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CIRCULAR BUSINESS MODEL TYPOLOGY:

Actor, Circular Strategy, and Service Level

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EXECUTIVE SUMMARY

The circular economy has become the 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 resource efficiency of the entire production and consumption system. 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.

Keywords: Business models, circular economy, circular strategies, value chain, value creation architectures, actor perspective, product-service systems, sustainability innovation, servitisation

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1 INTRODUCTION

The circular economy (CE) has become the major new paradigm for advancing sustainable development. It is meant to overcome the destructive “take-make-waste” value creation paradigm which has developed and strived since the post-second-world-war era and to replace it with restorative and regenerative practices for reusing products, components, and materials in the highest possible qualities over multiple cycles.

While pioneers such as Ricoh and Interface and their successful transformations towards CE-based business practices have been studied for some time (e.g. Hopkinson et al., 2018; Luqmani, Leach, & Jesson, 2017), a larger diffusion in industry and society has lacked so far. It has been increasingly understood that more *significant* progress towards the CE, such as exemplified by the above pioneers, requires considerable, if not *radical* business model changes to adapt the way companies create value while they are striving towards more circular business practices (Hopkinson et al., 2018; Lüdeke-Freund, Gold, & Bocken, 2019). The business model has therefore become a key construct in studying transformations towards the CE (Fraccascia et al., 2019; Lüdeke-Freund et al., 2019) and sustainable development more broadly (Schaltegger, Hansen, & Lüdeke-Freund, 2016; Schaltegger, Lüdeke-Freund, & Hansen, 2012). It is the goal of the present paper to explore radical business model designs for the CE, this is, Circular Business Models (CBMs).

Key to advance CBMs in organisations is to grasp their diversity and complexity. This is facilitated by classifications of generic business models, for example as archetypes or patterns. What they 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 these business models’ configurations. Sometimes also the *position of the focal actor* in the value cycle is considered (Zufall et al., 2020). While existing business model classifications are manifold (Bocken et al., 2014), they are often not CE-specific or they remain on a rather abstract level, leaving actors with only general understanding on how to approach CBM adoption and diffusion. But to be practically relevant, for example for decision-makers in business and politics, a CBM classification must be actor-specific and consider the opportunities (and barriers) of CBM adoption in relation to certain value chain positions.

Against this background, the goal of the CBM typology presented in this paper is to present actor-specific options for advancing towards CBMs. At the core of the typology is the idea that the opportunities of developing promising CBMs differ depending on how ambitious certain actors choose their core circular strategy and service level.

2 CONCEPTUAL BACKGROUND

2.1 Circular Economy

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. maintain, repair, reuse, remanufacture) and closing (i.e. recycling) strategies. It aims at lifetime extension on product, component, and material level, and is facilitated through new product designs (Hopkinson et al., 2018). 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). While closing loops (i.e. recycling), whether as open or closed-loop recycling, is considered the weakest option, slowing strategies are not perfect either. They may also lead to rebound effects (Skerlos et al., 2003; Makov and Font Vivanco 2018).

2.2 Business Models as Enablers for the CE

The 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. The business model is crucial for the commercial introduction of innovations based on life-cycle improvements (Hansen et al., 2009). It has therefore become of major interest to CE research and practice (Bocken et al., 2016; Fraccascia et al., 2019; Guldmann, Bocken, & Brezet, 2019).

2.2.1 CBMs in Context

At the core of CBMs, as with business models in general, is the ability of organisations to create, capture, and transfer value (see Figure 1). While circular strategies such as recycling, remanufacturing, reuse and repair – as well as related 'design-for-x' practices – influence how organisations create value in a CE, service level considerations such as transactional sales vs. products-as-a-service give shape to the modes of capturing value for the organisation and transferring value to customers and further stakeholders (Centobelli et al., 2020). In this regard, digital technologies are important to facilitate cross-cutting managerial practices: They can enable *smart* circular strategies such as smart repair, reuse, and remanufacturing (Alcayaga, Wiener, & Hansen, 2019) and also contribute to servitisation (e.g. Stahel, 2019). Moreover, the ability of organisations to create, capture, and transfer value based on CBMs requires changes in the policy and broader institutional contexts (Centobelli et al., 2020).

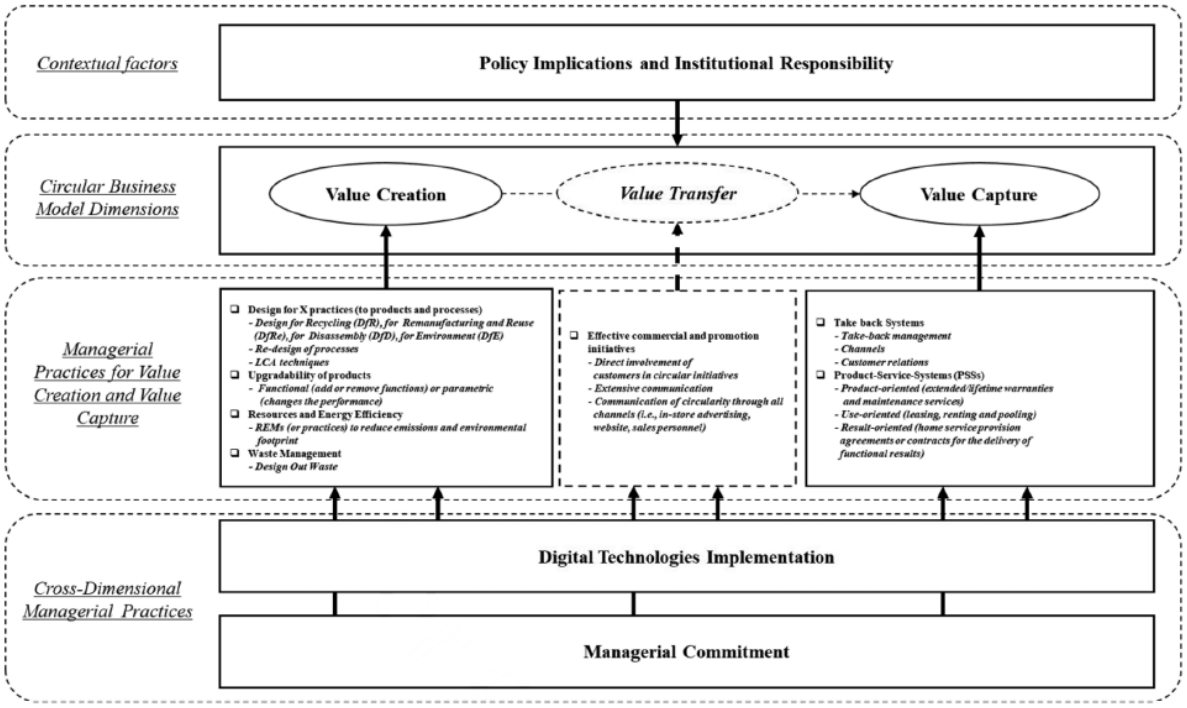


Figure 1: Circular business models: dimensions, managerial practices, digital enablers, and policy context

Source: Centobelli et al., 2020

2.2.2 CBM Classifications

Key to advance 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. Sometimes, also the position of the focal actor in the value cycle is considered (Zufall et al., 2020).

In a typology consisting of nine archetypes, Kortmann & Piller (2016) use the openness of business models and their integration along the product life cycle to distinguish different types of ‘maker economy,’ ‘sharing economy,’ and ‘circular economy’ business models. This typology considers three generic types of CBMs (circulation platform, recycling alliance, and rebound manufacturer). A categorisation framework to distinguish linear business models from three types of CBMs (upstream, downstream, and full circular) is proposed by Urbinati, Chiaroni, & Chiesa (2017). Several more, and more fine-grained, classifications are available. Lüdeke-Freund et al. (2019) analysed 12 of these and identified 26 business models with the potential to support closed-loop supply chains. These were analysed to distil

six generic CBM designs. The typology presented below partly makes use of these authors' classification.

3 COMPONENTS OF THE CIRCULAR BUSINESS MODEL TYPOLOGY

The CBM typology introduced in the following builds on three main components: actors, circular strategy, and service level (respectively product-service system type). Combining actors and circular strategies leads to the identification of 22 main CBM patterns. Adding different service levels to these patterns allows distinguishing different degrees of 'CBM maturity.' The typology, i.e. each of the 22 main CBMs and their different maturity levels, will be described in detail in chapter 4. Before, the typology elements *actor, circular strategy,* and *product-service system (PSS) type* are introduced and defined.

3.1 Key Components: Actors, Circular Strategies, and Product-Service System Types

3.1.1 Actor's Perspective

The actor perspective, though less often tackled in the literature, is crucial to identify relevant CBMs and to understand their specific characteristics as well as their 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, because:

a) Circular strategies such as maintenance or repair are in the 'DNA' of business actors; hence, close relationships between sellers and business customers along the entire product-life cycle are rather the norm.
b) The incentives to engage in higher service levels, such as performance-based pay, are often somewhat compatible with the desire of business customers to decrease the total cost of ownership over the entire timespan of using a good.
c) Sales practices used to approach business customers offer more room for communicating complex offerings such as more advanced product-service systems.

If the goal is to diffuse CE practices more widely, it is required to advance CBMs in B2C settings as well. But this is often hampered by consumer preferences. In particular, advancing to higher service levels often fails due to consumers' resistance to partially give away control over products to PSS providers (Tukker, 2015).

Beyond distinguishing between B2B and B2C, the adoption of CBMs leads to new roles in the value cycle (Hansen & Revellio, in Print; Zufall et al., 2020); for example:

- 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* collect used devices and, if possible, repurpose and remarket products or, otherwise, forward them to recycling.

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, in Print).

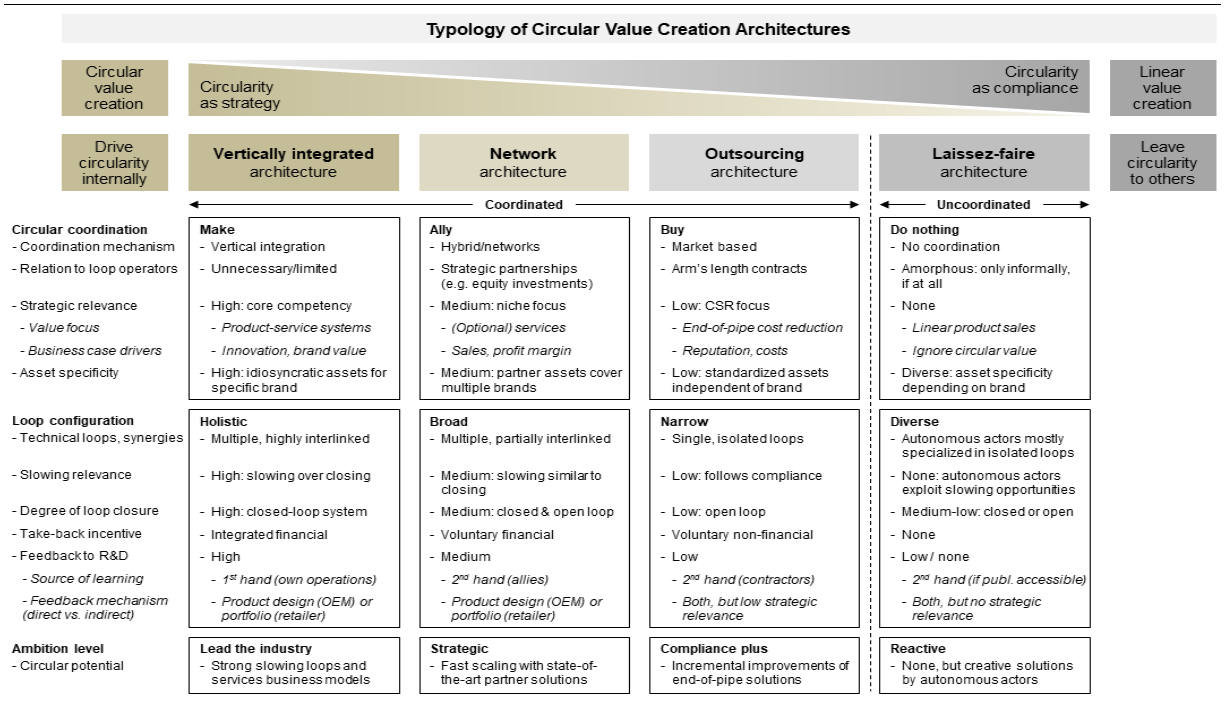


Figure 2 Make, Ally, Buy, and Laissez-Faire in Circular Value Creation Architectures

Source: Hansen & Revellio (in Print)

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). An ecosystem can be defined as *„the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize.“* (Adner, 2016, p. 42). Against this background, 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." (Takacs et al., 2020, p. 3)

Different actors in the value cycle can pursue the role of an ecosystem orchestrator with remaining actors serving as potential partners.

