, however, goes beyond the scope of this paper (see Fig. 2 in the Annex).

These patterns are in most cases not entire business models. Therefore, they should be combined (e.g., the producer's 'maintenance' business model can and should be combined

Actor's Main Role	Circular Strategy	Id	Business Model Pattern	Sub Pattern: Service Level		
				Product-oriented	Use-oriented	Result-oriented
Supplier (Molecules/Materials)	Recycle	A1	Circular Rawmaterial Supplier	Molecule & Material Recycling	Material Bank	-
	Maintain	A2	Process Molecule Service Provider	-	Molecule & Material Leasing	Molecule & Material Performance
Supplier (Machine building)	Reman	B1	Machine/Component "As New"	Machines/Components "as New"	Rental Machines/Components "as New"	Pay per Reman Machine-Performance
	Reuse	B2	Machine/Component Remarketing	Used Machines/Components Sales	Rental Machines/Components	*--> see B1 Pay per Reman Machine-Performance*
Producer	Recycle	C1	Proprietary Material Cycles	Waste Cherry Picking	Material Bank Partnership	-
	Reman	C2	Product "As New"	Selling Products "as New"	Product Leasing "as New"	*--> see C6 Total Care Producer*
	Reuse	C3	Used Product Remarketing	Used Product Sale	-	-
	Repair	C4	Out-of-Warranty Repair Service	On-Demand Repair	*--> see C6 "Leasing OEM"*	*--> see C6 Total Care Producer*
	Repair & Upgrade	C5	Upgrades, Spares & Accessories	Modules & Accessories Shop	Upgrade Subscription	-
	Maintain	C6	Maximising Product Uptime	Fee-based Maintenance	Leasing Producer	Total Care Producer
Retailer & Service Points	Recycling	D1	Retailer as Cycle Manager	Retailer as Cycle Manager	*--> see C1 Material Bank Partnership*	-
	Reuse	D2	Retail Remarketing & Reman	Used Goods on Sale	Rent-a-Wreck Fleet Manager	-
	Maintain & Repair	D3	One-Stop Shop (Retail)	Integrated Service Point	Rental Retail	Total Care Retail
Repair Provider	Repair	E1	Repair Gap Exploiter	Repair Transaction	Repair-based Rental	-
Prosumer	Maintain & Repair	F1	Prosumer Support System	Do-it-Yourself Repair	Peer-to-Peer Sharing	-
Logistics Provider	Recycle	G1	Material Reverse Logistics	-	-	Pay per Recycling Logistics Performance
	Reuse & Reman	G2	Refurb Logistics Services	-	-	Pay per Refurb Performance
	Repair	G3	Spare Part Management	-	-	Pay per Spare Part Performance
Recovery Manager	Reuse	H1	Revitalised Products	Used Goods Bargain	-	-
	Recycle	H2	Coordinator of Informal Collection	Fair-trade Recyclate	-	-
Intermediary	Recycle	I1	Recycling Platform	Recycling Platform	-	-
	Reuse	I2	Used Goods & Sharing Platform	Used Good Platform	Sharing Platform	-
Emerging Actors	*All*	*J1..x*	*?*	*?*	*?*	*?*

Table 1. An Actor-Centric Circular Business Model Typology (Source: Hansen et al. 2020, p.13)

with all other producer business models). The synergetic use of several patterns (and related circular strategies) will advance circularity more holistically and increase positive environmental impact.

Discussion

In this paper, we put forward a circular business model typology which goes beyond existing works by conceptualizing more detailed and practically grounded business model patterns based on the combination of three independent dimensions: actors in the value circle, circular strategy, and product-service system type. With these more detailed proposals for business model patterns, we aim at giving more practical guidance to practitioners aiming at redesigning their value chains and business models towards circularity. We also highlighted the role of partnerships to successfully implement CBMs and, relatedly, the orchestration of the various partners' business models within a circular ecosystem.

Our work is not without limitations: we focused on technical cycles based on the assumption that, independent of technical or biological nutrients, they should be (technically) cycled in the industrial system in order to unearth resource-efficiency potentials in the overall system. This does not mean that biological cycling is unimportant for the CE – much the contrary is true (e.g. biodegradability characteristics to address plastic littering) – but we see more relevance for business model change in the domain of technical cycling. Also, while we partly address bottom-up "do-it-yourself" circularity, the typology is more strongly inclined towards the industrial circular economy (Stahel, 2019, p. 7).

