4th PLATE 2021 Virtual Conference
Limerick, Ireland - 26-28 May 2021

Circular Economy Value Chain Collaborations - Exploring the 'Why,' 'Where', 'Who' and 'How'

Fenna Blomsma[(a)], Sophia Cornelißen[(a)], Julia Gross[(a)]
a) Universität Hamburg, Faculty of Business, Economics and Social Sciences, Hamburg, Germany

Keywords: closed-loop value chain; typology; circular strategies; collaboration; circular ecologies.

Abstract: This paper explores collaboration in Circular Economy Value Chains (CEVCs). The aim is to establish an analytical framework for better understanding how collaboration helps value chains (VC) to work in line with circular economy (CE) principles. In the transition from a linear economy to a CE, economic actors have to cooperate together in new ways. In a linear economy most actors involved in the VC are specialised and have only limited interaction, which means they cannot create circular systems autonomously. In contrast, in a CE companies and other actors need to collaborate to identify, develop, implement and operate circular strategies. However, currently, CE is in its early stages of development. In order to transition to more circular industrial systems there is a need to better understand how to create CEVCs. To this end, this paper presents the preliminary results of an analysis of CE cases contained in the CIRCLE LAB knowledge hub: focusing on 46 cases in the domain of textile and fashion. We identify the key characteristics of collaborative efforts aimed at creating CEVCs. This paper is structured as follows. First, the current state of the CEVC literature is described. Next, the methodology for the data gathering and analysis is explained. This is followed by a presentation of the resulting insights and an explanation through means of illustrative case examples. A discussion outlining the implications and uses of the framework, as well as further work conclude this paper.

Introduction

In order to avoid negative impacts from the linear 'take-make-waste' economy - such as the emission of greenhouse gases that result in climate change, or the pollution of aquifers and food chains by toxic chemicals and (micro)plastics - a new economic system based on looping and cycling of materials, components and products has been proposed (EMF, 2013. This new system known as circular economy (CE) is put forward as an approach for sustainable economic activity. In a CE, circular strategies address obvious (e.g. landfilling, prematurely broken products) and more inconspicuous types of waste (e.g. subsequent use of materials not optimised for value recovery, unused product capacity). To achieve this, a range of circular strategies can be used, such as alternate ways of fulfilling needs (replace), efficiency approaches (reduce), reuse, repair/ maintain, refurbish/ remanufacture, upgrade, recycle, industrial symbiosis, composting, etc (Blomsma and Brennan, 2017; Homrich et al., 2018).

Applying this set of strategies requires a life cycle perspective across production and consumption processes. Therefore, for the successful implementation of circular strategies, collaboration between VC actors is required. For example: for the high-quality recycling of materials it may be needed to consider product formulation (material choice) and design (for disassembly), to create incentives for the customer to return the product, a reverse logistics process to recapture these materials has to be put in place, and a specialised recycling partner may need to be sought out to process the materials before they can be used to make the next generation of new products. A similar argument could be made for product life extension and other circular strategies.

Moreover, in implementing (sets of) circular strategies collaboration between actors is key to creating, delivering and capturing shared value (Brown et al., 2019).

It can therefore be said that the creation of CEVCs requires the creation of new value chain relationships and collaborations: companies are unlikely to be able to become fully circular on their own (Kraaijenhagen et al., 2016), or to be successful in creating and capturing circular value on their own. However, there still exists a "circularity gap:" a lack of CE enabling connections in VCs (Schmid and Ritzrau, 2018). As such, it needs to be better understood how to transition from linear to CEVCs. Specifically,

we focus on four related elements: 1) 'why' - what problem/ opportunity needs to be addressed, 2) 'where' - the location in the VC where loops are closed, 3) 'who' - the maturity of the actors and their relationships, 4) 'how' - organisational resources and capabilities. Through focusing on 46 cases in the domain of textile and fashion included in a CE case database, these aspects are explored with the aim of establishing an analytical framework to better understand the development of CEVCs.

