DESIGNING BUSINESS MODELS FOR A CIRCULAR ECONOMY

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ABSTRACT

The megatrend sustainability will significantly change the future value creation of manufacturing companies. Their current linear value creation models need to change to conform to the requirements of sustainability. To face the challenges the circular economy has emerged as a promising economic model. With the shift from a linear to a circular economy, companies have to adjust their current business models. However, they still lack knowledge and adequate methods to develop circular business models. Hence, the aim of the paper is a circular business model canvas (CBMC) for designing circular businesses. A systematic literature review was conducted to identify significant criteria for circular business models. The criteria were analyzed utilizing a qualitative content analysis to derive the business model elements required for the circular economy. Existing elements from the Business Model Canvas were enriched and five new elements, e.g., reverse logistics, were found. Then, the business model elements were logically arranged resulting in the CBMC. It guides companies to systematically develop business models for the circular economy. The CBMC was evaluated by applying it within a medium-sized company in the electronics sector.

Keywords: Circular economy, Sustainability, Business models and considerations

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1 INTRODUCTION

The megatrend of sustainability will significantly change the future value creation of manufacturing companies. This confronts companies with a variety of challenges (Acatech, 2021). Thus, companies will have to restructure their existing business concerning economic, ecological and social perspectives (Brundtland, 1987; Elkington and Rowlands, 1999). Especially the historically established value creation structures of the linear economy cannot fulfil the increasing requirements of a sustainable business anymore. In this context, the circular economy model has emerged as a promising approach to contribute to sustainable development and address the specific challenges of sustainable business (Ellen MacArthur Foundation, 2013). However, the transformation towards a circular economy is linked to a fundamental systemic change. The core of the circular economy is based on the extension of the end-of-life concept by reusing, reducing, or recycling technical or biological resources. These so-called R-principles serve as the basic structuring of a circular economy and describe the way how resources flow in a cycle (Kirchherr *et al.*, 2017). The basic 3R model was extended to a 9R framework for making the complexity of a circular economy more transparent by Potting et al. In the 9R framework, the general structuring of a circular economy is extend to refusing, rethinking, repairing, refurbishing, remanufacturing, repurposing, and recovering (Potting *et al.*, 2017). The circular economy must be considered on three levels of abstraction. First, the micro-level includes products, companies, and the consumer. Second, the meso-level considers eco-industrial parks. Thirdly, the macro-level describes entire cities and regions (Kirchherr *et al.*, 2017). Due to the specific characteristics of a circular economy, new business models are needed that meet its requirements (Geissdoerfer *et al.*, 2018). A business model represents the underlying business logic of a company, how value is created, delivered and monetised (Gassmann, 2014). This understanding of business models reflects the traditional linear approach. In the context of circular business models, the underlying principles of a circular economy must be integrated into the design. The consolidation of the general business logic and circular business principles creates the understanding of a circular business logic. Figure 1 shows the resulting business logic of circular business models. In the following the circular business principles are described.