For the proposed CBM typology, 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 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.

3.1.2 Circular Strategies

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 Mac Arthur 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 of it), and recycling.
- *Biological cycling:* Refers to organic feedstock (i.e. renewable inputs) as a basis to develop biodegradable or compostable products.

Biological cycling is important because it presents new opportunities to replace fossil-based resources with renewable ones and potentially adds product characteristics such as biodegradability. However, from a resource efficiency perspective, replacing fossil with (renewable) biogenic feedstock resources alone is usually not enough and is subject to other sustainability challenges (e.g., impacts of industrialised agriculture, loss of biodiversity, direct and indirect land use changes). Hence, products based on renewable feedstock should also be subject to technical cycling before they are biodegraded or treated otherwise in the biological cycle. Against this background, independent of the resource origin, technical cycles are at the core of the CE and are therefore focused in the present paper. Moreover, we apply an ambitious understanding of technical cycles as closed-loop systems:

> "A technical nutrient, on the other hand, 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" (Braungart, McDonough, & Bollinger, 2007, p. 1343)

Moving from open to closed-loop systems has considerable environmental benefits (Dubreuil et al., 2010; Hansen & Revellio, in Print; Haupt, Vadenbo, & Hellweg, 2017). 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. In contrast, open loop circularity can be distributed across the value chain or economic setting, this is, while one organisation remains in the 'linear' economy producing waste as usual, another organisation specialises in reutilisation of that waste for other purposes (e.g. wool used in clothing is repurposed as insolation material in buildings), also creating new dependencies on waste. It is particularly these closed-loop changes which demand a more radical business model innovation perspective as applied here. This focus on closed-loop business models also explains why we do not explicitly consider cascading and repurposing as additional, stand-alone circular strategies here (still, we do not exclude

for open loops in the recycling strategy, which, in effect, can then also cover material cascading).

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, maintenance, and upgrade:* Offering prolonged usability and functionality of products through maintenance, repair, and/or control services, which reduce the need to buy and switch to new products. Optionally, products are upgraded with new features or advanced performance.
- *Reuse & redistribution:* This strategy requires that used products flow (back) to service providers, either directly or via an intermediary. The used products are then directly (re-)sold, perhaps in slightly enhanced form through cleaning and repairing small defects.[1]
- *Refurbishment & remanufacturing:* As part of the value creation process, used products or components flow (back) to an OEM or third party service provider, who repairs or replaces product components, including cosmetic updates (refurbishing). With remanufacturing, products are completely disassembled and reassembled with all parts and the resulting product being restored to quality equal to or better than the original product (i.e. quality “as new”).
- *Recycling:* Recycling requires particular knowledge in fields such as material sciences and the ability to deal with the physical and chemical properties of a large variety of composite materials. This knowledge is needed to allow for value creation processes involving down- and upcycling and taking back and winning back components and base materials.

These generic strategies focus on the value-creating activities from a company’s perspective, but do not consider the different states that resources can take (e.g., basic elements, manufactured components, final products). The resources states framework by Blomsma & Tennant (2020) offers a more fine-grained perspective that not only distinguishes different types of cycles, which can be related to those mentioned above, but also the different states in which resources occur. The way how circular strategies can be applied also depends on the state of the resources in question. Whether these occur as particles, parts, or products has an influence on the circular strategy and, as a consequence, on the CBM.

[1] When referring to circular strategies such as repair and maintenance it should be mentioned that this is not about compliance-based services, such as those based on product warranties. This is rather about voluntary, proactive strategies such as out-of-warranty repairs (Hansen & Revellio, in print).

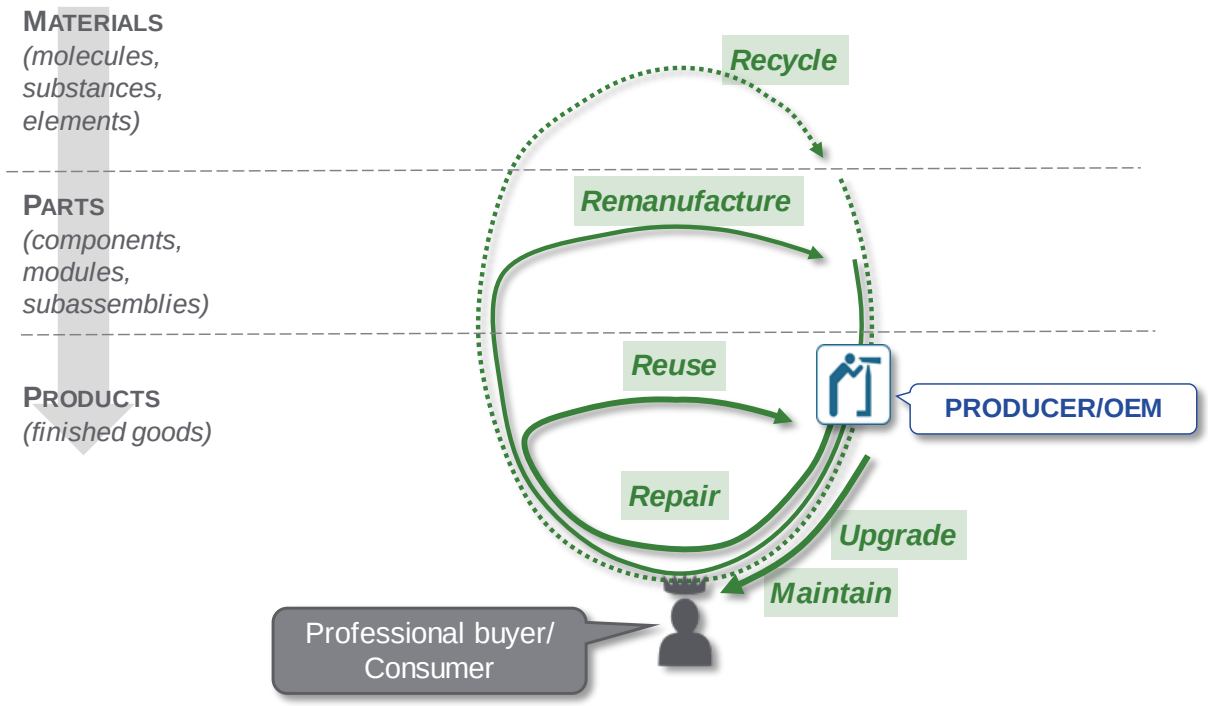


Figure 3 Main Circular Strategies and their relation to resource states (example of producers)

Source: based on Resource States Framework by Blomsma & Tennant (2020)

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, in Print). The choice between different core circular strategies is important, because in general their potential environmental impacts will differ (see the concept of CBM maturity below).

Based on the identified circular strategies and further considerations of related approaches, the following core circular strategies are included in the proposed typology:

- *Maintain and upgrade*[2]
- *Repair*
- *Reuse*
- *Remanufacture*
- *Recycling*

3.1.3 Product-Service System Type

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). Stahel – one

[2] Please consider that maintenance, repair, and upgrading strategies are not always fully distinct in practice. The typology presented in chapter 4 may therefore combine them where appropriate.

of the seminal authors and promotors of the CE in Europe – has also emphasised a servitisation approach based on the levels of molecules, materials, and goods (Figure 4).

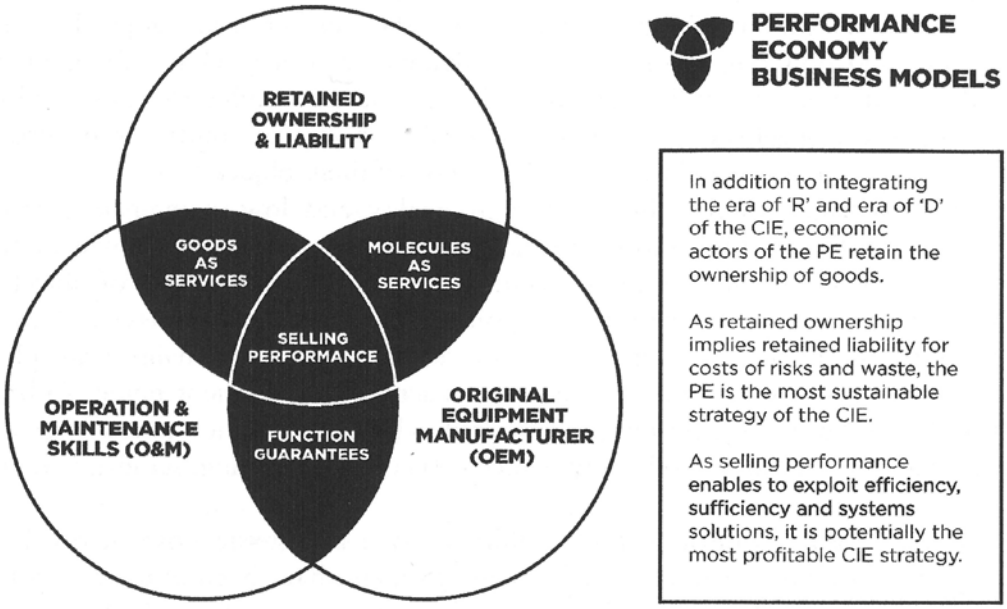


Figure 4 Circular Business Models from a Servitisation Perspective

Source: Stahel (2019, p. 67)

Product-service systems has been used to promote sustainable development for several decades (Tukker, 2004) and has recently also been reframed as business model types for the CE (Tukker, 2015; Tukker, 2015, p. 76):

> "In *product-oriented* business models firms have the incentive to maximize the number of products sold. This is their principal method of boosting turnover, increasing market share, and generating profits. However in *service-oriented* business models, in theory the incentive differs. Firms then make money by being paid for the service offered, and the material products and consumables that play a role in providing the service become cost factors. Hence, firms will have an incentive to prolong the service life of products, to ensure they are used as intensively as possible, to make them as cost- and material-efficiently as possible, and to re-use parts as far as possible after the end of the product's life. All of these elements could lead to a minimization of material flows in the economy while maximizing service output or user satisfaction."

The scope of PSS can probably be best understood by using Tukker's continuum of eight types of PSS.