Background

So far, the CE literature has primarily focused on the practical and technical levels of physical flows in industrial systems (Korhonen et al. 2018). There is, however, a nascent body of knowledge on organisational aspects related to CE. In particular, on conceptualising and designing circular business models (e.g. Geissdoerfer et al., 2018; Boons and Bocken, 2018; Pieroni et. al., 2019). Although this work acknowledges the role of VCs in the process of value creation, capture or delivery, it does not provide detail with regard to the specific roles that need to be fulfilled to enable the operationalization of a particular (set of) circular strategy(ies).

In addition to this, a second body of work attempts to better understand the development of Green, Sustainable, Closed Loop and CEVCs, but this is largely characterised by descriptive case studies containing small sample sizes, aimed at understanding factors regarding product design and manufacturing, end-of-life recovery, and the cycling of individual products, components, or materials. Typically, this work focuses on such factors as product design, power dynamics, demand and supply dynamics, transaction costs, the role of certification schemes and sustainability impact (Franco, 2017; Chkanikova, 2016; Acquier et al., 2017).

Although the need for proactive stakeholder management is a common theme in recent work on and related to CE that focuses on organisational aspects, there is currently no structured means for identifying and understanding different types of collaborations and their role in operationalising circular systems.

Specifically, there are 4 key knowledge gaps that prevent the identification of meaningful patterns in transitioning to CEVCs. First, the motivation behind addressing linear problems and/or capturing circular opportunities is often not (sufficiently) understood. That is: understanding what issue in relation to resources is being addressed or what resource opportunity is tapped into aids in identifying the 'why' of circular systems. If this is not articulated there is a risk that important problems are overlooked resulting in marginal improvement (e.g. 'circular washing') (Hofmann and Jaeger-Erben, 2020) or that new wastes are being created that result in circular rebound (Zink and Geyer, 2017).

Second, there is no consensus around how to systematically scan for the location in VCs where loops are closed. That is: whilst it is acknowledged that CE encompasses a range of circular strategies, there is no consensus around their meaning (Reike et al., 2017) and how to distinguish between their application in different stages of the life cycle (Potting et al., 2018). For example, a process such as industrial recycling is different from post-consumer recycling, with different barriers and enablers, and different outcomes with regard to material quality and value capture. A similar observation can be made for self-repair in relation to professional repair. As such, it is important to be able to distinguish between 'where' in a CEVC circular strategies are applied.

Third, there is a lack of clarity with regard to the nature of relationships and the type of actors involved. For example, in transitioning to product/service systems, there can be a need to reexamine existing relationships between existing VC actors. In addition, there is an emergent body of work around the role of incumbent firms in transitioning to a CE emphasising cross-sectoral collaboration (e.g. Hansen and Revellio, 2020). Furthermore, it is acknowledged that start-ups can take on new roles to fill gaps in existing value chains or create entirely new value chains (e.g. Boons and Bocken, 2018). As such, the term 'collaboration' covers: 1) the reinvention of existing relationships, 2) connecting between previously unconnected entities, and 3) adding new entities to fill gaps in VCs. It is important to distinguish between these types as they have different developmental trajectories. However, there is currently no clear way to examine 'who' is collaborating.

However, fourth, and importantly, different organisational resources and capabilities may be needed depending on the 'why,' 'where' and 'who.' But it is not yet understood to what degree this 'how' of identifying, developing, implementing and operating CEVCs is context dependent. For example, reverse logistics

capabilities are put forward as key for both recycling and reuse strategies (Vlachos, 2016). However, both may be driven by different motives: a (post-consumer) recycling scheme may be needed to recapture valuable materials, whereas a reuse scheme may leverage the remaining useful product life to service additional customers. As such, the capability of reverse logistics can serve different circular strategies, taking place in different resource states. In addition to this, reverse logistics resources may be developed in-house, outsourced to existing partners, new partners or a start-up, or collaboratively created through establishing a new entity. Decisions such as these, although driven by the need for the same capability, can therefore result in radically different CEVCs. Similar observations can be made about other organisational resources.