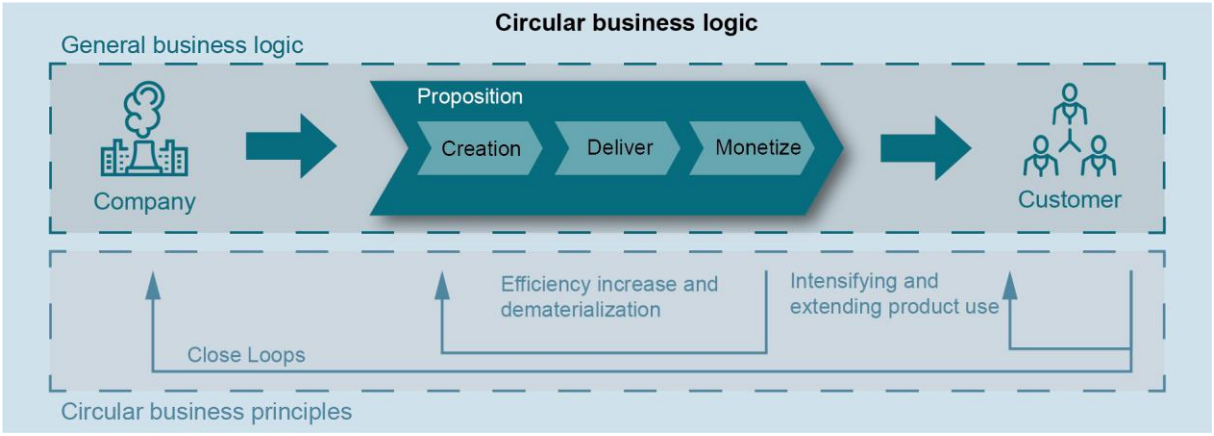

Figure 1: Visualization of the circular business logic

For describing the circular business principles, Bocken et al (Bocken *et al.*, 2016), Geissdoerfer et al (Geissdoerfer *et al.*, 2018), and, Oghazi and Monstaghel (Oghazi and Mostaghel, 2018) define concrete business model principles. These include aspects for closing cycles, increasing the efficiency of products, extending product use (Bocken *et al.*, 2016; Geissdoerfer *et al.*, 2018), intensifying product use (Geissdoerfer *et al.*, 2018) and, dematerialising products, for example through services and software solutions (Oghazi and Mostaghel, 2018). Based on the described understanding of a business model and the circular business model principles, a circular business model is defined as a basic business logic for the creation, delivery and monetisation of market offerings with the aim of closing, optimising, extending, intensifying or dematerialising the market offerings to be provided (Geissdoerfer *et al.*, 2020). However, the transformation of business models towards circular business models is not trivial at all. Rather, companies need to understand the specific requirements of the circular economy and integrate the underlying principles into the design of future business models (Ellen MacArthur Foundation, 2013). Thereby, it is necessary to think and develop circular business

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models spanning several life cycles of the market offering (Bocken *et al.*, 2016). However, as of now companies lack the concrete knowledge to integrate circular aspects into traditional business models. Hence, there is a need for a suitable structuring framework to fulfil the specific requirements of a circular economy and the concept of multiple life cycles (Ellen MacArthur Foundation, 2013). The challenges outlined above lead to two central research questions for the paper:

- What are the key business model elements for implementing a circular economy?
- How can the relevant business model elements be structured for developing circular and multiple lifecycle spanning business models?

The paper aims to provide a structuring framework for such circular business models. The research approach is based on a systematic literature review to identify concrete criteria for circular business models. These are examined with the help of qualitative content analysis and transferred and structured into suitable business model elements. For this purpose, the paper is structured as follows: In section two, the state of the art for developing and structuring circular business models is presented. The applied research methodology is presented in section three. The structuring framework for circular business models is derived and presented in section four. Furthermore, chapter five includes the application and evaluation of the structuring framework with a company from the manufacturing sector. Finally, section six presents the limitation and summary of the paper.

2 STATE OF THE ART

Circular business models operate on the micro-level of a circular economy (Kirchherr *et al.*, 2017). Existing approaches to the development of circular business models are based on conventional procedures, e.g., the business model canvas by Osterwalder/Pigneur (Osterwalder and Pigneur, 2010). Here, the business model canvas includes nine elements to describe how an organization creates, delivers, and captures value. In general, five phases were defined by Osterwalder and Pigneur for the development of a business model. These phases include mobilization, understanding, design, implementation, and management of business models. Serval approaches for designing circular business models are adapting these phases (Osterwalder and Pigneur, 2010). In the following an excerpt of approaches are described.

Lewandowski provides an approach for structuring and developing circular business models. The central result of his work is a circular business model canvas. For this, Lewandowski analysed existing approaches to circular business model development using a systematic literature review. Based on the findings, Lewandowski expanded the business model canvas according to Osterwalder/Pigneur to include the business elements "take-back systems" and "adaptation factors". Within the take-back system, all necessary activities are described to enable the return of products. However, no distinction is made between the activities and resources necessary to implement a circular economy. Within the context of the adaptation factors, the organisational structure of the business model is described, among other things (Lewandowski, 2016).

