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RESEARCH PAPER

An Analysis of a Bike-Sharing System from a Business Model Perspective*

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ABSTRACT

Goal: Product-service systems are innovative business models that aim to contribute to sustainability issues. Bike-sharing system is a classic example of this kind of business model. This work covers an analysis of a bike-sharing system implemented in the South of Brazil from a business model perspective by focusing on the value network.

Design / Methodology / Approach: Data was collected based on interviews with the executives of a focal company and information retrieved from other sources, e.g., company internal reports, PSS design documents, etc.). A research protocol was developed based on the literature to identify a set of variables to be interpreted. A semi-structured questionnaire was developed for interviews, which was recorded for later content transcription and analysis.

Results: The business model value network and mechanisms of value proposition, configuration, delivery, and value capture are described. This business model is based on a diverse value network and should be developed and updated on co-creation mechanisms to deliver more sustainable results.

Limitation of the investigation: It is a single study conducted in a medium-sized town in the South of Brazil that implemented a bike-sharing system. In addition, the analyis was considered in the "problem identification phase".

Practical implications: The bike-sharing business model analysis may improve the business model towards increasing the inhabitants' quality of life as well as city image.

Originality / Value: The study was conducted in a developing country, analyzing a PSS business model from a sustainable operations perspective, which is not common in the current literature.

Keywords: Product-service System; Sustainable Business Model; Bike-sharing; Bicycle Sharing System.

INTRODUCTION

Services have been offered as a strategy to leverage the sale of products, especially in emerging economies like Brazil (Ayala et al., 2019). Many manufacturing companies started to move from a business model focused on a product to one centered on service (Raddats et al.,

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2019). A product-service system (PSS) is characterized as an integrated package of products and services to create customer utility and generate value (Zheng et al., 2019). In PSS research, empirical analyses based on the structure of business models remain limited in the literature (Sousa-Zomer and Cauchick-Miguel, 2019). Much of the work on PSS investigates the contexts of developed countries; as a result, most business models are designed for such context (Pallaro et al., 2017). Due to subjectivity and involvement with contextual issues in the context of research in services, there is a need for studies that analyze the local context.

Bike-sharing systems are one of the most classic examples of PSS business model in business-to-consumer (B2C) markets and have been studied to improve urban mobility in the concept of micro-mobility (Moro, 2020). Bike-sharing systems provide access to a healthy, affordable, and convenient form of transport (Kwiatkowski, 2021). This kind of sharing systems can contribute towards sustainable (environmental, economic, and social) benefits, and their implementation has expanded in many countries (Sousa-Zomer et al., 2016). Nevertheless, there are examples of the failure of this kind of PSS (see, Moro et al., 2018). In China, for instance, while there are successful start-ups like Ofo and Mobike, small companies like Wukong Bicycle went bankrupt in June 2017, after only five months in operation, with 90% of its bicycles lost or stolen (Webster, 2018). Thus, it is highlighted that to achieve long-term benefits, it is necessary to understand the system more broadly (Webster, 2018), covering the context in which the PSS will be part of. In this sense, this work aims at analyzing a bicycle sharing system from the perspective of the business model value involving the entire network. Even though bike-sharing systems have existed in Europe for decades, and there are already some companies installed in Latin America offering such business models, the analyzed company serves a specific market niche of small and medium-sized cities.

The remainder of the paper is structured as follows. The following section outlines a brief background on product-service system business model design and, more specifically, bike-sharing systems. The subsequent section highlights the research methods adopted to analyze the bike-sharing business model, and then the results are described. Finally, the last section draws some concluding remarks and research implications of this study.

PRODUCT-SERVICE SYSTEM-RELATED BACKGROUND

PSS Business Model Design

Literature on business models shows that PSS is a sustainable way of offering value to customers (Bocken et al., 2014). The PSS approach is focused on new businesses that meet the customer's functional needs in innovative ways, adding services to products (Scheepens et al., 2016). This approach was proposed as an opportunity to promote sustainability and strategic development of the business model (Tukker, 2004; França et al., 2017) and deliver more value to customers (Reim et al., 2015). The design of a business model proposed by Moro (2020) is organized in four stages: (i) value proposition, (ii) value configuration, (iii) value delivery, and (iv) value capture. It also encompasses a set of components (or 'elements' in other words) that are used to represent the business functioning in a simplified way (Moro, 2020).

Value configuration and value delivery regard internal activities and processes in production. Value proposition and value capture refers to how the business model is structured to be connected with its value network. These previous cited stages represent a gap in PSS literature and were the main focus of this work, as follows.