Therefore, stating that a specific organisational resource is key to implementing circular strategies does not provide sufficient insight into why a certain CEVC develops. The 'why,' 'where,' 'who' and 'how' of circular strategies are intricately intertwined - and they need to be assessed in an integrated manner - to be able to find relevant patterns in CEVC development and to be able to compile best and good practice. However, at present, no analytical framework exists to support this. To address this gap this paper explores how such an analytical framework for understanding the design and development of CEVCs can be created.

Method

To fill the identified gap, a multi case analysis was used. This approach allows for examining phenomena in their context, where it is likely that important contextual conditions are relevant to understanding the phenomenon of interest (Yin, 2018).

Therefore, this paper analyses 46 cases from the CIRCLE LAB knowledge hub: a database that contains 1588 knowledge resources, 948 of which are categorized as case study examples (as of 20/10/2020). The cases selected for the analysis are those categorised as "collaboration for joint value creation."

Furthermore, the cases are restricted to the domain of textile and fashion, due to the largest number of cases relating to this sector

The analytical frameworks and concepts guiding this work are described in Table 1.

Analytical frameworks used and motivation	
'Why' - what problem/ opportunity needs to be addressed	**'The Big Five' of Structural waste** *By:* Blomsma (2018), Blomsma and Tennant (2020). *Approach:* used as underpinning typology for describing the main problem or untapped solution as described in the case documents. *Description:* The 'Big Five of structural waste consists of: 1. Excess/ harmful use of resources; 2. Premature End-of-Life of materials; 3. Underused material capacity; 4. Premature End-of-Use of components/ products; 5. Underused components/ product capacity.
'Where' - the location in the VC where loops are closed	**Resource States framework** *By:* Blomsma and Tennant (2020) *Approach:* used as underpinning structure to describe where in the industrial life cycle a circular strategy takes place. *Description:* This framework combines the idea of material entropy with a life cycle perspective. It depicts the journey of resources through the economy as first taking place from first manufacturing materials, then components and finally assembling finished goods. In a CE, various circular strategies are subsequently available to manage end-of-use/life.
'Who' - the maturity of the actors and their relationships	**[Emergent from data]** *Approach:* using the maturity of the organisation (e.g. existing organisation or new organisation/ start-up) and the maturity of the relationship (e.g. existing relationship that is reconsidered or new relationships being established) as a guide to classify the nature of the relationship. *Description:* Using the maturity of the organisation and the relationship we develop a typology iteratively from the dataset.
'How' - organisational resources and capabilities.	**Resource Based View (RBV)** *By:* Barney (1991) *Approach:* In order to achieve a sustainable competitive advantage (SCA), companies require a unique set of strengths/resources that can be divided into three parts. Physical capital, human capital, and organizational capital. *Description:* Each of these 3 main capital types are assigned subcategories. These resources are used to create supply, enable the operation of the CE, or generate demand.

Table 1 - overview of frameworks and approaches used for exploratory analysis.

Cases were subsequently filtered for data availability and accessibility. In addition to this, since the data in the database was not curated, input categories were verified against the case description as well as additional available data such as project websites.
In the next step, the cases were analysed in further detail using the frameworks described in Table 1, which were further developed using the data for the 'who' and 'how' elements. That is: the cases were analysed with regards to what organisational resources were identified, iteratively developing sub-categories that allowed for meaningful contrasting and comparing of cases. In this, for the 'how,' we follow the recommendation from Miller (2019) and Kraaijenbrink et al. (2010) to identify (more) precise definitions of the types of organisational resources the collaborations are aimed at creating.

Results

This section highlights the key preliminary insights with regards to the 'why', 'where', 'who' and 'how' for the selected fashion & textile cases. See also Fig. 1-3.

'Why' - Big Five of Structural Waste
Considering Fig. 2., which gives an overview of the structural wastes that are targeted in the cases, it can be seen that each of the five wastes are targeted. However, components and particles play a role in over half (53,6%) of cases. This is striking given the claims that CE is often still interpreted as dealing with (product) waste and recycling (Homrich et al., 2018). In contrast with such statements, this finding shows that CE is increasingly interpreted as an umbrella concept that addresses a wide range of issues associated with waste and resource management. In fact, the individual cases address on average 2,92 types of structural waste, with on average 1,38 instances of each waste being addressed - using a variety of different circular strategies (see outer circle).