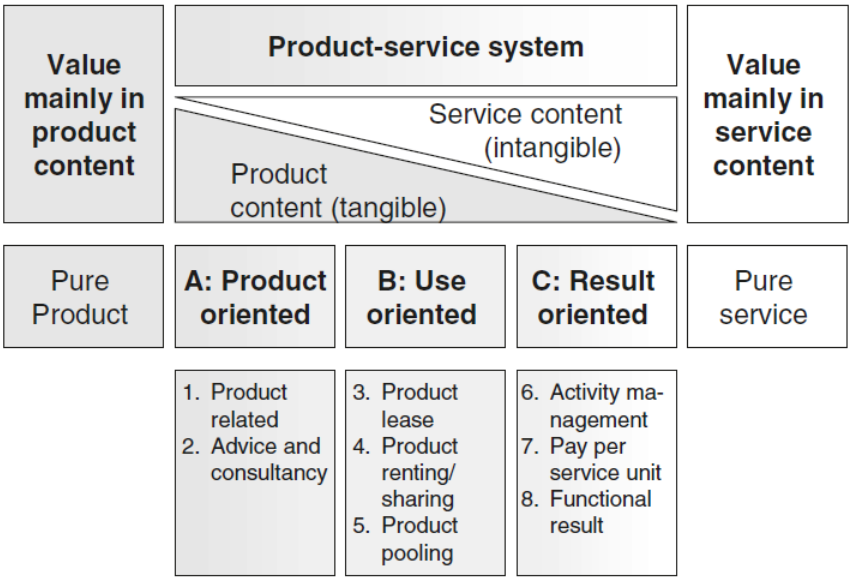


Figure 5 Eight Types of Product-Service Systems

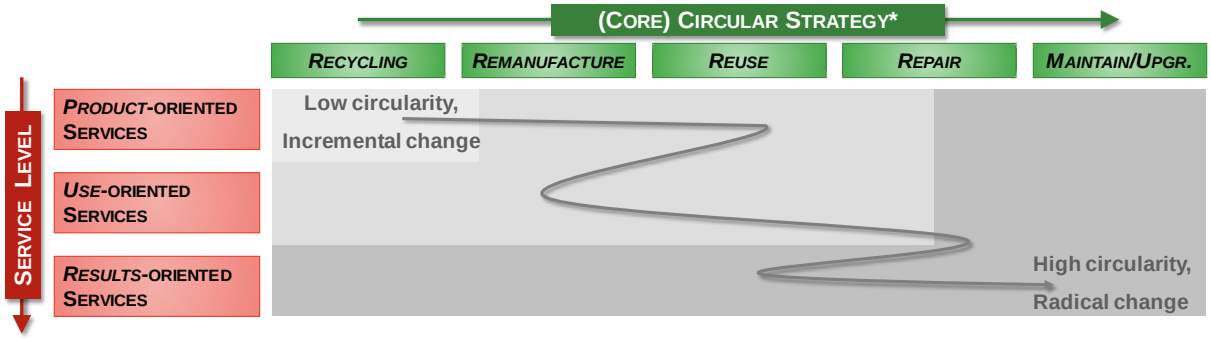
Source: Tukker (2004, p. 248)

Result-oriented PSS are seen as those with greatest potential for the CE, but also require the most radical change of the business model, therefore, to date, lack diffusion (Tukker, 2015). As a side note: The type of PSS business model will most likely determine whether and how organisations can capitalise on digital enablers – the more servitised the business model, the more connections and data exchange between producers, consumers, and their products will be possible (Alcayaga et al., 2019).

3.2 Introducing the CBM Maturity Grid

Combining the aforementioned circular strategies and the three main types of PSS allows constructing a maturity matrix 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 (Figure 6).

It should be mentioned that applying PSS is not a panacea, neither for environmental impact more broadly, nor for circularity in particular (Tukker, 2004). Both rather depend on how exactly the PSS approach is intertwined with circular strategies. As a negative example, a *financial* leasing approach – i.e. a use-oriented PSS – is often employed by companies for the reasons of tax benefits, but is hardly used to leverage the circular potential from the take-back of leased goods and their reuse in the form of products-as-is or incorporated components and materials.



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

Figure 6 CBM Maturity Grid Consisting of the Choice of a Core Circular Strategy and the PSS Level

3.3 Business Model Patterns

Finally, the identified CBMs must be 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 Alexander's 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." (Alexander et al., 1977)

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.

It is important to consider that a CBM pattern is not necessarily a complete business model. Most CBM patterns refer to certain aspects of a business model (e.g., its value creation logic, or a certain approach to transferring value). One can say that they are partial business models. Therefore, it is important to consider combinations of different patterns, which leads to a huge variety of CBM designs that can be derived from the proposed typology.

4 CIRCULAR BUSINESS MODEL TYPOLOGY – THE PATTERNS

4.1 Overview of Business Model Patterns

The following table provides an overview of the 22 main CBMs plus the emerging actor class with CBMs yet to be defined. These are ordered according to actor (first column), circular strategy (second column), and resulting pattern (third column). The different product-service types per pattern lead to a more fine-grained view on sub-patterns. Each of which represents a different CBM maturity.

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)	Remanufacturing	B1	Machines/Components "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 (OEM)	Recycle	C1	Proprietary Material Cycles	Waste Cherry Picking	Material Bank Partnership	-
	Remanufacture	C2	Products "As New"	Selling Products "as New"	Product Leasing "as New"	*--> see C6 Total Care OEM*
	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 OEM*
	Repair & Upgrade	C5	Upgrades, Spares & Accessories	Modules & Acessories Shop	Upgrade Subscription	-
	Maintain	C6	Maximising Product Uptime	Fee-based Maintenance	Leasing OEM	Total Care OEM
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 Sales	Rent-a-Wreck Fleet Manager	-
	Maintenance & Repair	D3	One-Stop Shop (Retail)	Integrated Service Point	Total Care Rental	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 & Repair	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 Good Bargain	-	-
	Recycle	H2	Coordinator of Informal Collection	Fair-trade Recyclate	-	-
Intermediary	Recycle	I1	Recycling Platform	Recycling Platform	-	-
	Reuse	I2	Used Goods & Sharing Platform	Used Goods & Sharing Platform	Sharing Platform	-
Emerging Actors	*All*	*J1..x*	*?*	*?*	*?*	*?*

Table 1 Circular Business Model Patterns: Overview

The patterns presented in the above table are not exhaustive. We focus on those patterns which:

- indeed require business model changes (e.g., in-plant recycling may contribute to circularity, but is rather an internal production-related improvement practice which doesn't touch upon the business model) and

- go sufficiently beyond compliance (e.g., warranty-based repair) and other mainstream practices (e.g., conventional maintenance practices in the B2B environment).

As described in in section 3.3, these patterns are in most cases not entire business models, but rather partial CBMs. Therefore, they should not be considered in isolation but can be combined (e.g., the producer's 'maintenance' business model can and should be combined 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. Last but not least, patterns, while analytical distinct, may empirically overlap (as is the case in most classification schemes).

4.2 Business Model Patterns

In the following section, each business model pattern will be presented in a structured way including a) the actor's perspective, b) circular strategies and related product design enablers, c) an introduction to the main pattern, d) three sub-patterns based on the service level and the related circular potentials, e) potential partnerships with other actors, f) barriers, g) social impacts, and h) industry case studies (Figure 7).

