Product Lifetimes And The Environment
2017 - Conference Proceedings
C. Bakker and R. Mugge (Eds.)

DOI: 10.3233/978-1-61499-820-4-309

PLATE conference
Delft University of Technology
8-10 November 2017

PLATE
Product Lifetimes And The Environment

Circular business model framework: mapping value creation architectures along the product lifecycle

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Keywords
Circular economy
Circular business model
Business model innovation
Value management
Product lifecycle

Abstract
Circular business models are foreseen to contribute to enabling prolonged lifetimes of products and components through successive cycles of reuse, repair, remanufacturing and closing material loops. To realize economic viability and resource efficiency savings from a circular business model, early consideration and integrated planning of the product lifecycle and value creation architectures at the relevant points in the lifecycle is pivotal. However, the current frameworks for business model design have not been designed to recognize the specific opportunity points of the product lifecycle to create and capture additional value from cycling resources. They do not acknowledge that it often takes distinct value creation architectures and value propositions to capitalize on the value creation potential. To attend to this gap, this paper develops a circular business model framework that is based on the current understanding of resource efficiency strategies and systematically integrates lifecycle value management with traditional business model design thinking. Through this, the developed framework is intended to serve as guidance for circular business model development to incorporate circular principles and to capitalize on additional value from cycling resources. To explore the usefulness of the framework developed from literature, a comparative case study design with two cases of Swedish companies operating circular business models is employed. The framework proved useful to map the companies' distinct value creation architectures that enable cycling of resources and to point to opportunity spaces for additional value creation. Suggestions for further refinement are made.

Introduction

To realize circular economy principles and resource efficiency strategies in a way that they generate sufficient business and customer value, the development of circular business models is regarded as pivotal (Bakker, Wang, Huisman, & den Hollander, 2014; EuropeanCommission, 2015; Linder & Williander, 2015). Circular business models are envisioned as contributing to enabling prolonged lifetimes of products and components through successive cycles of reuse, repair, remanufacturing and closing material loops. If planned and managed effectively, cycling resources and preserving embedded value open new possibilities for creating and capturing value for companies (Bakker et al., 2014; Den Hollander & Bakker, 2016; Moreno, De los Rios, Rowe, & Charnley, 2016). Yet the management of such continued networks of value generation and maintenance leads to new needs regarding business model planning. To realize economic viability and resource efficiency savings from a circular business model, early consideration and integrated planning of the product lifecycle and value creation architectures at the relevant points in the lifecycle is pivotal.

However, the existing tools for designing business models, e.g. the business model canvas (Osterwalder & Pigneur, 2010), as well as the newly emerging tools aimed at the design of circular business models, e.g. the framework for sustainable circular business model innovation (Antikainen & Valkokari, 2016; Lenssen et al., 2013; Rashid, Asif, Krajnik, & Nicolescu, 2013) do not incorporate the idea of value management along the product lifecycle. They have not been designed to recognize the specific opportunity points within the product lifecycle to create and capture additional value from cycling resources and that it often takes distinct value creation architectures (Velte & Steinhilper, 2016) and value propositions (Araujo & Spring, 2006) to capitalize on them.

To attend to this gap, this paper aims to develop a circular business model framework that is based on the current understanding of resource efficiency strategies (Bocken et al., 2016; Willskytt, Böcking, André, Tillman, & Ljunggren-Söderman, 2014) and that systematically integrates lifecycle value management with traditional business model design thinking. Through this, the developed framework is intended to serve as guidance for circular business model development to incorporate circular principles and to capitalize on additional value from cycling resources. It is aimed to support the mapping, analysis, design, and communication of circular business

models and the distinct value creation logic at the relevant points of the product lifecycle.

To explore the usefulness of the framework developed from literature, a comparative case study design with two cases of Swedish companies operating circular business models is employed. By applying the developed framework on the case companies, the validity of the literature-based framework is tested and evaluated. Its explanatory capacity is judged based on its ability to deliver insights that the 'linear' business model framework (Osterwalder & Pigneur, 2010) would not be able to deliver. In particular, additional information regarding distinct value creation architectures to cycle resources and to point to opportunity spaces for value creation. Based on this, suggestions for further refinement are made.

This paper proceeds with providing a literature background on circular business model innovation and value creation in section two, followed by the presentation of the framework. Section three presents the application on the case studies. Section four offers the validation of the framework. The paper concludes with a discussion and final remarks offered in section five.