'Where' - Circular strategies across life-cycle
See for this element Fig. 2., both the inner and outer circle. Although related to structural waste, this analysis adds the specificity of where in the life cycle circular strategies are positioned, ranging from raw material production, components manufacture, product assembly, distribution, use, reverse logistics, and various end-of-use/life strategies, covering the 3 resource states (particle/ material, part/ component and product) and 10 subcategories divided over the life cycle (Blomsma and Tennant, 2020).
In line with Fig. 1 the chart of Fig. 2. also shows that circular strategies are mostly applied to products, but that the parts- and particles states closely follow. Moreover, an even coverage of both pre-user (#1-4) as well as user (#5) and post-user strategies can be seen (#6-10).
Individual cases address on average 2,04 resource states, and they consist of 43% pre-use, 15% use and 42% post-use stages respectively.
In sum: the data shows that multiple structural wastes are addressed at multiple stages of the production chain. Through this it is shown that companies are moving towards the application of (more) holistic approaches.

'Who' - maturity of actors and relationships
Seven types of stakeholders were identified:

1. Focal companies;
2. Industry stakeholders (other companies/ industry bodies);
3. Government;
4. NGOs;
5. Knowledge institutes/ academia;
6. Communities;
7. Customers.

Involving customers has become a major part of marketing and the business model (consumers play a prominent role in 76,5% of cases). Often, the role of the consumer was considered to be of a dual nature: by returning worn clothing, the consumer was not only a customer, but also a supplier. In most cases, these take-back programs were used as a vehicle to establish a closer customer relationship through offering discount vouchers for the next purchase.
The relationship between companies and NGOs is also notable. Companies seemingly cooperate with NGOs whose mission is in line with the company philosophy, providing financial support for initiatives. Likewise, governments typically enter into a relationship with projects. For example, research projects on the CE for new sustainable recyclable materials are supported For example the project Trash-2-cash, a Eu funded research project, which aimed to create new regenerated fibres from pre-consumer and post-consumer waste. Moreover, knowledge institutes and academia also have a key function to play. They act as a form of catalyst in the engine of the CE by supporting companies in the transformation to circular processes, contributing their

knowledge, and connecting new business partners thanks to their comprehensive market insight. In an exchange with scientists and knowledge platforms, materials and processes can be optimized and shared with third parties.

Three different collaboration types and one hybrid type were identified, based on examining the maturity of the organisations and their relationships (classified according to the main type):

1. **New relationships** (30,4%): existing partners work together in new ways. That is: the relationship with existing suppliers and/or existing customers is reinvented.
2. **New partnerships** (34,8%): existing entities that haven't previously collaborated establish a new partnership.
3. **New entities** (34,8%): a new organisation is created or added so a new resource or capability can be leveraged.

The importance of new relationships, new partnerships and new entities alike illustrates the importance of transforming (parts of) existing (linear) systems for circularity, as well as the importance of novelty and invention.

'How' - organisational resources & capabilities

The 5 types of structural waste can be tackled with a wide variety of circular strategies and approaches at different stages of the value chain - as Figure 1 already illustrated. In this, it is striking that companies typically address multiple structural waste issues at the same time, which are enabled through organizational resources and capabilities.

For example, the collaboration between Houdini and Customers was aimed at establishing take-back programs and product maintenance and repair.

Other cases implied under the motto "to preserve what is already there" own brand second sales, and second sale distribution, but also self-repair, spare part services, and product maintenance. In other words, the companies ensure that the product either finds a new owner or is repaired if it is damaged to prolong the lifespan.

Circular strategies are applied not only in the use phase but also in the pre-use and post-use phases.

To have sustainable competitive advantages, organizational resources and capabilities are needed. As shown in Figure 3, these were categorised according to whether they are 1) creating a supply of circular resources (37,6%), 2) processing support for the operation of CEVCs (38,9%), or 3) generating demand (23,6%). The companies in the study were represented in each of these three categories.