The business model 'value proposition' describes the purpose of the business for customers, differentiating them from competitors and sustaining their activities and use of resources (Bocken et al., 2014). The value proposition relates to the strategic decisions taken by the focal company, describing its approach to competitive advantage, what the company delivers to its customers and why they are willing to pay for it (Andreassen et al., 2018). Charro and Schaefer (2018) present a proposal for developing new industrial PSS businesses in the context of cloud manufacturing. The previously cited authors use the 'Business Model Canvas'

structure (Osterwalder and Pigneur, 2010) and the 'Value Proposition framework' (Osterwalder et al., 2015), which comprises a more detailed analysis of the value proposition stage. The development of value proposition is one of the difficulties of business model designers, required to communicate potentially favorable changes in customer value such as reduced problems/sacrifices and benefits (Osterwalder et al., 2015). The value proposition is then composed of the following components (Moro, 2020): (i) customer segments; (ii) customer jobs; (iii) customer pains/problems solved; (iv) customer gains/benefits; and (v) value purpose.

The PSS 'value capture' highlights the systemic architecture, focusing on integrating the network of actors for the provision of the PSS (Helkkula et al., 2018) and how integration can bring improvements to the PSS. The value capture stage then corresponds to the definition of three components (Moro, 2020): (i) cost structure; (ii) revenue sources; and (iii) additional value generated for the network.

Bike-Sharing Systems

A Bike-sharing system is a set of bicycles available to users to ride for a short trip (Alvarez-Valdes et al., 2016). Generally, the bikes are distributed in a set of stations located in the city's center (Moro et al., 2018). This kind of PSS is classified as a use-oriented (according to Tukker, 2004 and Reim et al., 2015).

Bike-sharing can contribute towards environmental sustainability with the potential to reduce motorized traffic and, therefore, pollutant emissions (Alvarez-Valdes et al., 2016). It can be exploited as an intermodal public transport system, generally used in the first and last mile (Kwiatkowski, 2021). In this sense, bike-sharing contributes to promoting social equitability, potentially offering users a healthier way of life (Alvarez-Valdes et al., 2016). Public bike-sharing systems play a positive role in increasing physical activity (Kwiatkowski, 2021).

Therefore, the bike-sharing business model involves a range of stakeholders, which need to be analyzed when designing this kind of business model. Moreover, the system must deliver economic benefits to the focal company and promote facilities towards an easier-to-use and healthier means of transportation. In this sense, it is essential to analyze the value network involved and how value can be proposed and captured by the business model to deliver a sustainable solution, as presented in this work adopting the research methods described in the sequence.

Research methods

The PSS analyzed is a bike-sharing system provided to a city located in the South of Brazil, charging a monthly fee for the system's operation. The business model analyzed is a use-oriented PSS in the context of shared mobility. It offers customers short-term access to products for a fee rather than providing ownership (Akbar and Hoffmann, 2020). The focal company that offers the solution has developed projects to improve urban mobility since 2010. This company is not responsible for the manufacturing of the product, but only for the technology and processes involved in the provision of services.

Face-to-face interviews were conducted with those responsible for developing the business model to obtain information regarding its functioning, following recommendations elsewhere (Eisenhardt and Graebner, 2007). A research protocol was developed based on a literature review (Moro, 2020) in the "problem identification phase" and a list of variables to be verified was developed, as recommended in the literature (e.g., Sousa and Voss, 2001). A semi-structured questionnaire was developed for the interview, which was recorded for later content transcription. An executive director and two managers who work on developing the solutions offered by the company participated in the interview. This work also carries out direct observations, document analysis (e.g., operational reports in operation, company presentations, PSS design documents, and operational protocols. The importance of methodological data triangulation to increase the validity was highlighted, as recommended elsewhere (Yin, 2014).

Based on the information collected, a representation of the PSS business models was constructed based on Moro (2020), which was presented and discussed with the focal company executives. Subsequently, it was necessary to make further inquiries about the modified business components and update them until achieving the current version presented in this work.

RESULTS AND DISCUSSION

The PSS analyzed is in operation in a city with just over 200,000 inhabitants in the South of Brazil. One hundred bicycles were distributed in 10 stations and reached around 30,000 users. The use of bicycles is free of charge. It is noteworthy that business models of this type offered to city halls involve concession contracts obtained through competitive bidding. In addition to the analyzed PSS, the company is implementing similar systems in other locations. The analyzed PSS can be classified as a "diversification of the business model" of the focal company since initially, it only worked with the sale of the system. The company continues to sell the product (without the operation) but highlights some failure cases, as the bicycles are soon out of use due to reduced reliability.

Bike-Sharing Value Network

One of the solution's main competitive differentials is to adapt the solution according to the customer's needs, allowing the service of smaller customers and offering customized services. Figure 1 depicts the actors involved in the analyzed PSS value network.