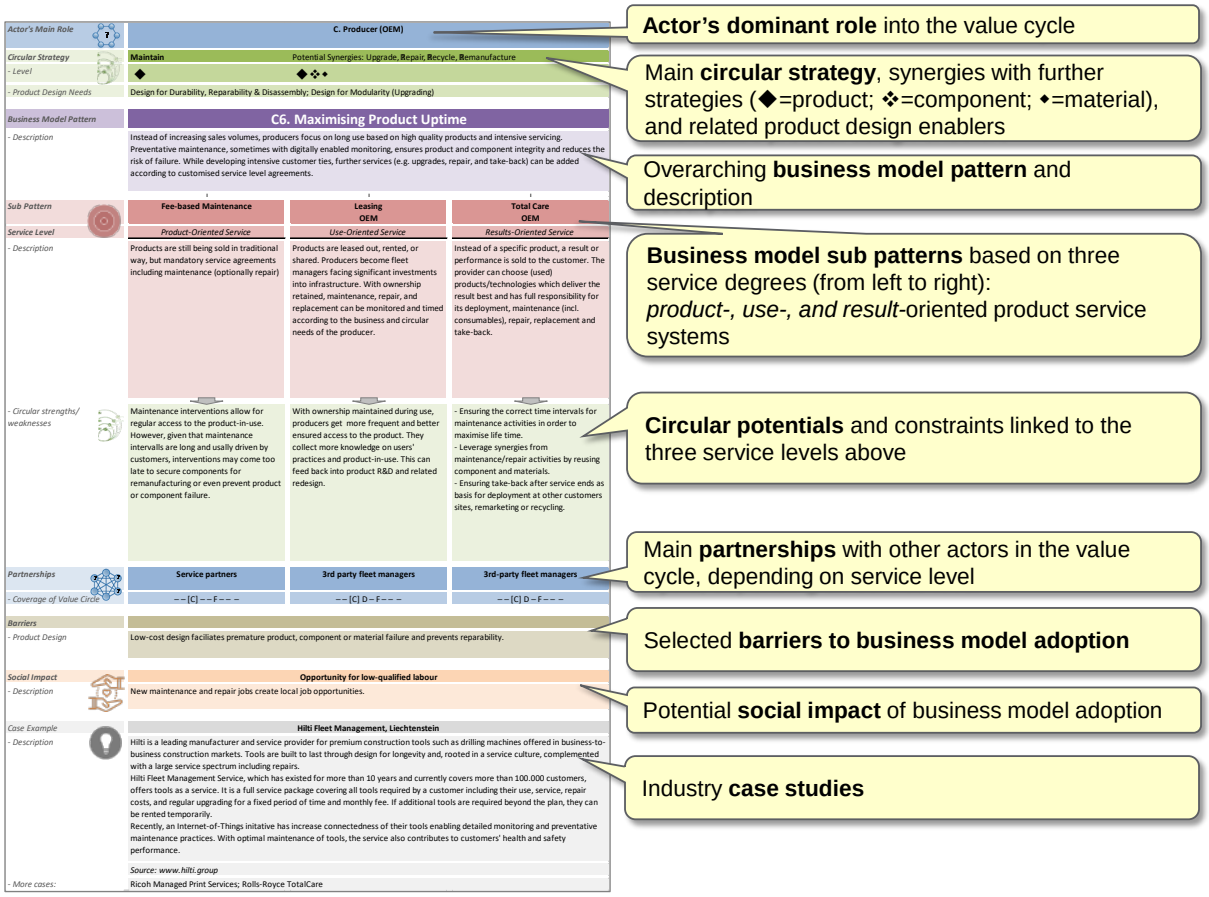


Figure 7 Guide on how to use the detailed business model patterns

4.2.1 A) Suppliers (Molecules/Materials)

Actor's Main Role	**A. Supplier (Molecules/Materials)**		
Circular Strategy	**Recycle**	Potential Synergies: ./.	
- Level	◆		
- Product Design Needs	Design for Recycling; Removal of SoC		
Business Model Pattern	**A1. Circular Rawmaterial Supplier**		
- Description	Suppliers vertically integrate - via strategic partnerships or own investments - into recovery and/or processing of secondary raw materials. With both primary and secondary materials, suppliers can flexibly respond to customer demand under fluctuating availability regarding quality and quantity of secondary inputs. Diversified suppliers who have hitherto focused on primary raw materials and entrepreneurial firms founded on a circular mission are covered.		
Sub Pattern	**Molecule & Material Recycling**	**Material Bank**	**-**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Klassischer Lieferanten knüpfen Partnerschaften (Ally) oder integrieren vertikal (Make) in die Wiederverwertungs-Wirtschaft	Materialien verbleiben im Eigentum des Lieferanten, werden in Absprache mit anderen Wertschöpfungspartnern kaskadisch zur Nutzung überlassen und nach deren Nutzungsende beim Endkunden eingesammelt und in möglichst gleichbleibender Qualität upgecycelt. (Management eines Material-Pools über die gesamte Wertkette)	
- Circular strengths/ weaknesses	- Recycling Zugriff durch Investition in Sammel-/Verwertungssystem. - Nur Open-Loop Recycling, da Lücken zwischen Rohstoffer-in-Verkehrbringer und Sammlung vom Endkunden.	Closed-Loop Recycling wird ermöglicht, da Materialien von der Bank koordiniert, überwacht und wieder eingesammelt werden.	
Partnerships	**Recovery Providers**	**Entire Value Circle**	
- Coverage of Value Circle	[A] – – – – – – H –	[A] B C D (E) F G H –	
Barriers			
- Product Design	Molecules/materials may be of inferior quality, limiting the duration of their initial use, maintainability, and recylability. Contained substances of concern additionally constrain maintenance and recycling.		
Social Impact	**Reduce impact of extraction activities**		
- Description	Significantly reduce extraction activities, which are linked to considerable social and ecological impacts in resource-rich regions, often in developing nations.		
Case Example	**Borealis AG, Austria: Everminds Initiative and Recycling Akquisitions**		
- Description	Borealis AG, the 8th largest chemical producer of polyolefins (e.g. polyethylene (PE) and polypropylene (PP). The company has begun in 2016 to invest in several recycling facilities in Europe. It has transformed from a mere virgin polyolefins supplier to one for both virgin and recycled ones. Since then it has tapped into learning processes from their recycling operations particularly regarding barriers to recycling. For instance, yellow plastic waste contaminated with cadmium (e.g. as colouring agent or printing dye) hinders most applications for recyclates. This has led to major circular economy initiatives such as EverMinds in which, together with stakeholders across the value chain, Borealis has, for instance, proposed a new Circular Design Guidelines for plastic packaging in order to maximize recovery of high quality materials and enable higher performance use scenarios for recycled resources.		
	Source: www.borealiseverminds.com		
- More cases:			

Actor's Main Role	**A. Supplier (Molecules/Materials)**		
Circular Strategy	**Maintain**	Potential Synergies: Reuse, Recycle	
- Level	◆	◆	
- Product Design Needs	Design for Longevity (High Quality); Design for Recycling		
Business Model Pattern	**A2. Process Molecule Service Provider**		
- Description	Process molecules or materials, usually with additional equipment (e.g. container for solvents), are provided as service to immediate customers allowing for superior performance and quality of the application. Materials are maintained at customer site and returned when necessary. Instead increased sales volumes, this business models aims at maintaining a given amount of materials as long as possible. It has become renown in the domain of Chemical Leasing.		
Sub Pattern	-	**Molecule & Material Leasing**	**Molecule & Material Performance**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description		Suppliers maintain ownership of the molecules/materials and sell their use by providing a solution (i.e. materials plus equipment), with the duration and frequency of use determining the leasing fee. The customer is responsible for controlling and monitoring the system in use. (Retro) logistics may be complementary or optional.	Suppliers maintain ownership of the molecules/materials. They sell the function performed by the molecule/material with the functional units being the basis for payments. With the expertise of suppliers used to configure, monitor, maintain, and optimise the materials during use, maximum performance can be achieved.
- Circular strengths/ weaknesses		As ownership is maintained, investments in high quality materials becomes a business case. Provision of a closed-loop system (molecules/materials + equipment) enables continuous maintenance for maximising longevity. Mandatory return (take back) of system at end of leasing period ensures proper recycling (or disposal) of molecules/materials.	Using the expertise of suppliers throughout materials' application, ensures optimal maintenance and efficiency and thus maximum performance. Suppliers have the financial incentive to prevent material deterioration and waste. Optimised used phases allow for materials to be taken back in the best possible condition as required in subsequent treatments (e.g. recycling, disposal).
Partnerships		**Equipment manufacturers, logistics, and waste managers.**	**Equipment manufacturers, logistics, and waste managers.**
- Coverage of Value Circle		[A] B – – – – G H –	[A] B – – – – G H –
Barriers			
- Product Design	Molecules/materials may be of inferior quality, limiting the duration of their initial use, maintainability, and recylability. Contained substances of concern additionally constrain maintenance and recycling.		
Social Impact	**Increased Occupational Health**		
- Description	Provision of serviced molecules/materials by suppliers, often packaged in closed-loop systems, ensures correct and safe use. Occupational risks related to such as contamination with hazardous substances is significantly reduced.		
Case Example	**SAFECHEM - COMPLEASE™ Chemical Leasing, Germany**		
- Description	SAFECHEM, founded in 1992 by Dow Chemicals and a waste management firm, is a service company focusing on sustainable and innovative use of chemicals in applications such as metal cleaning, textile cleaning, and asphalts analysis. High quality chemcials (e.g. solvents) are provided as a system in closed containers allowing for safe transportation, storage, and handling ensuring highest possible health and safety standards. Customers buy a customised performance package for a monthly fee including such as technical consultancy, high performance solvents and additives, safe delivery and collection, waste analysis, on-site quality monitoring system and documentation, and training. Chemical leasing can achieve a reduction of up to 93% in solvent use and 50% in energy while improving health and safety. In a service alliance with equipment manufacturers, distributors, and waste managers, all customer and regulatory demands are met.		
	Source: www.safechem.com		
- More cases:			

4.2.2 B) Suppliers (Machines and Equipment)

Actor's Main Role	**B. Supplier (Machine building)**		
Circular Strategy	**Remanufacturing**	Potential Synergies: Reuse, Recycle	
- Level	◆❖	◆❖◆	
- Product Design Needs	Design for Disassembly; Modular Design (for Technology Upgrading); Durability (Parts)		
Business Model Pattern	**B1. Machines/Components "As New"**		
- Description	Machines/components are taken back from customers, quality is checked, fully disassembled, worn parts/materials are exchanged, and then they are fully reassembled. Remanufactured machines have equal or superior quality at lower costs.		
Sub Pattern	**Machines/Components "as New"**	**Rental Machines/Components "as New"**	**Pay per Reman Machine-Performance**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Machines/components are sold in traditional form. Take-back system and infrastructure is offered.	Machines are are rented or leased out instead of sold. Ownership is not transfered to the customer. Customer relationships intensify over entire use phase.	Remanufactured machines/ components are offered as a service to customers. They are closely monitored and analysed for their performance and performance improvements and are modified or replaced once suitable against the background of Total Cost of Owernship.
- Circular strengths/ weaknesses	In order to get products back, financial incentives (e.g. reduced price for repeat sales; deposit) are offered. However, despite incentives, return of products cannot be ensured and related planning is difficult.	Rented/leased machines will usually come back to the owner after contract ends (or significant fines apply). With well planable take-back quantities and timeframes, remanufacturing processes and related procurement of further materials/components can be optimally planend.	Höhere Reman-Quote, da Maschine/Komp. im Eigentum des Lieferanten bleibt und nach Auslauf des Servicevertrags zurückgegeben wird. Learning from machine operation and ist design implications is maximised due to daily strive for performance optimisation and integrated maintenance and repair activities.
Partnerships	**Close ties with immediate customers**	**Close ties with immediate customers**	**Close ties with immediate customers**
- Coverage of Value Circle	– [B] C – – – G – –	– [B] C – – – G – –	– [B] C – – – G – –
Barriers			
- Product Design	Existing design may prevent disassembly, components/materials deteriorate too quickly for reuse, and high tech components be technically obsolescent.		
Social Impact	**Integrate disabled people**		
- Description	- Integration of physicially impaired workers in suitable reman processes (e.g. disassembly).		
Case Example	**SKF "Rotation for Life", Sweden**		
- Description	SKF, located in Sweden, is the world's largest bearing manufacturer. Bearings are crucial components in many machines and plants. They have recently pushed a "Rotation for Life" business model to focus on total cost of ownership. In this service offered to customers, payments are made based on key performance indicators of the bearing. Bearings are digitally monitored, taken out once they risk to fail, replaced, and remanufactured.		
	Source: www.skf.com		
- More cases:			

Actor's Main Role	**B. Supplier (Machine building)**		
Circular Strategy	**Reuse**	Potential Synergies: Maintani, Repair, Recycle	
- Level	◆❖	◆❖◆	
- Product Design Needs	Design for Durability; Design for Reparability		
Business Model Pattern	**B2. Machine/Component Remarketing**		
- Description	Used machines/components are taken back, quality-checked, reconditioned or repaired where necessary, and reintroduced to the same or other markets to new customers with lower performance expectations at competitive pricing. Thereby, the machine/component lifetime is extended with additional use cycles.		
Sub Pattern	**Used Machines/Components Sales**	**Rental Machines/Components**	**--> see B1 Pay per Reman Machine-Performance**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Used machines/components are sold at lower costs compared to their new counterparts.	A rental business for used machines/components is introduced. Customers pay rental fees with competitive pricing. Customers may be provided with complementary or optional services for maintenance, repair, and upgrading. Penalities must be payed for unappropriate use, wear, and damages.	
- Circular strengths/ weaknesses	In order to get products back, financial incentives (e.g. reduced price for repeat sales; deposit) are offered. Reuse transactions depend on whether customers use the incentives by suppliers to indeed return machines/components. However, customers may prefer to sell them on the second-hand market themselves, with goods then leaving the control of the supplier.	Given that ownership is remained by the supplier, all products are returned at defined timings, allowing for better planning and management of rental pool. Suppliers' own maintenance and repair of the returned products makes products last longer. Unfit machines/components can be cannibalised for spare parts and systematically prepared for recycling.	
Partnerships	**Close ties with immediate customers**	**Partner with Fleet Managers operating the product pool.**	
- Coverage of Value Circle	– [B] C – – – G – –	– [B] C D – – G – –	
Barriers			
- Product Design	Components/materials may deteriorate too quickly for reuse.		
Social Impact	**Limited amount of new regional service jobs**		
- Description	Servicing of used goods and related rental business may provide for new job opportunities for low-skilled labour.		
Case Example	**Rubble Master Rentals, Austria**		
- Description	Rubble Master is a leading producer for mobile recycling machines (e.g. crushers, sorting) for (de)construction waste. Next to their sales unit for new products, they also operate a rental unit in which customers have access to a pool of products. Rental includes training and wear, but no operation costs (e.g. fuel, operator) or transport. Some of the machines from the rental pool are later sold as used goods to lower prices allowing to address customers with smaller budgets, showing the interelatetness of rental and used good business lines.		
	Source: www.rubblemaster.com		
- More cases:			