Literature background and development of framework

Business model innovation

Business models can be used to present the organizational structure and value creation processes of a company (Wirtz, Pistoia, Ullrich, & Göttel, 2016), defining how an organization will convert resources and capabilities into economic value (Teece, 2010). A framework for conceptualizing business models that has been acknowledged for its practical relevance is the "business model canvas" by Osterwalder and Pigneur (2010). The authors distinguish nine business model elements. These elements describe three value dimensions:

(1) The value proposition - What value is provided and to whom? (comprising elements of value proposition, the offer, customer segments, and customer relationships)
(2) The value creation and delivery- How is value provided? (comprising elements of key resources, key activities, key partners, and channels)
(3) The value capture mechanisms - How does the company make money and capture other forms of value? (comprising elements of cost structure, and revenue flows)

Business model innovation has received attention as a way to implement and capitalize on resource efficiency strategies that enable cycling of resources (Planing, 2015). Through innovating what value is provided, an offer can be designed with a resource efficiency strategy in mind. Innovating how value is created, delivered, and captured, can help to implement and capitalize on a resource efficiency strategy and its associated value. Where value creation in circular business models stems from is explored in the following.

Value creation in circular business models

It is commonly assumed that value in circular business models is, to some extent, created differently compared with linear business models (Bakker et al., 2014; Bocken et al., 2016; Moreno et al., 2016). Particular about circular business model is that they preserve and utilize the value embedded in products, parts, and material through resource efficiency strategies of cycling resources. Generally, two fundamental strategies towards cycling of resources can be distinguished (Bocken et al., 2016; McDonough & Braungart, 2010; Stahel, 1994, 2010). Those that;

(1) prolong useful life of products through design for long-life and through life extending measures as reuse, repair, or remanufacturing (also referred to as slowing loops); and
(2) reuse of materials through recycling (also referred to as closing loops).

Cycling resources can create environmental gains from utilizing the energy and resources embedded in products as long as possible. Additionally, it can create economic gains from exploiting the residual economic value in products (Bakker et al., 2014) and from creating additional value-adding business activities (Ferrer & Clay Whybark, 2000) through the design of new offerings.

A logical consequence of cycling resources is that products, parts, and materials need to be in some form recovered at the end-of-use and reintegrated into the value chain for an additional life (Wells & Seitz, 2005). Moreover, long useful life should be enabled. When the end-of-life is irreversibly reached, material cycles should be closed (Bocken et al., 2016). Thus, capturing the embedded value through strategies for cycling resources, can be seen to occur through three generic interventions at different lifecycle points.

(1) recovery and reintegration in the value chain,
(2) enabling prolonged use, and;
(3) addressing the end of life.

When embedding strategies of cycling resources into a market offering, these three interventions should ideally be considered. To effectively utilize these opportunities beyond a single life of a product in the business model, timely consideration and integrated planning of the required activities is pivotal (Araujo & Spring, 2006). If a company spans more than one of these three phases, -to some extent separate- revenue architectures and value creation logics will need to be designed to effectively create, deliver and capture the potential value. For instance, to enable a second life of a product, its value proposition - from the beginning- needs to be thought of as more fluid, and subject to re-definition along the product lifecycle (Araujo & Spring, 2006).

To attend to these needs, based on the business model framework of Osterwalder and Pigneur (2010), a