Bocken et al. examined the development of sustainable business models based on the business model canvas according to Osterwalder/Pigneur. For this purpose, the business model element "value proposition" was divided into three fields "people", "profit" and "planet". In this way, the benefits within the individual sustainability dimensions are taken into account and specified. Furthermore, the existing elements were supplemented by specific guiding questions to be able to depict the characteristics of a circular economy. Due to the structuring and subdivision of the business model elements, Bocken et al. focus on the sustainable benefits within a business model (Bocken *et al.*, 2018).

Antikainen and Valkokari developed a framework for specifying circular business model innovations. They distinguish between three business levels: The business ecosystem level, the business level and the sustainable impact. On the business ecosystem level, the authors integrated concrete trends and drivers as well as the participation of necessary stakeholders in the design of circular business models. For describing the business level, the elements of the business model canvas according to Osterwalder and Pigneur are used. Finally, the sustainable impact level includes specific requirements in the context of sustainability and the resulting benefits (Antikainen and Valkokari, 2016).

For the development of business models beyond the classic life cycle, Nußholz developed a business model matrix to describe the activities after the first sale of a product based on the business model elements according to Osterwalder/Pigneur (Osterwalder and Pigneur, 2010). For this purpose, Nußholz added the business model element "Offer", which comprises the concretisation of the market

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offering. By presenting the circular business model in a matrix structure, the idea of multiple business models for a circular economy is taken up (Nußholz, 2018).
From the presented approaches and tools for structuring and developing circular business models a comprehensive description of all characteristics of a circular economy is only partially available. On the one hand, the understanding of R-principles is only rudimentarily touched upon in most approaches. On the other hand, the underlying idea of multiple business models over several life cycles is only vaguely addressed. Hence, it can be concluded, that a more extensive descriptions of circular business models as well as suitable structuring, also beyond several life cycles, is necessary.

3 REASEARCH METHODOLOGY

The development of a structuring framework for circular business models is oriented towards the design science research approach according to Hevner (Hevner, 2007). It comprises three cycles: relevance cycle (I), rigor cycle (II), and design cycle (III). Within the relevance cycle, the challenges and problems of circular business model development are presented from a research perspective as well as from a company perspective (section 1). During the rigor cycle, existing approaches and theories are investigated to generate a knowledge base (sections 2). This serves as the scientific basis for the design cycle. During the design cycle, a new solution is developed based on the challenges and problems presented as well as the existing approaches (section 4). It is also evaluated in practice (section 5). For the establishment of the knowledge base during the rigor cycle, a systematic literature review according to Webster/Watson (Webster and Watson, 2002) and Xiao/Watson (Xiao and Watson, 2019) was conducted. The procedure encompasses four phases: Selection of the database (I), definition of the search string (II), conducting the search (III), and paper analysis (IV). For the selection of a database, a variety of databases, such as Google scholar, Web of Science and Scopus, were initially checked. Based on the findings, the Scopus database was selected for further analysis. Concerning the challenges and problems presented in the development of circular business models, a suitable search string was developed. It is composed of three central aspects. First, the circular economy was set as the underlying object of consideration. In the second part, the business model aspect was focused on. Finally, the scope of the systematic literature review was refined. For this purpose, concrete challenges, barriers, and requirements for circular business model development were included. This resulted in the following search string:
("circular economy") AND ("business model" OR "business model canvas") AND ("requirement" OR "criteria" OR "components" OR "challenges" OR "barriers")
To identify relevant literature, the search string was used to search the Scopus database at the title, keyword, and abstract levels. A total of 202 (= n) papers were identified which represent the longlist. In a five-step evaluation process, a shortlist of all relevant papers was created. The evaluation process and the main results are shown in Figure 2.