4.2.3 C) Producers

Actor's Main Role	**C. Producer (OEM)**		
Circular Strategy	**Recycle**	Potential Synergies: ./.	
- Level	◆		
- Product Design Needs	Design for Recycling (including elemination of Substances of Concern)		
Business Model Pattern	**C1. Proprietary Material Cycles**		
- Description	Producers introduce a product design with specific premium materials resulting in higher customer value (e.g. durability, health, visual appearance) but at acceptable costs. Higher virgin material costs are offest (or overcompensated) by measures to keep their own premium materials in closed loops in order to reuse them continously for their own production.		
Sub Pattern	**Waste Cherry Picking**	**Material Bank Partnership**	**-**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Producers arrange partnerships with recovery managers for the exclusive take-out of proprietary materials from presorted waste streams (e.g. based on optics, tracers, digital watermarks, or even manual picking). In a more radical advance, producers could, similar to Circular Raw Material Suppliers (A1), vertically integrate into recovery operations to get direct access to waste streams.	Producers maintain ownership over their specific premium materials (or components).	0
- Circular strengths/ weaknesses	Only possible for materials which the local collection and sorting facilities can clearly identifiy, or which can be manually collected at acceptable efforts. High material losses from the "closed" loops are to be expected, due to mixed waste streams not in control of the producer.	As the ownership of materials (incorporated in products) remains with the producer (or is managed by a material bank as in A1), after the (fixed) service end of the product, materials are returned to or taken back by the producer (as a part of the service package).	0
Partnerships	**Recovery managers**	**Material banks**	
- Coverage of Value Circle	– – [C] D – – – H –	A – [C] D – – – H –	
Barriers			
- Product Design	Low quality materials may not be optimised for continous recyling in close loops or not recognisable in the waste stream (missing identifiers); Recycling is hindered by substances of concern.		
Social Impact	**Improve occupational and consumer health through quality materials**		
- Description	Being able to source higher quality materials with no or considerably reduced substances of concern eliminates occupational and consumer health and safety risks.		
Case Example	**Frosch brand's Recyclate Initiative, Germany**		
- Description	Werner & Mertz is a German producer for detergent and related consumer household chemicals. They have been an eco pioneer since the Frosch brand introduction in 1986. More recently, Werner & Mertz has completly redesigned its packaging programme according to the cradle to cradle quality certification. As of the standard's criteria, substances of concern have been mostly removed from the (premium) packaging materials, related labels, and printing inks enabling high quality recycling streams. In a cross-value chain partnership with a recovery manager (Grüne Punkt), recycling machine builder (Unisensor), converter (APLPA), retailer (REWE), and environmental NGO (NABU), they developed and commercialised premium recyling material (e.g. PET) and product stream. While recycling streams are not brand exclusive (i.e. next to Frosch packaging also other similar packagings are retrieved) and therefore not proprietary in a narrow sense, new R&D projects in the area of tracers clearly show the development direction.		
	Source: wir-fuer-recyclat.de; initiative-frosch.de		
- More cases:	Clarios (lead-acid batteries); MUD Lease-a-Jeans; Wolford "Aurora" biodegradable Cradle to Cradle Collection		

Actor's Main Role	**C. Producer (OEM)**		
Circular Strategy	**Remanufacture**	Potential Synergies: Reuse, Recycle	
- Level	◆	◆ ❖ ◆	
- Product Design Needs	- Design for Durability of Products, Components, Materials; Design for Modularity (Technology Upgrading)		
Business Model Pattern	**C2. Products "As New"**		
- Description	Companies offer products with "Quality as New" (i.e. equal or better quality then "virgin" products), but at more competitive pricing. Customers get financial incentives for returning products (e.g. deposit; discounts). Returned products are then quality checked, fully dissassembled, worn parts/materials replaced, and then reassembelt. Reman activities are usually centralised and are similar/remain close to primary production.		
Sub Pattern	**Selling Products "as New"**	**Product Leasing "as New"**	**--> see C6 Total Care OEM**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Wiederaufbereitete Produkte werden analog zu Neu-Produkten vertrieben, aber zu günstigeren Verkaufspreisen.	Customer leases (or rents) products "as new" for a monthly fee. The leasing product pool consists mainly of remanufactured products, but is restocked with new products, without the customer able to distinguish. Producers need to establish an own product pool and financing schemes for their customers or partner with fleet operators and external banks.	
- Circular strengths/ weaknesses	In order to get products back, financial incentives (e.g. reduced price for repeat sales; deposit) are offered. Reuse transactions depend on whether customers use the incentives by suppliers to indeed return them. However, customers may prefer to sell them on the second-hand market themselves, with goods then leaving the control of the producer.	As ownership remains with the producer, all products are returned at defined points in time. This allows for acurate planning of the subsequent reman processes and the size of the product pool. It also allows for better product (and user) monitoring which can increase (and ensure a minimum) quality of returned products and thereby make sure that remanufacturing is possible and at lowest possible costs.	
Partnerships	**Dealers for take-back;**	**Dealers for take back or as fleet managers**	
- Coverage of Value Circle	– – [C] D – F – – –	– – [C] D – F – – –	
Barriers			
- Product Design	Low-cost design prevents dissassembly and upgrading. Premature product, component or material failure prevent their reuse and increase remanufacturing costs.		
Social Impact	**Regional job growth; Integrate people with disabilities**		
- Description	New regional jobs in labour-intensive reman processes (e.g. disassembly, quality control, recondition), which may integrate disabled people (some with special abilities) at lower labour costs (e.g. public funding).		
Case Example	**Smartmeter Remanufacturing, Messtechnikhersteller Lorenz, Germany**		
- Description	Smart Meters are sold or leased to households (via intermediary organisations such as building management providers). They are designed for several use cycles and then demounted and returned to the producer. As financial incentive, customers get a payback for each product returned. Smart Meters are then disassembled and refabricated using specialised machinery. As a basis, the product was developed according to design for remanufacturing and modularity principles.		
	Source: www.lorenz-messtechnik.de		
- More cases:	Apple "Refurbished" (e.g. smartphones); Caterpillar Reman (heavy equipment/vehicles)		

Actor's Main Role	**C. Producer (OEM)**		
Circular Strategy	**Reuse**	Potential Synergies: Recycle	
- Level	◆	❖◆	
- Product Design Needs	Design for Longevity		
Business Model Pattern	**C3. Used Product Remarketing**		
- Description	Producers (or retail partners) take used products back from customers, conduct quality control, optionally conduct minor refurbishing activities, and remarket used goods in the same or other markets at lower costs. Warranties are provided, but usually not with the same conditions as new products.		
Sub Pattern	**Used Product Sale**	-	-
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Next to new products, producers sell used products at lower costs as a form of differentiation. Complemented with quality assurances and warranties, customer awareness and confidence considerably increases, making used goods true alternatives.Trade-in programmes provide financial incentives to customers to return used products, with the value deducted from further purchases.		
- Circular strengths/ weaknesses	Used product lines enable additional use cycles of products not having reached end of life. However, while financial incentives to return used products exist, it is not the only option customers have and therefore only a fraction of goods is returned. Disused products often remain stored in households or are sold in non-proprietary used goods markets.		
Partnerships	**Retail partners and retro logistics**		
- Coverage of Value Circle	– – [C] D – – G – –		
Barriers			
- Product Design	Low cost components and materials may lead to premature damage and prevent additional use cycles.		
Social Impact	**Accessability through low-priced goods**		
- Description	Lower cost products for customer groups unwilling or unable to purchase new products.		
Case Example	**Patagonia Worn Wear Online Shop, US**		
- Description	Patagonia is a producer for high quality outdoor clothing and was founded in 1973 on a sustainability mission. Clothing is designed for long use under extrem outdoor conditions. With own shops in key cities, a close customer relationship is built. Shops offer local repair services. With the marketing campaign "Don't buy this jacket" Patagonia has become renown for their anti consumerism approach. After a sequence of local "Worn Wear" pop-up events, the company launched a permanent online store for used clothes and has sold more than 120.000 items since. Items in good condition are traded-in in Patagonia's own stores or via mail with contributors receiving discounts on new purchases. Clothes are washed and put online for remarketing. Recently, Patagonia also opened physical pop-up stores for Worn Wear.		
	Source: www.wornwear.patagonia.com		
- More cases:	SHIFT Phones (e.g. smarthones)		

Actor's Main Role	**C. Producer (OEM)**		
Circular Strategy	**Repair**	Potential Synergies: Upgrade, Reman, Recycle	
- Level	◆	❖◆	
- Product Design Needs	Design for Reparability; Modularity		
Business Model Pattern	**C4. Out-of-Warranty Repair Service**		
- Description	Producers of premium quality goods incentivise extended use by customers by offering accessible, affordable, and competitive out-of-warranty repair services ("repair pays"), either as centralised, decentralised, or home delivery service. Products are supported in the long term through related availability of consumables, spare parts, necessary software upgrades, and, optionally, technological upgrading.		
Sub Pattern	**On-Demand Repair**	**--> see C6 "Leasing OEM"**	**--> see C6 Total Care OEM**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Optional repair services are provided in addition to conventionally sold goods with the aim to enable extended use (instead of repeat purchases). Customers contact the producer's service centre on demand, once a repair is necessary. Either customers pay a fixed annual service fee covering a range of repairs, or each repair transaction is payed for individually.		
- Circular strengths/ weaknesses	With attractive repair offerings, customers are enabled to use products longer. As key contact when products fail, producers can coordinate informed decisions to repair or replace devices. Taking back broken products/components allows for cannibalising or remanufacturing spare parts and feeding them back into repair operations or, otherwise, professional preparation for recycling (e.g. disassembly).		
Partnerships	**Decentralised repair and service operators and stores**		
- Coverage of Value Circle	– – [C] – E F G – –		
Barriers			
- Product Design	Low-cost design faciliates premature product, component or material failure and prevents disassembly.		
Social Impact	**Regional job opportunties for skilled and semi-skilled crafts**		
- Description	Emphasis on repair services requires strong service organisation with field workers and back office support, either internally organised or via partnerships. This provides opportunities for (semi) skilled trades and crafts.		
Case Example	**Miele, Germany**		
- Description	Miele is a German manufacturer for whitegoods and other household electronics. With a reputation for high quality durable goods and strong service culture, they have maintained premium prices in the market. Products have considerably longer lifetimes than competitors. Production takes place both in Europe and China. With local retail and service partners in majors cities they remain close to their customers. Intensive customer support is in local sales points is key to differentiation in the market. Repair and maintenance contracts can be locally concluded and are supported with centralised online offerings. Usually, individual components of products can be replaced when broken or worn and minor software upgrades can be conducted. *Source: www.miele.de*		
- More cases:			

Actor's Main Role	**C. Producer (OEM)**	
Circular Strategy	**Repair & Upgrade**	Potential Synergies: Maintenance, Repair
- Level	❖	❖
- Product Design Needs	Design for Modularity, Reparability	
Business Model Pattern	**C5. Upgrades, Spares & Accessories**	
- Description	Producers provide spare parts, tools, and related services for their core products, either through own online or offline sales channels, or by partnering with retailers and local service shops. As a prerequisite, core products must follow a modular design: easily repairable either directly by consumers ("do it yourself") or by decentralised service points without special training needs.	
Sub Pattern	**Modules & Acessories Shop**	**Upgrade Subscription**	**-**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Producers offer spare parts as traditional sales transaction. Own direct sales channels or partnerships with existing retail and service points (online or offline) are used for customer contact.	New technological or nontechnological modules/parts, remaining in ownership by the producer, are provided as a service to enable upgrading of customers' core devices in defined frequencies. Modules are returned once replacement upgrades are provided or customers have no need anymore. New modules are provided to high performance users, then cascaded to users with lower needs.	
- Circular strengths/ weaknesses	Provision of spare and upgrade modules support decentralisd repairs and upgrading with the ultimate aim to increase a core product's longevity. Aside the module sales transaction, the repair and upgrading processes remain strongly in the domain of the customers with little feedback to the producer, who misses to learn even more from a product's deficiencies.	Extended use of core product is facilitated through preventative and technology upgrades. With ownership of modules maintained by producers, opportunities for component and (core) device monitoring enabling preventative maintenance emerge. Risks of component-level fashion obsoles-cence or "upgrade consumerism" need to be contained (eco impacts of cumulative upgrades vs. core product).	
Partnerships	**DIY customers; retail & repair partners, logistics.**	**DIY customers; retail & repair partners; (retro) logistics**	
- Coverage of Value Circle	– – [C] D E F – – –	– – [C] D E F G – –	
Barriers			
- Product Design	Current product designs focused on integration and miniaturisation prevent module replacements and related after sales opportunities.		
Social Impact	**Support of DIY communities**		
- Description	- Förderung des DIY Communities		
Case Example	**Fairphone's Online Shop for Spare parts, Netherlands**		
- Description	Fairphone, founded in 2013, is a social enterprise with the mission to transform the electronics industry. By introducing alternative smartphones in the market, they showcase new supply chain practices (e.g. fair gold) and product designs (e.g. exchangable battery), together advancing sustainability. Recently they have introduced the 3rd generation design, called the Fairphone 3. The modular phone is shipped with a skrew driver, with which the phone can be easily dissassembled by consumers into 7 main modules (e.g. battery, display, mainboard, cameras, speaker, microphone). Fairphone's online shop provides replacements for each of these modules, next to usual assessories (e.g. chargers, cases).		
	Source: www.fairphone.com		
- More cases:			