In each of these categories, a distinction is made between physical capital resources, human capital resources, and organizational capital resources. The organizational capital resources were the most prominent within each of the three categories. It is also worth noting that the human capital resource of knowledge also played an important role in the category 'supporting the operation of CEVCs', such as the education, experience, judgement, intelligence, relationship and insight of individual managers and workers in a company.

Discussion & conclusion

In this paper we set out to create an analytical framework for understanding the design and development of CEVCs, in order to better understand the degree to which the 'how' of identifying, developing, implementing and operating CEVCs is context dependent. That is: to explore to what degree the 'why,' 'where' and 'who' of collaboration shapes the implementation of circular strategies. To this end, this paper presented a preliminary analysis of 46 textile and fashion cases, to explore how such an analytical framework can be created and utilised to find patterns and other salient insights.

The preliminary analysis highlights the importance of adopting a systems perspective when engaging in CE oriented-innovation. That is: to consider where each type of waste is present in the life cycle, and to put in place circular strategies that address these - very likely as part of a set of two or more circular strategies that interact - either synergistically or through trade-offs (Blomsma and Brennan, 2017; Hansen and Revellio, 2020). It is this view of CE that allows for a holistic approach addressing waste in all its different forms across the entire production chain and extending and renewing the value of resources.

With the proposed framework we have contributed to the formulation of an analytical approach that deals with CE in its richness and complexity, advancing the field of CE and connecting it to both the industrial ecology and business literatures.

Limitations

The analysis presented in this paper is part of an ongoing analysis, with key preliminary insights described here. Further work is needed with regards to refining the analysis, pattern finding, and extending the number of cases. Also note that use of the CIRCLE LAB database comes with inherent limitations: the cases are self-selected, meaning that no uniform inclusion or exclusion criteria were applied. Moreover, most of the cases are situated in the global north.

References

Acquier, Aurélien; Daudigeos, Thibault; Pinkse, Jonatan (2017): Promises and paradoxes of the sharing econ-omy: An organizing framework. In Technological Forecasting and Social Change 125 (1), pp. 1–10. DOI: 10.1016/j.techfore.2017.07.006.

Barney, Jay (1991): Firm Resources and Sustained Competitive Advantage. In Journal of Management (17), pp. 99–120. Available online at https://journals-1sagepub-1com-1003eb83c00eb.emedien3.sub.uni-hamburg.de/doi/pdf/10.1177/014920639101700108, checked on 11/29/2020.

Blomsma, Fenna; Brennan, Geraldine (2017): The Emergence of Circular Economy: A New Framing Around Prolonging Resource Productivity. In Journal of Industrial Ecology 21 (3), pp. 603–614. DOI: 10.1111/jiec.12603.

Blomsma, Fenna; Tennant, Mike (2020): Circular economy: Preserving materials or products? Introducing the Resource States framework. In Resources, Conservation and Recycling 156, p.104698. DOI: 10.1016/j.resconrec.2020.104698.

Boons, Frank; Bocken, Nancy (2018): Towards a sharing economy – Innovating ecologies of business models. In Technological Forecasting and Social Change 137 (20), pp. 40–52. DOI: 10.1016/j.techfore.2018.06.031.

Brown, Phil; Bocken, Nancy; Balkenende, Ruud (2019): Why Do Companies Pursue Collaborative Circular Oriented Innovation? In Sustainability 11 (3), p. 635. DOI: 10.3390/su11030635.

Chkanikova, Olga (2016): Sustainable Purchasing in Food Retailing: Interorganizational Relationship Management to Green Product Supply. In Bus. Strat. Env. 25 (7), pp. 478-494. DOI: 10.1002/bse.1877

Circle Economy (2021): Circularity Gap Report 2021. Available online at https://www.circular-ity-gap.world/2021.

EMF (Ellen MacArthur Foundation), 2013. Towards the Circular Economy: Economic and Business Rational for an Accelerated Transition.