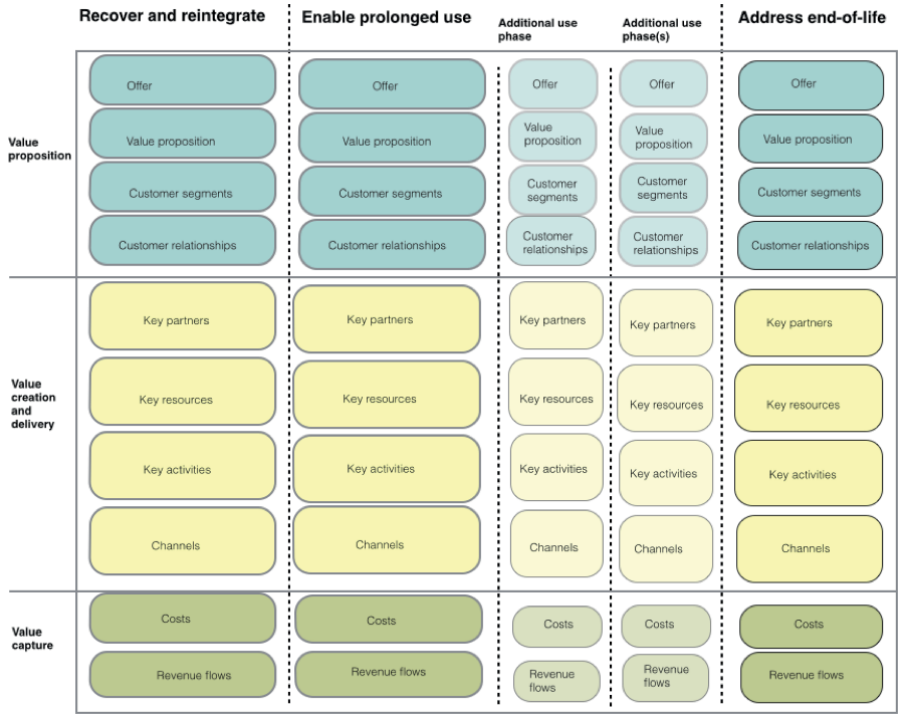

Figure 1. Circular Business Model Framework.

framework for circular business model mapping is suggested (Figure 1). The framework integrates the three value dimensions ((1) Value proposition, (2) Value creation and delivery, and (3) Value capture), and their business model elements, with the three lifecycle intervention points ((1) Recovery and reintegration, (2) Prolonged use, and (3) End-of-life). Prolonged use is subdivided in two segments. One accounting for prolonged single life by the same owner, and the other accounting for additional use phases, in which a change in ownership takes places. The framework is considered as a tool for further exploration in this study and tested in the following.

Case study application

Two Swedish companies, Company A and Company B, which operate business models that enable long life and cycling of resources were selected for an initial pilot study. The Swedish context was chosen due to its longstanding tradition of innovative business models, high consumer awareness of environmental issues, and forward-looking policies in regard to resource efficiency. To verify suitability of the framework for different circular business models and strategies, the case companies were selected to represent different value chain positions, product groups, types of offers, sectors, and resource efficiency strategies. Table number 1 offers an overview on both case companies' operations. Thereinafter, an analysis of each companies' business model is presented, using the developed framework. The analysis offers a short description of each business model, focusing on their value creation architecture along the product lifecycle.

Description of Company A's business models

Company A's business model to this date enables the recovery and reintegration of by-products from the wood and plastic company. These are used as an input for the production of a material composite. From the composite a variety plank products are manufacture that are designed for long-life and recycling. Figure number 2 presents Company A's value creation architecture from the by-product recovery to the end-of-life phase. Business model elements in the lifecycle points that are currently not fully addressed through the business model configuration are presented in dashed lines.

Mapping Company A's value proposition in each of the phases, highlights that two distinct value propositions can be identified; one to the material suppliers, and another to the customers of the product. While the one to the customers is comprehensive, including low maintenance and long-life products, resulting in low life-cycle costs, the value proposed to suppliers in the reintegration phase is developed to a lesser extent. Value to the by-product supplying companies does not go beyond a short-term market transaction, based on the highest price offer. Thus, there is potential to find partners to whom additional value could be offered, e.g environmental reports on closed-loop practices (Schenkel, Caniëls, Krikke, & van der Laan, 2015). Business developers at Company A are indeed currently pursuing such innovation (Fernlund, 2017).