Actor's Main Role	**C. Producer (OEM)**		
Circular Strategy	**Maintain**	Potential Synergies: Upgrade, Repair, Recycle, Remanufacture	
- Level	◆	◆ ❖ ◆	
- Product Design Needs	Design for Durability, Reparability & Disassembly; Design for Modularity (Upgrading)		
Business Model Pattern	**C6. Maximising Product Uptime**		
- Description	Instead of increasing sales volumes, producers focus on long use based on high quality products and intensive servicing. Preventative maintenance, sometimes with digitally enabled monitoring, ensures product and component integrity and reduces the risk of failure. While developing intensive customer ties, further services (e.g. upgrades, repair, and take-back) can be added according to customised service level agreements.		
Sub Pattern	**Fee-based Maintenance**	**Leasing OEM**	**Total Care OEM**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Products are still being sold in traditional way, but mandatory service agreements including maintenance (optionally repair)	Products are leased out, rented, or shared. Producers become fleet managers facing significant investments into infrastructure. With ownership retained, maintenance, repair, and replacement can be monitored and timed according to the business and circular needs of the producer.	Instead of a specific product, a result or performance is sold to the customer. The provider can choose (used) products/technologies which deliver the result best and has full responsibility for its deployment, maintenance (incl. consumables), repair, replacement and take-back.
- Circular strengths/ weaknesses	Maintenance interventions allow for regular access to the product-in-use. However, given that maintenance intervalls are long and usally driven by customers, interventions may come too late to secure components for remanufacturing or even prevent product or component failure.	With ownership maintained during use, producers get more frequent and better ensured access to the product. They collect more knowledge on users' practices and product-in-use. This can feed back into product R&D and related redesign.	- Ensuring the correct time intervals for maintenance activities in order to maximise life time. - Leverage synergies from maintenance/repair activities by reusing component and materials. - Ensuring take-back after service ends as basis for deployment at other customers sites, remarketing or recycling.
Partnerships	**Service partners**	**3rd party fleet managers**	**3rd-party fleet managers**
- Coverage of Value Circle	– – [C] – – F – – –	– – [C] D – F – – –	– – [C] D – F – – –
Barriers			
- Product Design	Low-cost design faciliates premature product, component or material failure and prevents reparability.		
Social Impact	**Opportunity for low-qualified labour**		
- Description	New maintenance and repair jobs create local job opportunities.		
Case Example	**Hilti Fleet Management, Liechtenstein**		
- Description	Hilti is a leading manufacturer and service provider for premium construction tools such as drilling machines offered in business-to-business construction markets. Tools are built to last through design for longevity and, rooted in a service culture, complemented with a large service spectrum including repairs. Hilti Fleet Management Service, which has existed for more than 10 years and currently covers more than 100.000 customers, offers tools as a service. It is a full service package covering all tools required by a customer including their use, service, repair costs, and regular upgrading for a fixed period of time and monthly fee. If additional tools are required beyond the plan, they can be rented temporarily. Recently, an Internet-of-Things initative has increase connectedness of their tools enabling detailed monitoring and preventative maintenance practices. With optimal maintenance of tools, the service also contributes to customers' health and safety performance.		
	Source: www.hilti.group		
- More cases:	Ricoh Managed Print Services; Rolls-Royce TotalCare		

4.2.4 D) Retail/Wholesale

Actor's Main Role	**D. Retailer & Service Points**		
Circular Strategy	**Recycling**	Potential Synergies: ./.	
- Level	◆		
- Product Design Needs	Design for Recycling (including elemination of Substances of Concern)		
Business Model Pattern	**D1. Retailer as Cycle Manager**		
- Description	Retailers adopt a proactive role in managing packaging and related materials through vertical integration into or strategic partnerships with the recovery sector. They coordinate material flows between producers, retail, customers, recovery managers, and logistic firms with the vision to establish closed (packaging) loops, both in technical loops (i.e. recycling) and biological loops (i.e. composting/biodegredation). Particular relevance for fast-moving goods sectors (e.g. food retail), where packaging considerably contributes to total product impact.		
Sub Pattern	**Retailer as Cycle Manager**	**--> see C1 Material Bank Partnership**	**-**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Retailers adopt a proactive role in managing packaging and related materials. Materials (in the form of packaging) and their ownership are passed on, but through different degrees of vertical integration their flow can be coordinated along the cycle.		
- Circular strengths/ weaknesses	Under the coordination of the retailer, recycling turns from rather open loops to more closed loops. This enables more effective recycling regarding quantities and qualities. A strong influence on producers, putting materials into the market, allows for better design for recycling, and may lead to a virtuous cicyle continously improving the system.		
Partnerships	**Cross-value chain, incl. potential intermediation**		
- Coverage of Value Circle	A – C [D] – F G H I		
Barriers			
- Product Design	Low quality materials may not be optimised for continous recyling in close loops; Recycling of materials may be hindered by substances of concern.		
Social Impact	-		
- Description	-		
Case Example	**Schwarz Group's "REset Plastic" Strategy, Germany**		
- Description	The Schwarz group, with Lidl and Kaufland considered the largest European retail chain, launched the "Reset Plastic" strategy in 2018. It is an ambitious cross-value chain strategy based on vertical integration into waste and material management with the goal to introduce 100% recyclable packaging and to reduce plastic waste. As a first building block, the Schwarz Group founded the waste management companies GreenCycle in 2009 (for managing group internal wastes) and the digital waste management platform PreZero in 2018 (to serve external partners in the market). Furthermore, starting in 2018 they acquired two recycling operations: Tönsmeier in Germany and Sky Plastic Group AG in Austria. The group is the first retailer able to coordinate material streams across the value chain through vertical integration into recovery management and recycling.		
	Source: www.reset-plastic.com		
- More cases:			

Actor's Main Role	**D. Retailer & Service Points**		
Circular Strategy	**Reuse**	Potential Synergies: Reman (Refurbish)	
- Level	◆		
- Product Design Needs	Partnerships may allow giving design feedback to producers based on (autonomous) refurbishing activities.		
Business Model Pattern	**D2. Retail Remarketing & Reman**		
- Description	Retailers specialise in or differentiate into used goods to access cost-sensitive customer groups. Used goods have different conditions and quality, but are provided with warranties. Some degree of refurbishment is usually also conducted (e.g. cleaning; repairs) and may even extend to full remanufacturing operations. Discarded goods are either sourced from own customers trading-in devices, or through larger business-to-business partnerships from which bulks of discarded devices are taken over (e.g. when firms upgrade to new device generations).		
Sub Pattern	**Used goods on Sales**	**Rent-a-Wreck Fleet Manager**	**-**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Used goods are still sold with the conventional transactional scheme, but at lower costs. Customers can trade-in used devices.	Spezialisierte Dienstleister für die Vermietung von gebrauchten Produkten zu günstigeren Preisen als vergleichbare Angebote.	
- Circular strengths/ weaknesses	Given the transactional sales schemes, this business model often only leads to a single further use cycle. While the retailer could potentially take used goods back again, customers often do not return the goods due to missing financial incentives.	With ownership retained by the retailer or fleet manager, then operating a pool of used products, products can be maintained and their lifetime extended to a maximum degree. Spare parts can be harvested, reused, and refurbished further adding to life extension.	
Partnerships	**Customers, Large organisations discarding goods, Logistics**	**Customers, Large organisations discarding goods, Logistics**	
- Coverage of Value Circle	– – – [D] – F G – –	– – – [D] – F G – –	
Barriers			
- Product Design	Goods may not be designed for long use (i.e. damages prevent second use)		
Social Impact	**Accessability through low-priced goods**		
- Description	New regional jobs in labour-intensive reman processes (e.g. disassembly), which may integrate disabled people at lower labour costs (e.g. public funding). Affordable products for low income groups.		
Case Example	**AfB Social & Green IT, Germany**		
- Description	AfB was founded in 2004 as a social business for IT remarketing with the mission to integrated people with disabilities (and special abilities) in qualified work processes. They own operations in Germany and Austria, 13 logistic operations with attached shops and two stand-alone shops. Used or discarded IT is picked up from partners' sites and returned to the logistics centres, where it is prepared for remarketing (e.g. data deletion). Functioning devices are refurbished (i.e. cleaned and then repaired where necessary), other devices are prepared for recycling. Used devices are then given to the attached shops for direct sales or promoted in the online shop. Customer groups for used devices include both consumers and business customers alike.		
	Source: www.afb-group.de		
- More cases:	Amazon Refurbished & Used products; Rent-a-Wreck (car rental)		

Actor's Main Role	**D. Retailer & Service Points**		
Circular Strategy	**Maintenance & Repair**	Potential Synergies: Reuse, Recycle	
- Level	◆	❖◆	
- Product Design Needs	Design for Durability & Reparability; Design for Modularity (Upgrading)		
Business Model Pattern	**D3. One-Stop Shop (Retail)**		
- Description	Retailers offer, next to conventional sales, extended services such as maintenance, repair, upgrading, and take-back.		
Sub Pattern	**Integrated Service Point**	**Total Care Rental**	**Total Care Retail**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Complementary or optional maintenance, repair, and insurance service components are sold together with a conventional transactional sales of the core product.	Retailer leases or rents out products for a monthly fee and keeps ownership and responsibility for maintenance, repair, upgrading, and take-back. Customers profit from accessability to most recent products.	Instead of a specific product, a result or performance is sold to the customer. The provider can choose (used) products/technologies which best deliver the result and has full responsibility for its deployment, maintenance (may include consumables), repair, replacement and take-back.
- Circular strengths/ weaknesses	With the same point of contact and service offerings linked to or included in the original product purchase, complexity and transaction costs are reduced for the customer, and it becomes more likely that customers return products for for maintenance, repair and related services. This maximises product lifetime and environmental benefits.	Retailer becomes a fleet operator. Professional maintenance and repair allows for maximised product lifetime. Once products retire, the can be professionally prepared for adequate recycling.	Ensuring the correct time intervals for maintenance activities in order to maximise life time; Leverage synergies from maintenance/repair activities by reusing component and materials; Ensuring take-back after service ends as basis for deployment at other customers sites, remarketing or recycling.
Partnerships	**Producers of goods; third party service providers**	**Strong customer relationship; Producers**	**Producers to fill product pool; Close customer ties**
- Coverage of Value Circle	– – C [D] E F – – –	– – C [D] – F – – –	– – C [D] – F – – –
Barriers			
- Product Design	Low-cost design faciliates premature product, component or material failure and prevents reparability.		
Social Impact	**Limited amount of new regional service jobs**		
- Description	Servicing of used goods and related rental business may provide for new job opportunities for low-skilled labour.		
Case Example	**Telekom Endgeräte Servicepaket**		
- Description	Telekom, Germany's largest telecommunicaton provider, offers devices such as DSL modems (in support of Internet services) to customers for a rental fee as part of the overall service contract (e.g. Internet and/or telephony provision). Devices can be returned to service points for repair, upgrading, or disposal. For the latter, they are then refurbished or recycled.		
	Source: www.telekom.de		
- More cases:	Expert Repair Service (electrical and electronic goods retail)		