Franco, Maria A. (2017): Circular economy at the micro level: A dynamic view of incumbents' struggles and challenges in the textile industry. In Journal of Cleaner Production 168 (1), pp. 833-845. DOI: 10.1016/j.jclepro.2017.09.056.

Geissdoerfer, Martin; Savaget, Paulo; Bocken, Nancy M.P.; Hultink, Erik Jan (2017): The Circular Economy – A new sustainability paradigm? In Journal of Cleaner Production 143, pp. 757–768. DOI: 10.1016/j.jclepro.2016.12.048.

Hansen, Erik G.; Revellio, Ferdinand (2020): Circular value creation architectures: Make, ally, buy, or laissez-faire. In Journal of Industrial Ecology 24 (6), pp. 1250–1273. DOI: 10.1111/jiec.13016

Hofmann, F., & Jaeger-Erben, M. (2020). Organizational transition management of circular business model innovations. Business Strategy and the Environment, 29(6), 2770–2788. https://doi.org/10.1002/bse.2542

Homrich, Aline Sacchi; Galvão, Graziela; Abadia, Lorena Gamboa; Carvalho, Marly M. (2018): The circular economy umbrella: Trends and gaps on integrating pathways. In Journal of Cleaner Production 175, pp. 525–543. DOI: 10.1016/j.jclepro.2017.11.064.

Kaza, Silpa; Yao, Lisa C.; Bhada-Tata, Perinaz; van Woerden, Frank (2018): What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050: Washington, DC: World Bank.

Korhonen, Jouni; Nuur, Cali; Feldmann, Andreas; Birkie, Seyoum Eshetu (2018): Circular econ-omy as an essentially contested concept. In Journal of Cleaner Production 175, pp. 544–552. DOI: 10.1016/j.jclepro.2017.12.111.

Kraaijenbrink, Jeroen; Spender, J.-C.; Groen, Aard J. (2010): The Resource-Based View: A Re-view and Assessment of Its Critiques. In Journal of Management 36 (1), pp. 349–372. DOI: 10.1177/0149206309350775.

Kraaijenhagen, Christiaan; van Oppen, Cécile; Bocken, Nancy (2016): Circular business. Collaborate and circulate. 4th ed. Amersfoort: Circular Collaboration.

Miller, Douglas (2019): The Resource-Based View of the Firm. In Douglas Miller (Ed.): Oxford Research Encyclopedia of Business and Management: Oxford University Press.

Pieroni, Marina P.P.; McAloone, Tim C.; Pigosso, Daniela C.A. (2019): Business model innovation for circular economy and sustainability: A review of approaches. In Journal of Cleaner Production 215, pp. 198–216. DOI: 10.1016/j.jclepro.2019.01.036.

Potting, José; Hanemaaijer, Aldert (eds.), Roel Delahaye, Roel; Ganzevles, Jurgen ; Rutger Hoekstra; Lijzen, Johannes (2018), Circular Economy: what we want to know and can measure. Framework and baseline assessment for monitoring the progress of the circular economy in the Netherlands. PBL Netherlands Environmental Assessment Agency, The Hague.

Schmid, Daniel; Ritzrau, Will (2018): Why the circular economy must link up the whole supply chain. World Economic Forum. Available online at https://www.wefo-rum.org/agenda/2018/09/why-the-circular-economy-needs-to-link-up-the-whole-supply-chain/, updated on 2/12/2021, checked on 2/12/2021.

Vlachos, Ilias P. (2016): Reverse logistics capabilities and firm performance: the mediating role of business strategy. In International Journal of Logistics Research and Applications 19 (5), pp. 424–442. DOI: 10.1080/13675567.2015.1115471.

Yin, Robert K. (2018): Case study research and applications. Design and methods. Sixth edition. Los Angeles, London, New Dehli, Singapore, Washington DC, Melbourne: SAGE.

Zink, Trevor; Geyer, Roland (2017): Circular Economy Rebound. In Journal of Industrial Ecology 21 (3), pp. 593–602. DOI: 10.1111/jiec.12545.