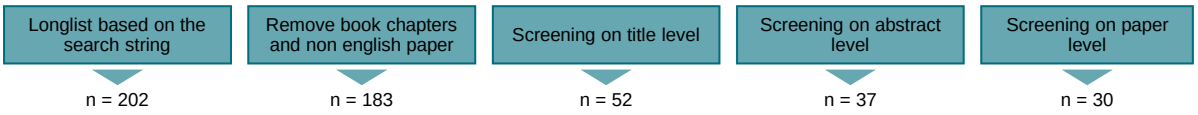

Figure 2: Evaluation scheme for conducting the search

As a first step, book chapters and non-English language papers were removed. For the evaluation of the remaining papers on the title-, abstract-, and paper-level, a two-stage evaluation scale was applied. For this purpose, two researchers used the guiding question "Does this paper address aspects relevant to business models for the circular economy or approaches for the implementation of the circular economy?". Relevant papers were rated with an "x" and irrelevant papers with an "o". 183 papers were analysed at the title level according to the evaluation scheme. 52 papers remaining were then analyzed at the abstract level and irrelevant papers were eliminated. Finally, the remaining 37 papers were read in their entirety, leaving a total of 30 papers as data basis for the development of a structuring framework for circular business models. In the course of the data analysis, the paper database were analyzed using qualitive content analysis (QCA) according to Mayring (Mayring, 2000). The QCA encompasses the three phases: Summary, Explication, and Structuring. For the Summary the paper database was reduced to the general criteria for developing circular business models. Further, the explication is based on the creation of a consistent understanding of the general criteria. For this, the criteria were paraphrased to consistent criteria. Finally, the paraphrased criteria were structured to new business elements.

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4 RESULTS

The core of the following section is the structuring framework for the design of circular business models. Based on the data of the systematic literature review, significant criteria for circular business models are identified. For this purpose, concrete requirements, challenges, or barriers for the design of circular business models were extracted and summarised into meaningful criteria. A total of 45 criteria have been identified that influence the design of circular business models. Based on the criteria and their specifications, it emerged that a many of the criteria could be assigned to the business model elements of the business model canvas according to Osterwalder and Pigneur refining them. Figure 3 visualize the criteria which are assigned to the elements of the business model canvas according to Osterwalder and Pigneur.

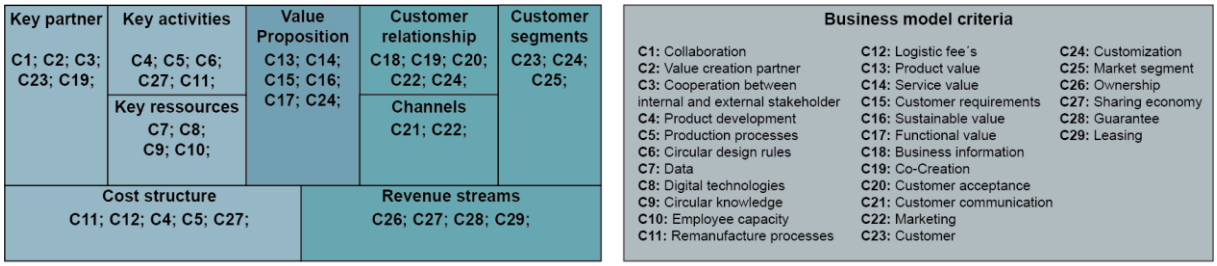

Figure 3: Assignment of the criteria to the elements of the business model canvas

Consequently, the business model canvas according to Osterwalder/Pigneur was chosen as a basic structure for the new framework. In the following, the influence of the identified criteria for circular business models on the business model elements of the business model canvas according to Osterwalder/Pigneur are described and explained.

Customer segment

Customer segments describe the different groups of users or organisations that are to be addressed by the business model. Due to the increasing importance of sustainability, new customer groups with extended requirements are emerging, which can be addressed, for example, by complementary services for resource conservation or used products (Osterwalder and Pigneur, 2010; Lewandowski, 2016).