4.2.5 E) Repair Service Provider

Actor's Main Role	**E. Repair Provider**		
Circular Strategy	**Repair**	Potential Synergies: Maintenance, Upgrade	
- Level	◆❖	◆	
- Product Design Needs	Design for Repair, Disassembly, Modularisation		
Business Model Pattern	**E1. Repair Gap Exploiter**		
- Description	Third party service provider for repair and maintenance (maybe refurbishing). They operate either in cooperation with producers and retailers (i.e. service partnerships), or - if no or no attractive offerings are offered by focal actors - they work autonomously as "gap exploiters". Services may be offered online with national or even international reach, in local service points, or as delivery service.		
Sub Pattern	**Repair transaction**	**Repair-based Rental**	**-**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Repair services are provided with the aim to enable extended use (instead of new purchases). Customers contact the service point on demand, once a repair is necessary.	Autonomous third party service providers repair goods at own costs and use the initial repair request only as a basis for providing a use-based service for (repaired) products, thereby entering the realm of relational selling. All repair-related risks - such as repair success, actual costs of repair, long-term reliability of repaired good, and potentially necessary follow-up repairs - are taken by the provider.	
- Circular strengths/ weaknesses	Repair services address premature technical obsolescence and can significantly contribute to extended use cycles and product lifetimes. This considerably reduces environmental burden of consumption. Single repair transactions may suffer from expensive fees and low customer acceptance, particularly when offered through official producer-related partnerships in which producers focus on repurchases rather than life-extension.	Many repair transactions don't take place due to users' reluctance to pay (overpriced) repair fees. With "Rental Repair", all repair-related risks are taken by the provider and no (high) upfront repair costs are necessary, making users more prone to return goods for repair. This increases the market for repairs.	
Partnerships	**Certified service partners for producers/ other retailers**	**Strong customer relationship**	
- Coverage of Value Circle	– – C [D] – F – – –	– – – – E F – – –	
Barriers			
- Product Design	Low cost design optimised for production prevents opening, disassembly, and repair.		
Social Impact	**Regional job opportunities for skilled and semi-skilled crafts**		
- Description	Emphasis on manual repair services requires considerable labour which leads to opportunities for (semi) skilled trades and crafts.		
Case Example	**Akkutauschen.de, Germany**		
- Description	Akkutauschen is a large online service offering the replacement of batteries from consumer electronics (e.g. tooth brushes, shavers, e-Bikes), an online shop for spare parts, and repair manuals for self help. Founded in 2009, today the company processes several thousand devices each year, thereby contributing significantly to the repair and extended use of goods. Every battery exchange job comes along with minor maintenance and related repair activities (e.g. replacement of seals). As autonomous actor, the firm works without offical relationships to producers. The service also contributes to recycling, because (waste) batteries and broken electrical devices are professionally prepared and disposed.		
	Source: www.akkutauschen.de		
- More cases:	Reparando (Smartphones)		

4.2.6 F) Prosumer

Actor's Main Role	**F. Prosumer**		
Circular Strategy	**Maintain & Repair**	Potential Synergies: n.a.	
- Level	◆❖		
- Product Design Needs	Design for Reparability & Modularity (Consumer-level); Durability		
Business Model Pattern	**F1. Prosumer Support System**		
- Description	Alternative non-market circular model based on sufficient lifestyles, self-help, and the "right to repair". It is supported by several non-commercial initiatives (e.g. repair cafes) and commercial support business models (e.g. C5 Upgrades, Spares & Accessories). New technologies such as 3D printed spare parts additionally enable users' self help. Producers loose control over products, except when providing commercial support services themselves (e.g. spare parts).		
Sub Pattern	**Do-it-Yourself Repair**	**Peer-to-Peer Sharing**	**-**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Own products are maintained and repaired (or even upgraded) as long as possible and may subsequently be repurposed. In support of these self-help activities, noncommercial and non-commercial offerings support users' need for knowledge (e.g. "how to repair" from online sources or local experts), spare parts, and tools. For instance, spare parts may be 3D-printed in community centres or retreived from professional suppliers.	In this non-commercial approach, users provide goods to other users for a lump-sum fee. While this model's origin is in the offline world, to date it is mostly operationalised with transactions through sharing platforms (see intermediary business models)	
- Circular strengths/ weaknesses	Own products are maintained and repaired (or even upgraded) as long as possible. After the use-cycle, they may be forwarded to other users in the community for second use. In result, the product life-time is maximised and repurchases minimised.	With sharing, products are used more intensively (less idle time) and less total products are needed in the market. In principle, this allows for the procurement of higher quality products, because investment pays off sooner.	
Partnerships	**Producers or intermediaries (original vs. used spares)**	**Sharing platforms**	
- Coverage of Value Circle	– – C D H [F] – – I	– – – – – [F] – – I	
Barriers			
- Product Design	Low cost design optimised for production is subject to premature failure and prevents opening and repair.		
Social Impact	**More budget available; Support of social cohesion in local communities**		
- Description	Maintenance and self-repairs make new purchases obsolete and frees budget for more important activities. Often with support from local initiatives or neighbourhoods, it increases social ties and strengthens a circular society.		
Case Example	**ifixit, US**		
- Description	The private company ifixit, founded 2003 in California, US, focuses on the provison of online user repair guidelines and selling related spare parts and repair tools and toolkits. ifixit operates an online repair community with more than 1 Million users. The company is a strong promotor of the "right to repair" movement which has launched several legislative initiatives to strengthen users own repairs.		
	Source: www.ifixit.com		
- More cases:	RepaNet (Austria); Netzwerk Reparatur-Initiativen		

4.2.7 G) Logistics and Transport Providers

Actor's Main Role	**G. Logistics Provider**		
Circular Strategy	**Recycle**	Potential Synergies: ./.	
- Level	◆		
- Product Design Needs	Design for Recycling (including elemination of substances of concern)		
Business Model Pattern	**G1. Material Reverse Logistics**		
- Description	Reverse logistics providers specialise in recycling logistics. They collect materials (as incorporated in products) from customers or retail, conduct value-added activities (e.g. presorting, cleaning, recycling) , and deliver the secondary material to either the original source of the materials (e.g. producers, material banks) or resell them in (electronic) markets, sometimes via intermediaries and related platforms. Depending on the value added activities, logistics providers may serve as recovery managers themselves.		
Sub Pattern	-	-	**Pay per Recycling Logistics Performance**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	0		Based on a client's outsourcing, service providers manage activities and optimise reverse material flows for the maximum economic and/or environmental value. Specific payments may be linked to the amount of material processed or recovered, or the economic value generated from reselling. Profit sharing from reselling activities can align incentives and allows for a win-win situation for both clients and providers.
- Circular strengths/ weaknesses	0		As service providers specialise in reverse flows from various clients and value chains, they can generate the necessary economies of scale to make reverse flows economically viable and thereby enlarge the market for secondary materials. Through the incentive system incorporated in the service contract, economic and environmental benefits should align in principle. Still, not always are the most economic recycling activities also the most ecologic ones.
Partnerships			**Interweaving the value circle**
- Coverage of Value Circle			A – C D – F [G] H I
Barriers			
- Product Design	Molecules/materials may be of inferior quality, limiting the duration of their initial use and recylability. Contained substances of concern additionally constrain their use and recycling.		
Social Impact	-		
- Description			
Case Example	**intersoh zero waste solutions and "recycled-resource", Germany**		
- Description	Intersoh is an integrated service provider for the circular economy covering logistics and transport, waste management, sorting, recycling and plastic reprocessing operations, and secondary raw material trading. With "Recycled-Resource", Intersoh introduced a new process for compounding of waste plastics based on which they introduced two recyclates (recythen and procyclen) for different applications.		
	Source: www.interseroh.de		
- More cases:			

Actor's Main Role	**G. Logistics Provider**		
Circular Strategy	**Reuse & Repair**	Potential Synergies: Recycle	
- Level	◆ ❖	◆	
- Product Design Needs	Design for Durability, Reparability, and Disassembly		
Business Model Pattern	**G2. Refurb Logistics Services**		
- Description	Logistics providers plan and operate product returns for producers or retailers. They link returned products from customers or points of sales, value-added services such as refurbishing, with remarketing channels by producers, retailers, or and recovery managers. Based on an initial quality check of returned goods, logistics providers make decisions on the best possible circular strategy: direct reuse, some degree of refurbishment (e.g. repair, polishing, repackaging), or - when technical or economic reasons prevent reuse - material recycling.		
Sub Pattern	-	-	**Pay per Refurb Performance**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description			As part of a client's outsourcing, service providers optimise reverse product flows for maximum economic and/or environmental value. Specific payments may be linked to the number of items processed, the number of refurbished items, or the economic value generated from reselling. Profit sharing from reselling activities can align incentives and allows for a win-win situation for both clients and providers.
- Circular strengths/ weaknesses			In theory, profit sharing from remarketing activities can contribute to simultaniously maximise environmental potential from reuse activities. However, the economic value from reutilisation of products or materials is not always alinged with the best possible environmental value (e.g. efforts for refurbishing might be too high, leading to recycling instead).
Partnerships			
- Coverage of Value Circle			
Barriers			
- Product Design	Low cost design optimised for production is subject to premature failure and prevents opening, disassembly, and repair.		
Social Impact	**Limited amount of new regional service jobs**		
- Description	New regional jobs in labour-intensive logistics and refurbishing processes (e.g. quality controls, reconditioning).		
Case Example	**RLG Cycleon Refurbish & Resell, Netherlands**		
- Description	Cycleon, a subsidiary of the Reverse Logistics Group, offers a Refurbishment programme which aims at maximising value from product returns stemming from either retail or consumers directly. Data-based screening and quality control of returned goods enable a smart decision on the best possible reutilisation scenario with the aim to generate highest possible quality of returned items: from refurbishment to "as new" condition (includes repair, polishing, repackaging), to direct reuse, or material recycling. Reused or refurbished goods are either returned to the distribution centres of the client (i.e. a producer or retailer), or directly resold in B2B or B2C online markets.		
	Source: www.cycleon-revlog.com		
- More cases:	Intersoh IT and communication Refurbishing		

Actor's Main Role	**G. Logistics Provider**		
Circular Strategy	**Repair**	Potential Synergies: Reuse, Recycling	
- Level	❖	❖◆	
- Product Design Needs	Design for Repair		
Business Model Pattern	**G3. Spare Part Management**		
- Description	Based on clients' outsourcing, service providers manage spare part-related activities (this may include modules for upgrading) including delivery, exchange/repair, return management, reuse or refurbishing of used parts, and recycling of waste components/materials. Spare part logistics either supports the clients' own infrastructure/assetts (i.e. maximise uptime) or after-sales services for their products in the market (e.g. car repair). The specialised logistics providers, leverage on economies of scale across clients.		
Sub Pattern	-	-	**Pay per Spare Part Performance**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description			Performance-based contracts align incentives for effective and efficient repair between logistics provider and clients. Performance-based payments may be linked to the number of spare parts covered, the availability of parts, or the prevented economic loss from downtimes.
- Circular strengths/ weaknesses			Shared incentives between logistics provider and clients drive repair. The professional management by specialists, leveraging on economies of scale, make some transactions possible in the first place and enlarge the market for repair. Still, incentives may be driven more strongly by economic than environmental performance; to maximise circularity KPIs underlying the contracts need to be carefully designed.
Partnerships			**Close ties with producers or (repair) service organisations**
- Coverage of Value Circle			– – C D – F [G] – –
Barriers			
- Product Design	Low cost design optimised for production prevents opening and repair, or makes repair activities economically unviable.		
Social Impact	-		
- Description			
Case Example	**TGW Spare Parts & Components, Austria**		
- Description	The TGW Spare Parts & Component programme covers spare parts delivery, on-site and return-to-base repairs, returns, exchanges and recycling.		
	Source: www.tgw-group.com		
- More cases:			