Future research should further elaborate the business model patterns, explore the role of partnerships in the related ecosystems, validate them with real companies, explore the dynamics when they are adopted within the context of firms' innovation processes, and analyse the economic, environmental, and societal impacts of their adoption. From a practical viewpoint, it could be worthwhile to further develop the typology into an innovation toolkit to serve innovation managers and facilitators.

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Annex

Each individual business model pattern can be structured along a) the actor's perspective, b) circular strategies and related product design enablers, c) three sub-patterns based on the service level and the related circular potentials, d) potential partnerships with other actors, e) barriers, f) social impacts, and g) industry case studies.

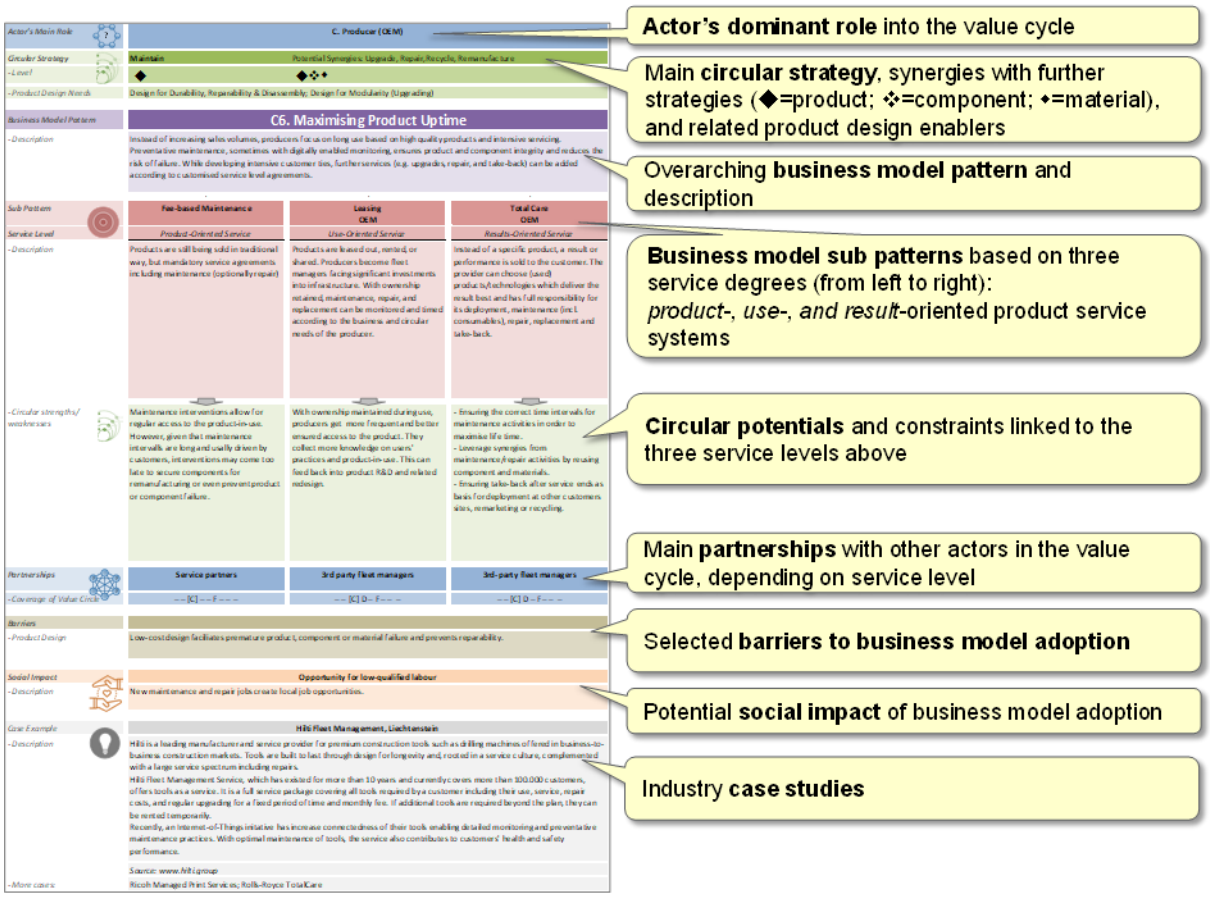

Figure 2. Individual business model pattern in detail (Source: Hansen et al. 2020, p.14).