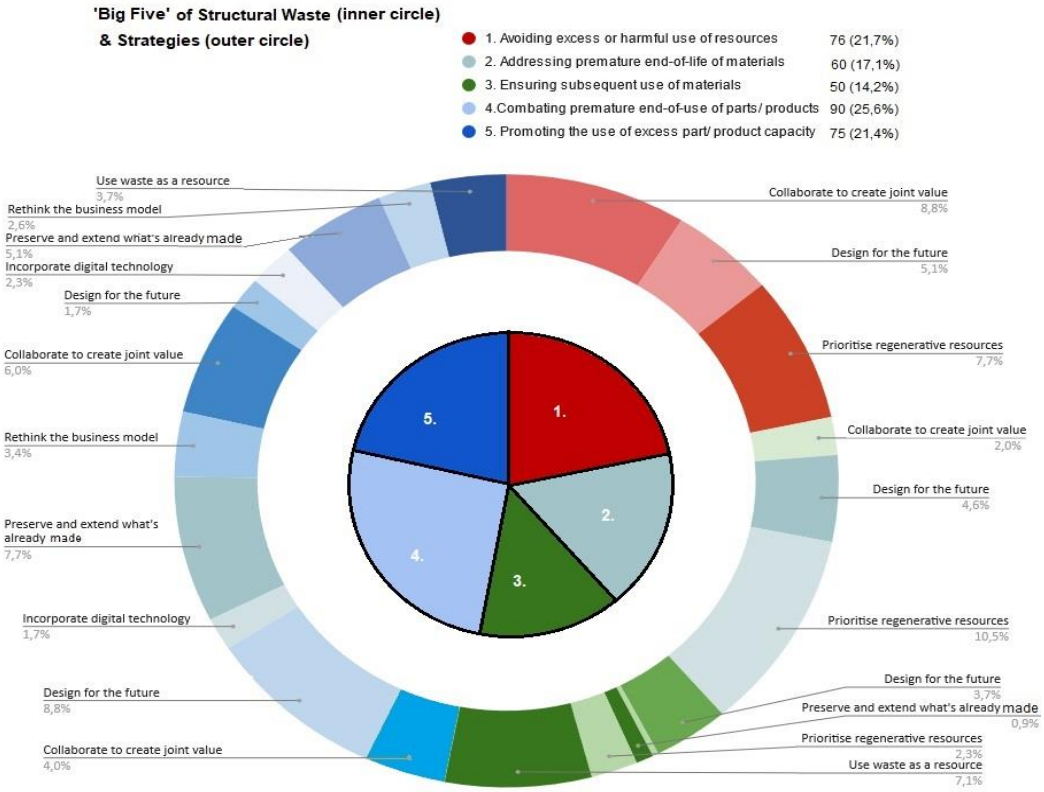

Figure 1. BIG-Five' of structural Waste & Resource StateFramework (Image: authors)