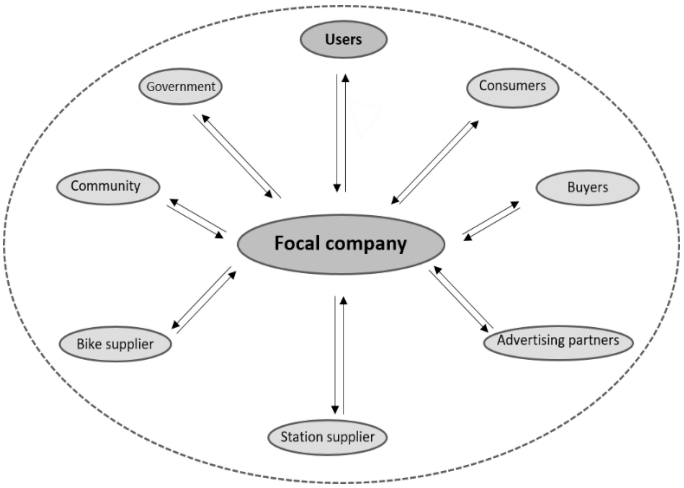

Figure 1. Bike-sharing business model value network.

The focal company of the business model analyzed developed the technology for PSS supply and is not the product manufacturer. The analyzed company already has a mindset focused on sustainability, and this scenario facilitates the development of a more innovative and sustainable business model.

Bike-Sharing System Business Model

Figure 2 presents the bike-sharing business model, based on the stages and components developed by Moro (2020).

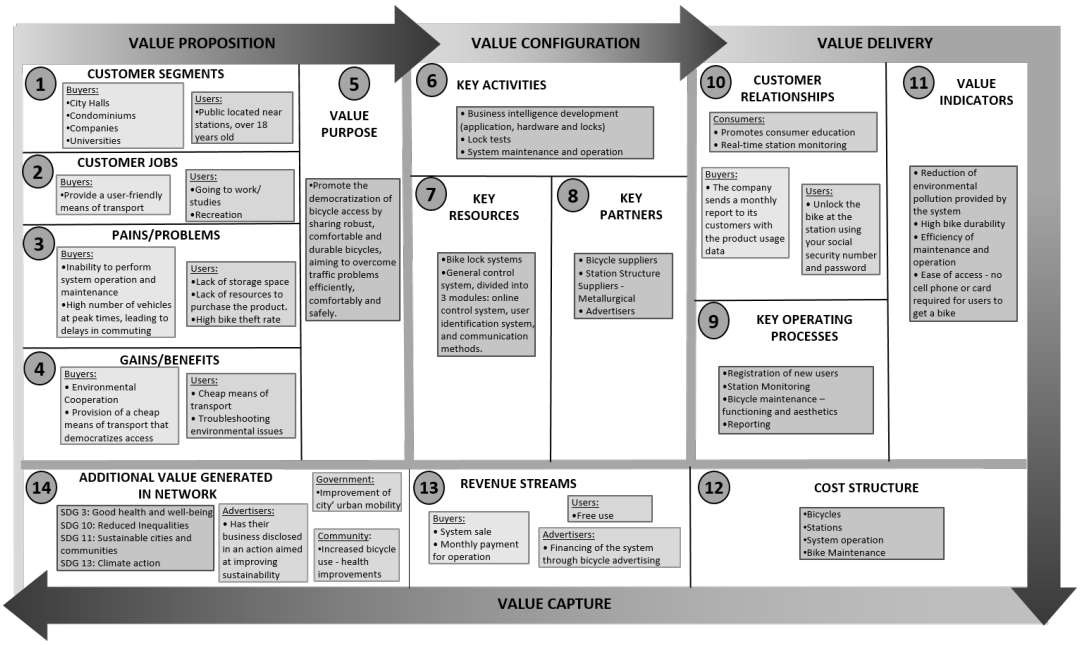

Figure 2. Bike-sharing business model.

The bike-sharing business model contributes towards delivering benefits and solving problems to its users and buyers. Moreover, the business model purpose also contributes to the community, aligned with the following Sustainable Development Goals (United Nations, 2022): "SDG 3: Good health and well-being", "SDG 10: Reduced Inequalities", "SDG 11: Sustainable cities and communities", and "SDG 13: Climate action". For instance, one of the focal company's directors highlighted that according to reports from the city's public administration, bicycles use as means of transport has increased in the city since the implementation of the sharing system contributing towards achieving these SDG.

It is noteworthy that the business model was already in operation at the time of the interviews and new similar business models are being developed and implemented in other locations. Each bike-sharing business model requires a specific design that is appropriate to the context that will be inserted.