The end-of-life of Company A's product is addressed by

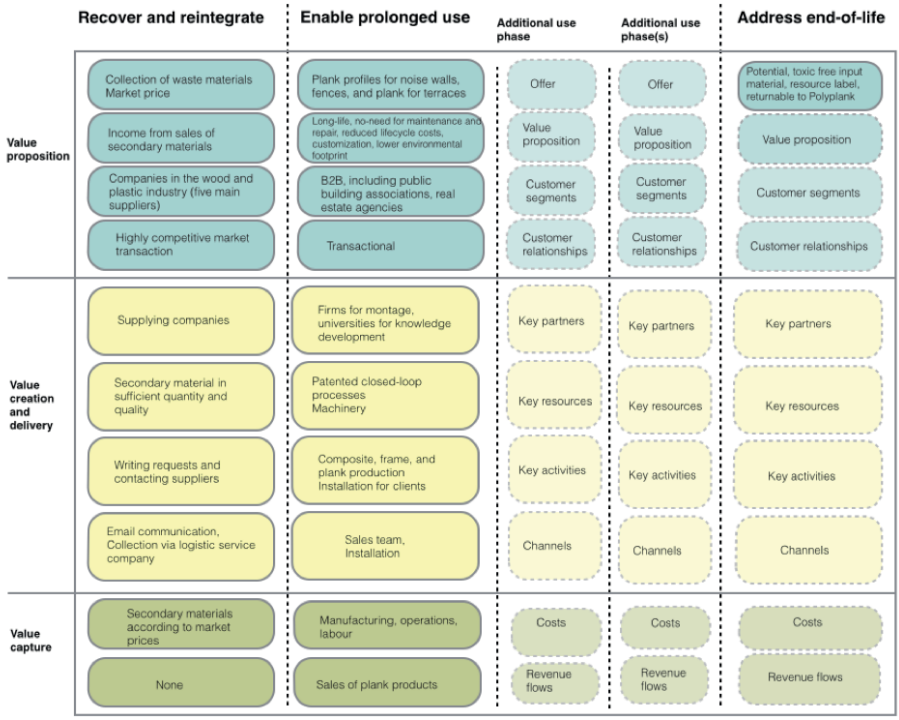

Figure 2. Circular Business Model Framework for Company A.

the products' suitability for recycling (either as hazardous substance-free input for waste-to-energy processes or as input material for their own production). Therefore, each product is labelled with a resource passport and company contact information. Yet, the business model mapping reveals that the associated value can currently not be fully captured. This is credited to the long lifetime of products (approximately 25 years), which hinders Company A to establish a take-back system. The product design for recycling and labelling however can be considered as important steps towards capturing this value. To further enhance value capture, for some selected short-term applications of the products, the value creation around the additional life phases and end-of-life could be revisited.

Description	Company A	Company B
Offer	Plank profiles from recyclable, toxic free and long-life material composite. Plank profiles are used for instance for noise walls, fences, terraces.	Match-making service to enable reuse of unused goods within an organization by means of an IT platform
Sector	Building	Various
Main product groups[1]	Fences, noise walls, terrace planks	Furniture and office equipment
Value chain activities	1) Production of material composite, 2) Production of frames 3) Assembly to plank profiles 4) Installation	1) Intermediator
Resource efficiency strategy enabled	Substitution of virgin material Design for long life Design for recyclability	Reuse
Number of employees	20	2

Table 1. Overview on Case Company Characteristics.

Description of Company B's business models

Company B's business model creates value from enabling reuse of unused goods in private and public organizations through offering access to an IT platform, through which new applications for surplus goods can be identified. Figure number 3 illustrates the value creation architecture around realizing reuse practices. Business model elements at the lifecycle points, that are currently not fully addressed through the business model configuration, are presented in dashed lines.

The value proposition dimension is designed to encourage provision of unused goods by one organizational unit and the purchase of these goods by another unit. This partly leads to two distinct value propositions (highlighted in bold in Figure 3). The providing unit benefits from reduced storage and waste creation, while the purchasing unit benefits from quick, worry-free and low-priced delivery of goods. Overall the customer organization that uses the IT platform benefits from utilizing residual value in goods, from monitoring and reporting of financial and environmental savings, and from consultancy services and training to establish organisational practices for reuse.