Value proposition

The value proposition characterises the way of a product or service to create added value for the addressed customer segment. The value proposition covers the problems of the customer segment under consideration and provides a solution (Osterwalder and Pigneur, 2010). In a circular economy, the value proposition is an essential component of circular business model development. This involves the description of the sustainable value of a circular market offering in addition to the functional value (Bocken *et al.*, 2018).

Channels

Channels clarify the way a company communicates with the focused customer segment regarding the value proposition of different products and services. This ensures that the customer segments develop a constant awareness of the company (Osterwalder and Pigneur, 2010). In addition, the company can use the channels to verify that the value proposition is reaching the customer in the context of a circular economy (Antikainen and Valkokari, 2016; Geissdoerfer *et al.*, 2020).

Customer relationship

The intensity of communication and relations with the customer is specified by the element customer relationship (Osterwalder and Pigneur, 2010). Here, the acquisition of new customers as well as the verification of customer acceptance towards circular market offerings is an essential feature, e.g. for remanufactured products. The collaboration with the customer, the so-called co-creation, for new market offerings is also specified in the context of the customer relationship (Pieroni *et al.*, 2019).

Revenue stream

The incoming cash flows that are generated through the market offering are specified using the revenue stream element. It is divided into one-time and continuous cash flows (Osterwalder and Pigneur, 2010). Here, it is necessary to design the revenue streams according to the requirements of a circular economy. Alternative operator models can, for example, increase product use through leasing offers, whereby the user only pays for the use of the product. In this case, the ownership remains with the company (Bocken *et al.*, 2016; Sousa-Zomer *et al.*, 2018).

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Key resources

Within the business element key resources, all assets are specified that are needed to enable the operationalisation of the business model. These include, for example, financial resources, employee capacities or know-how (Osterwalder and Pigneur, 2010). Especially in the course of a circular economy, the development of specific competencies regarding the functioning and implementation of a circular economy is necessary (Ellen MacArthur Foundation, 2013). Particularly, for potential reprocessing processes, reprocessing centres act as a significant resource for the introduction of a circular economy (Bocken *et al.*, 2016). In the course of a sharing economy, the establishment or entry of a platform is an important resource to enable access to the market offering for the customer (Jabbour *et al.*, 2020).

Key activities

The most relevant activities of a company to realise the operationalisation of the business model are documented in the element key activities (Osterwalder and Pigneur, 2010). Depending on the design of the circular business logic, different key activities are required. For example, remanufacturing processes of products is an essential component for the implementation of a circular economy (Kirchherr *et al.*, 2017). Similarly to the key resources, activities to build and implement a platform are activities to be considered, e.g. to achieve a sharing economy (Antikainen *et al.*, 2018).

Key partners

The network of strategic partners and suppliers to deliver the focused market offering are called key partners (Osterwalder and Pigneur, 2010). Concerning the implementation of a circular economy, on the one hand, partners are necessary who cooperatively design the market offering to be provided, e.g. development partners or platform operators (Bressanelli *et al.*, 2019), and on the other hand, partners who implement activities for return logistics, e.g. logistics service providers, are needed (Reim *et al.*, 2021).

Cost structure

The costs incurred to provide the market offering are recorded in the cost structure element. The costs incurred are the basis for determining a suitable price for the focused market offering (Osterwalder and Pigneur, 2010). Exemplary costs for the introduction of a circular economy are logistics fees for the return of products, repair costs, or additional production costs for the reprocessing of products (Bressanelli *et al.*, 2019).