DISCUSSION

The business model value proposition is determined by many contingent factors, including the type of PSS and the type of product involved in the PSS, the potential consumers, the context, and local habits. The development of a PSS business model requires the input of consumer data and their subjective perceptions (Vendrell-Herrero et al., 2018). Therefore, the value proposition is largely related to the context in which the PSS is inserted. Companies focused on services that offer PSS are favored by the proximity to customers since a more direct relationship is possible (Ayala et al., 2019). In this sense, the importance of interacting with customers to develop the PSS value proposition is highlighted. Moreover, the development of local PSS business models tends to satisfy customer needs better, as more interaction is possible.

Another point to be considered is that the value proposition of a PSS can only be translated into value-in-use if the customer can assume that access will be guaranteed (Akbar and Hoffmann, 2020). Therefore, PSS developers are looking for diverse partnerships to expand their business model offerings. This is because, in general, the more extensive the PSS' value network', the more intensely the community will use PSS offerings and/or the more intensely the community will interact, leading to greater value-in-use (Akbar and Hoffmann, 2020). Thus, the importance of understanding the business model' value network' before its design is highlighted, aiming to ensure access to the use of the PSS. Moreover, recent concepts

such as digitalization require aligning a company's business model with others in the 'value network' (Kohtamäki et al., 2019). Finally, it is pointed out that, at this stage of the design of the business model, much necessary information comes from the marketing area. It is important to consider them so that the PSS is developed to provide value-in-use based on real customer expectations.

PSS could favor obtaining circular results in the value configuration because the suppliers own the product rather than the customers. In circular economy research, PSS often appears as an enabler; allowing multiple life cycles to the product involved in the solution (Ceschin and Gaziulusoy, 2016). Therefore, strategies, such as: stimulating the production of more durable goods, facilitating reuse and remanufacturing (Moro et al., 2021), and closing the life cycle (Pallaro et al., 2017) can be used to obtain environmental benefits and reduce the costs of providing a PSS (Moro et al., 2021). Economic value could be created from the entire product lifecycle, including the end of life (Yang et al., 2018).

The design and operation interfaces between products, services, enabling systems, and urban infrastructure add barriers to the business model (Zhang et al., 2015). Moreover, bike-sharing business models need the project and adaptation to the reality that they will be implemented, as they depend on agreements and partnerships with city halls, which in some cases occurs through a bidding process. Furthermore, even if not financed by the municipality, bicycle-sharing systems also need concessions to use public spaces. The PSS is offered free of charge to users, unlike most current systems - e.g., the Bike Rio system (Sousa-Zomer and Cauchick-Miguel, 2019). In the case of a business model offered for free, additional sources of revenue are needed to cover the initial PSS costs and its operating cost. In this sense, the company can explore partnerships with advertisers, as Moro et al. (2018) also pointed out.

In the PSS value delivery, the users could unlock the bikes using only their ID and password. PSS delivery is generally improved if new technologies of information and communication are developed (Coreynen et al., 2017). The focal company prepares a monthly report for the system's buyer (local city hall). It includes system usage data based on the initial registration of the users in the digital system. As pointed out by Bressanelli et al. (2018), data analysis on PSS usage is helpful to provide technical assistance. Data collected on PSS use may also allow the company to develop know-how about the users' profile.

The more a PSS business model involves manufacturers, owners, and users, the greater the potential for creating sustainable value (Yang and Evans, 2019). Furthermore, considering current trends to increase the flexibility of modern production systems, the wide dissemination of production knowledge and a better-educated workforce, it is important to consider that the possibility of producing final products closer to consumption surpasses the traditional concept of manufacturing whereby economies of scale dominate decision making (Kaihara et al., 2018). In addition, the geographic proximity between information technology companies and product manufacturers in a specific geographic area increases competitiveness (Bustinza et al., 2019) and, thus, favors the development of innovations such as the PSS, which demand integration between products and services.

CONCLUSION

The bike-sharing business model analyzed was developed by a start-up created to offer a PSS solution. The focal company develops the solution and is responsible for the system's operations. It is worth noticing that company managers already had a receptive mentality to changes. Thus, this facilitates to demonstrate how the proposed structure could improve the business models. It also can be highlighted that this context enabled the solution development, as managers and other stakeholders already have a mindset focused on sustainability and the provision of services. It is noteworthy that actions have been carried out in Brazil to develop more intelligent and sustainable cities at the local levels. In this sense, PSS business models such as the analyzed can represent significant contributions to improve micro-mobility.

One of this work limitations is the fact it is a single study conducted only considering the focal company so restricting the external validity. Future studies should bring about the perspective of a larger group of companies. It is also essential to analyze the system from a business model perspective by integrating the three dimensions of sustainability (economic, environmental, and social). The contributions of this business model towards achieving the targets of Sustainable Development Goals - proposed by the United Nations in the Agenda 2030 - could also be explored in future studies. Additionally, further analysis of other business models could be conducted, and the results can be compared and contrasted as potential research opportunities.

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