4.2.8 H) Recovery (and Waste) Management

Actor's Main Role	**H. Recovery Manager**		
Circular Strategy	**Reuse**	Potential Synergies: Repair, Reman, Recycle	
- Level	◆❖		
- Product Design Needs	Partnerships may allow to give design feedback to producers based on autonomous reverse cycle activities (e.g. disassembly,		
Business Model Pattern	**H1. Revitalised Products**		
- Description	Abfallwirtschaft wertet Produkte/Materialien durch Qualitätskontrollen und Aufbereitung selbst ökonomisch auf und fungiert als for-profit Anbieter im Recyclat oder Gebraucht-Gütermarkt oder bietet non-profit Dienste (Gebraucht Produkte) an.		
Sub Pattern	**Used Good Bargain**	-	-
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Recovery managers take the role of retailers, but with collected used goods. Traditional sales schemes are applied, this is, consumers can buy used goods and thereby take owernship.		
- Circular strengths/ weaknesses	Through collection or take-back, recovery managers become the temporary owners of the used goods. This allows them to add selected value added activities such as refurbishing, repair, upcycling, or repurposing - depening on a product's condition.		
Partnerships	**With take back organisations (e.g. producers, retailers)**		
- Coverage of Value Circle	– – C D – F – [H] –		
Barriers			
- Product Design	Goods may not be designed for long use (i.e. damages prevent second use)		
Social Impact	**Accessability through low-priced goods**		
- Description	Provision of low-skilled jobs in preparation and remarketing of used goods, with potential to integrated employees with special needs; Provision of used goods to affordable prices for disadvantaged population groups.		
Case Example	**ReTuna Återbruksgalleria, Sweden**		
- Description	ReTuna is the world's first recycling mall, revolutionizing shopping in a climate-smart way. It is operated by the municipality. Old items are given new life through repair and upcycling. Everything sold is recycled or reused. Additionally, ReTuna aims to be a public educator (e.g. events, workshops). The mall opened its doors in 2015 and is located next to the Retuna recycling centre. It is easy for visitors to sort materials they are discarding into the containers and then drop off reusable toys, furniture, clothes, decorative items, and electronic devices in the mall's depot, called "Returen". In the depot, staff of the municipality perform an initial culling of what is usable and what is not. The items are then distributed to the recycling shops in the mall. The shop staff then perform a second culling, where they choose what they want to repair, fix up, convert, refine – and ultimately sell. In 2018, ReTuna had SEK 11.7 million in sales for recycled products.		
	Source: www.retuna.se		
- More cases:	ReVital Products, Logo, and Shops (Austria)		

Actor's Main Role	**H. Recovery Manager**		
Circular Strategy	**Recycle**	Potential Synergies: ./.	
- Level	◆		
- Product Design Needs	Usually no feedback channel to material suppliers and producers.		
Business Model Pattern	**H2. Coordinator of Informal Collection**		
- Description	The coordinator serves as a hub for informal waste pickers and organisations with demand for recyclates. Waste pickers collect materials from littering or households and sell it to the coordinator. The coordinator may sell pooled materials directly or engage in various value-added activities in the sense of a secondary raw material producer to then sell recyclates to the market.		
Sub Pattern	**Fair-trade Recyclate**	-	-
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	The coordinator engages in trade-based market transactions: material is bought from waste pickers, processed through value-added activities (e.g. sorting), and then sold in the recyclate market.		
- Circular strengths/ weaknesses	Depending on the amount of own value-added activities, the coordinator can significantly contribute to recyclate quality. For example, internal sorting processes, preparation for recycling (e.g. washing), and recycling itself can enable high quality recyclates.		
Partnerships	**Supply contracts with producers or circular raw material suppliers**		
- Coverage of Value Circle	A B C – – – – [H] –		
Barriers			
- Product Design	Low quality materials (e.g. substances of concern; composits/insufficient separation) may considerably reduce economic value		
Social Impact	**Job opportunity for marginalised groups**		
- Description	- Additional source of income for people in need; - Face lift for neighbourhoods by removing littering.		
Case Example	**Mr. Green Africa**		
- Description	The Future of Recycling will be changed by alleviating the marginalisation, suffering, and large scale disadvantage of informal waste pickers and their communities. Mr. Green Africa incentivises marginalised waste pickers and base of the pyramid stakeholders with premium prices and added benefits, to provide a continuous supply of valuable recyclables which in turn creates pathways out of poverty for them, while simultaneously creating a positive environmental impact. Mr. Green Africa then processes the recyclable material into valuable raw material and feeds it back into plastic manufacturers' supply chain to enable them to achieve their circular economy goals, and benefit from raw material cost savings. *Source: www.mrgreenafrica.com*		
- More cases:			

4.2.9 I) Intermediaries and Platform Operators

Actor's Main Role	**I. Intermediary**		
Circular Strategy	**Recycle**	Potential Synergies: ./.	
- Level	◆		
- Product Design Needs	Intermediary may influence sellers (e.g. producers) to switch to more recylable materials to maximise intermediation success		
Business Model Pattern	**I1. Recycling Platform**		
- Description	Business-to-business platform business model which provides electronic market places to match supply and demand of residual, used, or wasted materials.		
Sub Pattern	**Recycling Platform**	-	-
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Based on the platform, supply of residual or waste material (e.g. pastics), for example from machine builders or other producers, can be offered to meet demand of secondary materials. Materials are characterised (amount, quality, material properties) to facilitate search. The platform provider (i.e. intermediary) charges transaction fees. Ownership changes from the seller to the buyer.		
- Circular strengths/ weaknesses	Platform lowers transaction costs (search, negotiate, pay) for trading materials and therefore can increase the market for recycling materials. Better information and characterisation allows for higher quality recycling streams and, subsequently, applications with higher performance needs.		
Partnerships	**Bilaterally across the value circle**		
- Coverage of Value Circle	A B C D – – – H [I]		
Barriers			
- Product Design	Low quality materials (e.g. substances of concern; insufficient separation)		
Social Impact	**May enable fair-trade materials**		
- Description	- May provide better market access to decentralised fair-trade material traders (see business model pattern H2)		
Case Example	**cirplus, Germany**		
- Description	cirplus is a global marketplace for recyclates and plastic waste feedstock. They are on a mission to make buying and selling recycled plastics easier and more efficient than before. With the B2B-marketplace, plastic and recycling industries are connected. At the heart of cirplus is the improvement of qualities and quantities of recycled plastics. Additional consultancy services are offered to support companies along the value chain to improve such as their feedstocks, product design for recycling, material flows.		
	Source: www.cirplus.com		
- More cases:			

Actor's Main Role	**I. Intermediary**		
Circular Strategy	**Reuse**	Potential Synergies: ./.	
- Level	◆ ❖		
- Product Design Needs	Design-for-longevity		
Business Model Pattern	**I2. Used Goods & Sharing Platform**		
- Description	Platform business models provide an electronic market place to match supply and demand of used products or components. The electronic platform minimises transactions costs for sellers and buyers (e.g. search, communication, and negotiation costs).		
Sub Pattern	**Used Goods & Sharing Platform**	**Sharing Platform**	**-**
Service Level	*Product-Oriented Service*	*Use-Oriented Service*	*Results-Oriented Service*
- Description	Reuse intermediaries provide platforms to match supply and demand for used goods in business-to-business, business-to-consumer, and consumer-to consumer-contexts. The role of intermediation may be taken by third-party actors, or by core actors in the value chain (e.g. retail).	Intermediaries focus on organising sharing transactions between owners of goods/infrastructure and potential users, thereby allowing for access to products/infrastructure. The intermediaries operate digital platforms offering search, negotiation, rental contract design, financial transaction, and related offerings (e.g. insurance) - but they do not own or operate a pool of products.	
- Circular strengths/ weaknesses	Platforms, by minimising transactions costs, help to increase the market for reused goods. Given the nature of the platform business model, the focus is restricted to intermediating classical sales transactions between seller and buyer (with ownership of the good being transfered), with no additional circular potential for the intermediary.	Shared products are used more intensively (less idle time). In principle, this allows to procure higher quality products, because investment pays off sooner. However, given that intermediaries are not fleet managers - i.e. no central pool of products is managed - this model cannot leverage on additional circular potentials such as centralised maintenance, repair, upgrading, and preparation for recycling.	
Partnerships	**Users, producers/retail (i.e. take-back) or recovery managers**	**Users, producers/retail (i.e. take-back) or recovery managers**	
- Coverage of Value Circle	– – C D – F – H [I]	– – C D – F – – [I]	
Barriers			
- Product Design	Goods may not be designed for long use (i.e. damages prevent second use)		
Social Impact	**New local job opportunities in remarketing**		
- Description	- Additional source of income for sellers. - More afordable goods for people with lower incomes.		
Case Example	**eBay classified [Kleinanzeigen], Germany**		
- Description	eBay Classified, in Germany ebay Kleinanzeigen, is a platform in which consumers can put used goods for sales to other consumers. Among other characteristics of the good, a price is defined. The buyer contacts the seller, and together they finalize the transaction outside of the eBay platform (i.e. the platform is just the matchmaker, but not engaging in the further transaction process).		
	Source: www.ebay-kleinanzeigen.de		
- More cases:	www.floow2.com (B2B asset sharing)		

4.2.10 J) Emerging Actors

The previous business model patterns have given voice to the perspectives of the main actors enrolled in the physical product, component, and material flows. However, many more (support) actors are necessary to successfully transition into the CE. These actors can support other actors' business models in the sense of partners and adopt circular (support) business models themselves. Some of these actors are the following:

- *Non-technical service providers:* This umbrella category includes any actor providing non-technical services. While they may work in a technological context, their core service is non technological. This may involve, but is not limited to, actors providing broader consultancy services for the CE, facilitation of innovation processes, incubation services, and support in market intelligence and introductions.
- *Banks and financial service providers:* Particularly in support of higher-level service business models based on leasing, rental, and performance pay, companies have to invest considerable financial resources into product pools and related infrastructure. While some companies may found their own internal banks, external support by existing financial service providers may be a faster and easier step into provisioning of product financing to customers.
- *Circular design agencies:* They consult actors regarding how to improve product designs for maximising potentials in a CE (e.g. design for remanufacturing, design for recycling). They may also engage in contract engineering for new or revised product designs.
- *Certification bodies:* They provide standards and certification systems for the CE to be able to credibly communicate circular properties of the product or solution in the market. They can either specialise in individual properties and life-cycle stages (e.g. recycled content; biodegradability; durability) or across several properties and life-cycle stages (e.g. Cradle to Cradle).
- …

Not all potential actor types have become evident yet. Moreover, the industry dynamic in the context of transitions to the CE provide extensive room for innovation and entrepreneurship – which will certainly lead to new actor types.

5 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. The rising ambition levels specified for each actor type, as represented by more advanced circular strategies and service degrees, shall inspire creativity and continuous improvement on the way towards circularity. This also contributes to further integrating previously separated bodies of knowledge on circularity and product-service systems. 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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