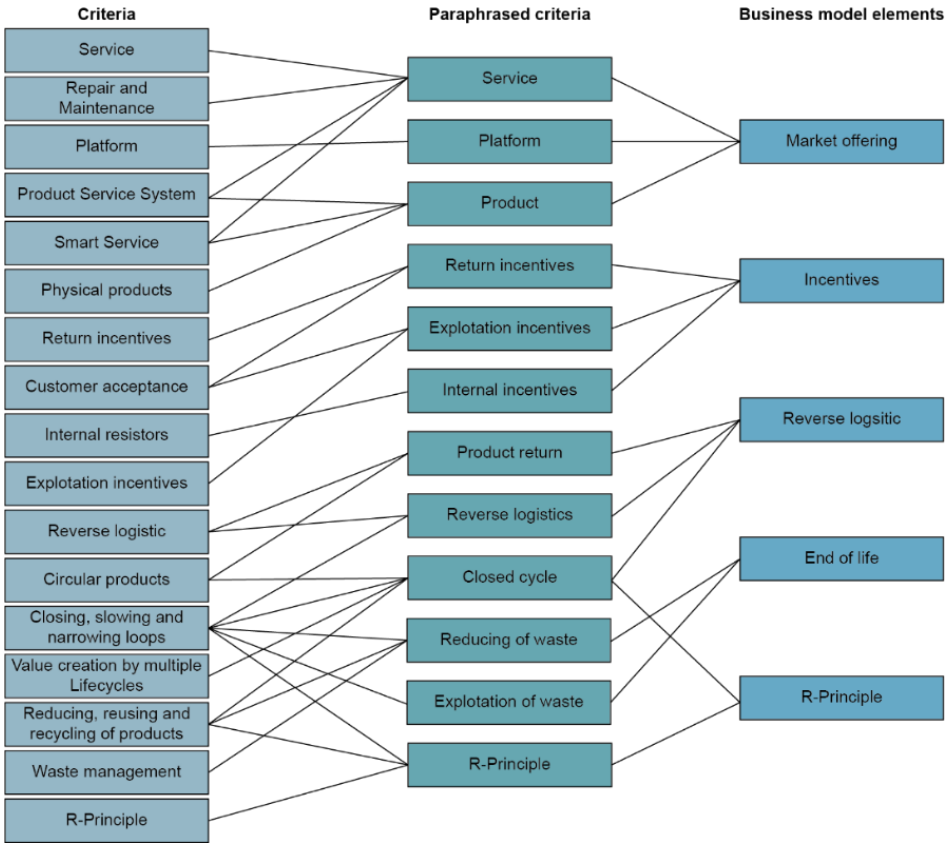

Figure 4: Identifying of business model elements for a circular economy

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Complementary to the criteria and business model elements already outlined, a total of 17 criteria could not be directly assigned to the elements of the business model canvas according to Osterwalder/Pigneur. In the following, the circular criteria are examined using qualitative content analysis. For this purpose, the criteria were divided into similar thematic areas and paraphrased to a standardised level of consideration. This ensures comparability between the criteria. A total of 12 paraphrased criteria were derived. Finally, concrete business model elements are derived from the paraphrased criteria. The hierarchical structure shown in Figure 4 reflects the procedure for deriving the circularity-specific business model elements. The result of the qualitative content analysis are five additional business model elements that support the circular business logic. The elements include market offering, incentives, reverse logistics, end of life, and R-principles. The outlined circular business elements are defined and explained below.

Market offering

The market offering comprises the product or service to be offered for providing the defined value proposition to the customer segment under consideration (Nußholz, 2018). The market offering can be a separate product or a service, such as maintenance, servicing or platform service, as well as a bundle of a physical product and a complementary service (product-service system) (Tukker, 2015). The service business especially promotes the implementation of a circular economy. Services have the potential to be individualised to the customer and to simplify the return processes, for example through track and trace technologies to create transparency on the product location (Treick *et al.*, 2022).

Incentives

Within the business model element incentives, all motivating factors for relevant stakeholders to participate in the circular business model are described. Here, internal stakeholders (e.g., maintenance managers) (Bressanelli *et al.*, 2019), as well as external stakeholders (e.g., end users) (Lewandowski, 2016), should be addressed with appropriate measures to get them to participate in implementing a circular economy. For that, incentives for recycling and proper disposal in the context of end-of-life are described. These can take place on a monetisation basis, among other things (Bigliardi and Filippelli, 2021).