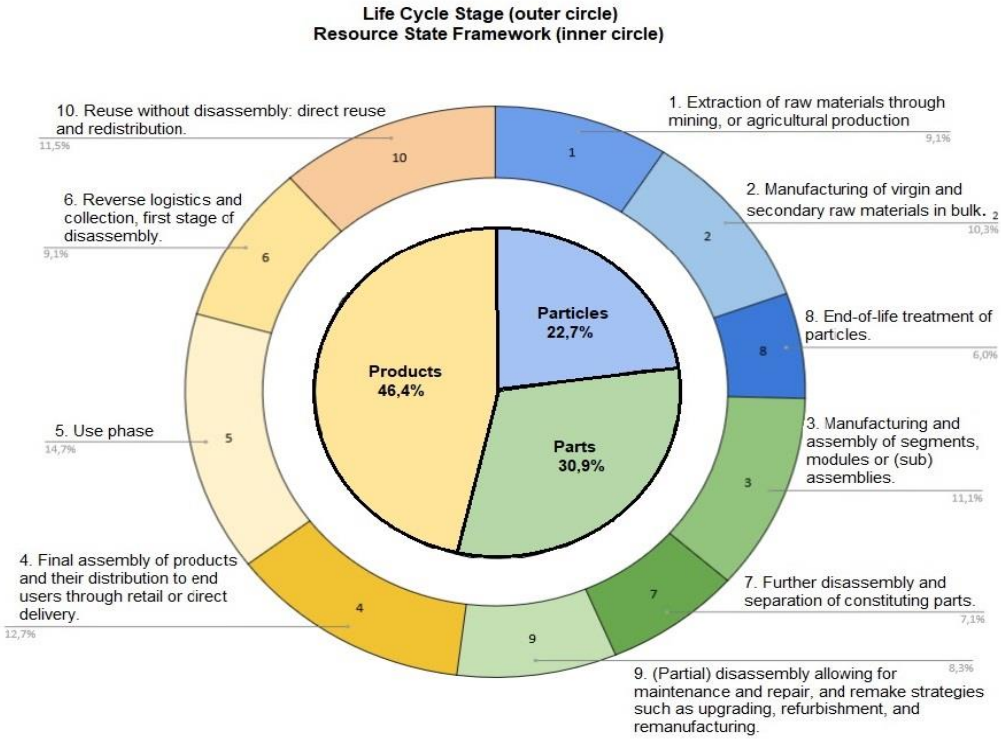

Figure 2. Life Cycle Stage & Resource State Framework. (Image: authors)

Organisational Resources and Capabilities

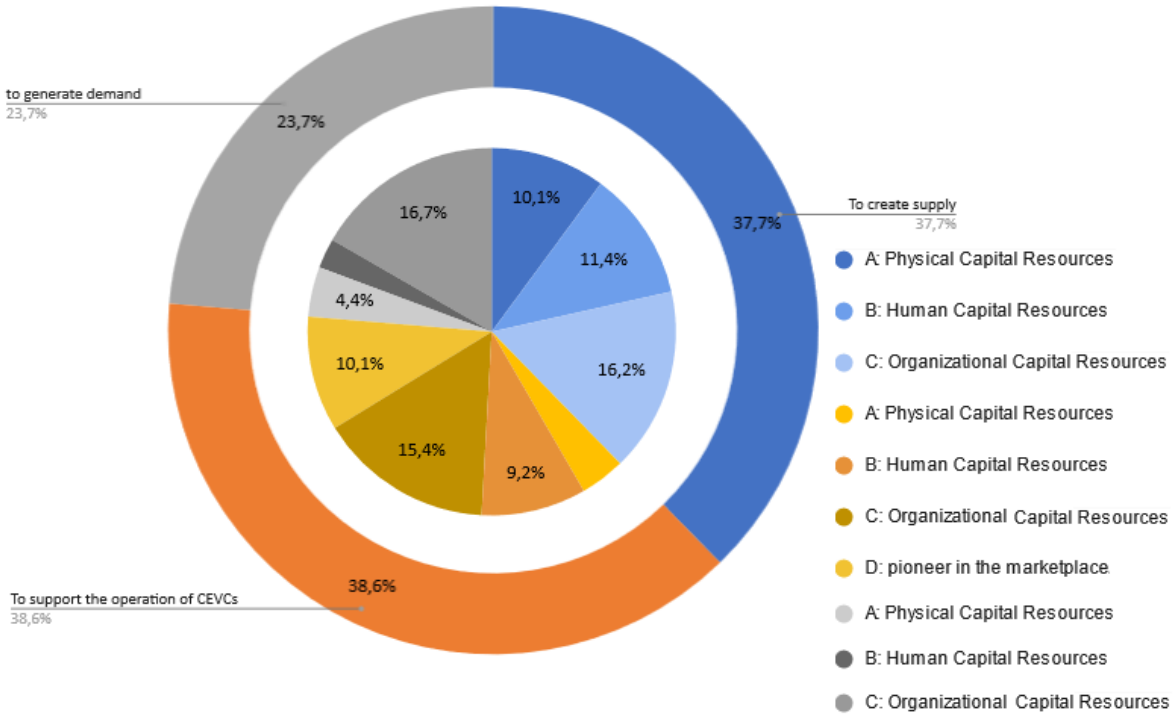

Figure 3. Organisational Resources and Capabilities