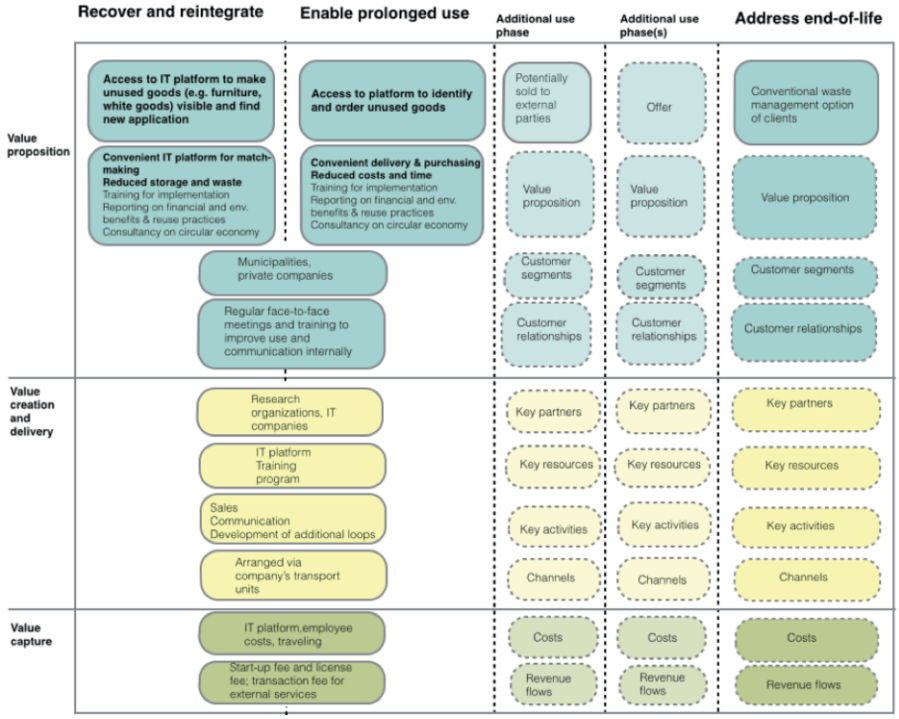

Figure 3. Circular Business Model Framework for Company B.

Application of the framework illustrates that, to this date, reuse is predominantly realized within one organization, as opposed to redistribution to third-parties. This explains why value creation, delivery and capture is configured in a similar manner for both, the recovery and use phase. The mapping reveals that opportunities exist for creating and capturing value from enabling several additional use phases, potentially through involving third parties. Such business model innovation is indeed currently explored by company managers (Östlin, 2017). It also shows that the end-of-life of goods, when no additional application can be found, to this date is handled according to the common waste management practices of the participating organization. Revisiting this lifecycle phases to explore innovation for additional value creation and capture could be another innovation opportunity. The framework may be of guidance in creating suitable revenue creation architectures around such additional offerings.

Validation of framework

Applying the framework showed that it lends itself to illustrate how value dimensions are configured at the distinct intervention points in the product life cycle to enable cycling of resources. For both case companies, it was useful to recognize, in which intervention points are currently addresses and which ones not. Although companies will certainly not always be engaged in all of them[1], this can point to opportunity spaces where potentially more of the embedded value could be captured and value-adding activities organized. Thus, a main benefit of the framework can be deemed its guiding function to address value creation opportunities from circular practices.

While in Company A's business model indeed distinct value creation architectures were identified, Company B's value creation architectures were similar, as the focus was on reuse within the same organization. Thus, the more cycles a company realizes and the more divers value architectures for each of the phases become, the more valuable the framework can be deemed. In these cases, the framework lends itself to analyse value creation architectures at each step in an integrated manner, recognize interdependencies, and innovation opportunities.

The framework was found suitable to depict different types of business model offers and resource efficiency strategies (e.g. service offer vs. a product offer, as well as long-life, recyclable product vs. reuse). Yet, more research is needed that includes different types of business models, as identified by Bakker et al. (2014), focusing on cases companies that enable several use phases. Future research should also validate the usefulness involving practitioners.

Conclusions

The developed circular business model framework can be judged useful to conceptually express the business logic of firms spanning various points in the product lifecycle.

[1] *For instance, due to external barriers to operate strategies of cycling resources. Or, because cycling resources in the specific case may not lead to economically and environmentally superior results.*

It appears to be valuable to map and analyse the case companies' distinct value generation architectures and networks at the relevant points of the product lifecycle. For business models that enable a limited number of cycles – or cycle resources within the same organisation - value creation networks can be assumed to differ to a lesser degree between lifecycle points. Here, the framework seems of lower added value compared to the linear business model framework. Yet, it can visualize potential opportunity spaces to further capitalize on the embedded value in products in other lifecycle stages. Thus, the main contribution of the framework can be deemed its guiding function and detailed analysis for business model design based on circular strategies.

Acknowledgments

This research was supported by the Mistra REES (Resource Efficient and Effective Solutions) program, funded by Mistra (The Swedish Foundation for Strategic Environmental Research).

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