Reverse logistics

Reverse logistics describes the necessary processes and measures for the return of products (Bressanelli *et al.*, 2019). Thus, reverse logistics is an essential component in the closing of cycles and describes the transition between different product life cycles (Ranta *et al.*, 2018). For example, it can be defined whether the end-user or the company is responsible for the return (Lewandowski, 2016).

R-principle

The business element R-principle defines the planned thrust of the circular business logic and describes how specific components or products are to be reused or recycled. The 9R framework according to Potting et al. can serve as a basis for this (Potting *et al.*, 2017). Through the concretisation of the R-principle, the coming product life cycle is specified (Ranta *et al.*, 2018). By planning the R-principle to be carried out, necessary activities (e.g., function control) and resources (e.g., spare parts) for the coming product life cycle can be derived as well (Bjørnbet *et al.*, 2021).

End of Life (EoL)

The End of Life (EoL) is the final element of the business model and describes all activities and operations to dispose of the product properly and under sustainable aspects (Bigliardi and Filippelli, 2021). In the process, the end user can be provided with information on the composition of materials, for example, to enable downstream recycling (Geisendorf and Pietrulla, 2018).

The five resulting new business model elements are added to the traditional business model canvas according to Osterwalder/Pigneur. The resulting 14 business model elements are suitable to describe a circular business logic holistically. To address the requirement to illustrate multiple business models, the business model elements are rearranged through a creative modelling process. In the following, the final structuring framework for the development of circular and multiple lifecycles spanning business models is presented and explained in Figure 5.

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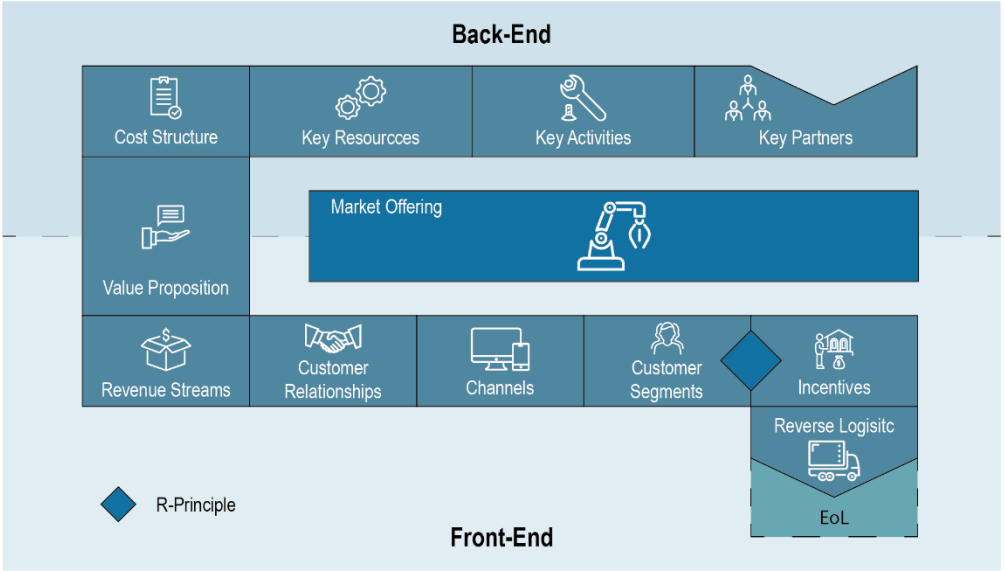

Figure 5: Visualization of the circular business model canvas

The processing sequence of the circular business model canvas presented is based on the value-added-oriented design according to Osterwalder/Pigneur. The underlying logic of the canvas is to be understood vertically from the top to the bottom. The starting point is the focused market offering at the centre of the business model canvas. Depending on the defined market offering, all partners, activities, resources, and costs that are necessary to provide the market offering in the life cycle under consideration are specified. These elements are not perceived by the customer and are therefore referred to as the back-end of the business model. The boundary between the back end and the perceivable front end is the value proposition. Following this, the revenue streams, customer relationships, channels, and customer segments are defined. The transition to the new product life cycle is described with the specified R-principle. To operationalise the R-principle, the necessary external and internal incentives and finally the required logistics processes are defined. The business model element end of life is only filled in as soon as there is no R-principle to be specified and disposal of the market performance is focused. For the application to several product life cycles, the canvas is structured in a modular way. Thus, reverse logistics describes the transition from the front end of the previous to the back end of the following cycle enabling depicting a multiple lifecycle spanning business model. In the following section 5, the application of the circular business model canvas is illustrated using the example of a medium-sized company in the manufacturing industry.

5 EVALUATION

In the following section, the developed circular business model canvas is evaluated with a medium-sized company from the manufacturing industry. The focus of the business model to be developed is a charging stations in the automotive sector. Due to the anticipated life expectancy within a product life cycle of up to 15 years, the company decided on a total of two cycles before aiming for disposal. Based on this strategic decision, the circular business model canvas was modularly extended by another life cycle before the final element describes the EoL of the product. Due to partially sensitive data, the content representation of the individual elements has been generalised. In the following an excerpt of the circular business model canvas is described. First, the company decided to offer a sharing platform for charging electric cars. For this, the charging station and the resulting ecosystem of the platform were specified as the market offering. Following this idea, the back-end was elaborated. For this, development and payment service providers were specified as key partners. Following on, the development of the platform and the specification of the payment system were characterised as necessary key activities. This requires a high level of employee capacity for realising the development of a platform. The accompanying maintenance and operating costs for the platform were listed as examples in the cost structure. The planned ecosystem will provide customers with easy access to charging their electric cars. Lock-in offers and brokerage fees are initial revenue streams for realising the business model. Here, it is planned to implement the business model as an operator model. As soon as the function of a charging station is not guaranteed, the company plans to return the

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used products to the ecosystem via remanufacturing in the second life cycle. For this purpose, the used products will be replaced by functional charging stations and returned through a logistics service provider. The necessary remanufacturing processes are to be conducted by the company itself to offer these to other customers. Based on the elaborated multiple business models, the company can concretise and implement the first measures for operationalisation.

6 DISCUSSION AND CONCLUSION

In this paper, two central research questions were investigated, and corresponding solutions were presented. First, significant business model elements for the characterisation of circular business logic were elaborated. For this purpose, a systematic literature review identified criteria that are relevant to the business model and transformed them into business model elements by qualitative content analysis. In total, 5 circular business model elements were derived and added to the existing business model canvas according to Osterwalder/Pigneur. Through this, companies receive a tool for the concretisation of circular business logic and a general orientation for the implementation of a circular economy. For research, the circular business model elements serve for a deeper understanding of the description and development of circular business models. Furthermore, the business model elements were transferred into a suitable structuring framework to develop multiple lifecycle spanning business models. The proposed circular business model canvas includes all aspects for describing a circular business logic and can be extended in a modular way depending on the anticipated number of life cycles. The evaluation outlined in the paper demonstrates that the practical applicability of the circular business model canvas is ensured. This provides companies with an applicable and customisable structuring framework for designing circular business models.

However, a couple of limitations arise in the course of the paper. First, only the Scopus database was searched in conducting the systematic literature review. This raises the possibility that not all relevant papers on circular business model development were considered. Furthermore, the presented circular business model canvas provides a defined direction (value-added oriented) for the concretisation of the individual elements. Therefore, the structure of the canvas should not be understood as sequential, but rather must be carried out in an iterative approach.

Based on the results presented in the paper, future activities in this field of research arise. On the one hand, a systematic method for deriving concrete measures for operationalising a circular business model is needed for planning the implementation of a circular economy in a structured way. Furthermore, the developed circular business model must be quantified and evaluated concerning the sustainability dimensions. A suitable methodological support does not yet exist.

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