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Designing Collaborative Business Models for Sustainable Digital Solutions: The Case of a Shared-Micromobility Service

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Abstract. Existing firm-centric approaches to business model design cannot sufficiently capture the essential elements characterizing sustainable digital solutions enabled by collaborations in a network. To foster value co-creation and align the interests and responsibilities of all stakeholders involved in such networks, a network-centric perspective to business model design is more appropriate. In this paper, we present the design of a collaborative business model for a digital solution - a shared-micromobility solution. We examine three prominent approaches to represent the business model and discuss their limitations. Following an inductive approach based on the business case, we derive and propose core conceptual elements of collaborative business models in the context of sustaina-bility.

Keywords: Collaborative business model, Sustainable digital solution, Collaborative business model matrix, Collaborative network, Shared-micromobility solution.

1 Introduction

The advancement of digitalization has resulted in significant changes across various business domains. In an increasingly digital world, the advent of digital solutions has revolutionized the way services are delivered, offering unprecedented accessibility and personalization across various domains [1]. *Digital solutions* refer to specific offerings (e.g., platforms) that leverage digital technology as a core enabler to address a particular business need, problem, or opportunity and involve interactions between multiple actors [2]. These solutions involve interactions between multiple actors, making a firm's value creation increasingly dependent on external resources and capabilities [3]. Hence, in this digital era, it is vital to configure the capabilities of a diverse range of stakeholders into meaningful assemblages through *collaboration*, characterized by direct, non-hierarchical, and goal-oriented firm interactions [4, 5].

In this landscape, organizations engage in ecosystems to form *collaborative networks* that foster the sharing of knowledge and resources, thereby creating a focal

value proposition [6, 7]. A collaborative network refers to an assemblage of actors comprising heterogeneous entities that interact with one another in pursuit of a common objective— i.e., to enable value co-creation. These actors, perceived as socio-economic participants, are linked through their unique value propositions and collaborate through service exchange within the network to attain desired outcomes [8].

In addition, there is a growing consensus that firms should repurpose themselves to address the needs of their stakeholders and the natural environment rather than solely focusing on shareholders, seeking both firm-level and system-level changes through collaboration [5, 9, 10]. Hence, they aim to offer *sustainable digital solutions* in the form of digital services that are not only economically viable but also socially responsible and have a minimal negative impact on the environment. Offering sustainable digital solutions requires collaboration among diverse stakeholders, such as businesses, government agencies, non-governmental organizations, and individuals [11]. This collective effort is crucial for balancing economic progress, social well-being, and environmental preservation [12].

Consequently, business models for sustainable digital solutions must transcend the basic narrative of how a single company creates, delivers, and captures value [13]. Collaborations among organizations offer chances to harness additional, complementary capabilities, thereby enhancing or developing joint value propositions [6, 7]. Current research and practice emphasize the critical need to design new sustainable business models and adapt existing ones to become more sustainable [14].

Several studies have proposed methods for defining business models [15]. While acknowledging the importance of cross-organizational partnerships, these studies often adopt a firm-centric perspective [16]. This approach is inadequate for designing business models for sustainable digital solutions, as it lacks the network-centric view necessary for mutual value creation in cross-sector collaborations [12, 17–21].

This necessitates new business model design approaches that underscore the core value proposition of collaborative networks, encompassing cost and benefit structures beyond mere financial consideration, depicting actor interactions as service exchanges, and illustrating how they collaboratively generate value through shared processes [18, 22, 23]. Current research emphasizes the need for a more robust conceptualization of these approaches [5, 24]. Therefore, *the objective of this paper is to outline the initial step in conceptualizing collaborative business models within the context of sustainable digital solutions.* We base this on a specific business case that is firmly rooted in both collaboration and sustainability, serving our purpose well. We then apply three prominent business model design approaches to describe the case and discuss their limitations in capturing the core elements of the business model. Using an inductive approach, we derive and propose fundamental conceptual elements of collaborative business models with a focus on sustainability.

In the remainder of this paper, we describe the business case of a shared micromobility service and describe its business, from which we derive the core elements of a collaborative business model. We then discuss the limitations of the selected approaches in representing the case and propose our own approach. We conclude with an overview of research limitations and suggest avenues for future research.

2 Business Case of a Shared-Micromobility Service

Offering micromobility services through shared electric bikes (e-bikes) and e-scooters is gaining recognition as an effective urban transportation option, especially for their potential to decrease the reliance on private vehicles for short trips, thereby promoting sustainability and reducing carbon footprints [25].

Founded in 2019 in the Netherlands, *Go Sharing* (*nl.go-sharing.com*) offers a micromobility service, operating over 7000 e-vehicles (e-bikes and e-scooters) in more than 36 cities across Europe. Through its *mobile app*, travelers can locate, reserve, unlock, and use these e-vehicles, ending their trips in designated city zones. While different pricing options exist, travelers typically pay based on the trip duration, with discounts available for trips starting or ending in specific city-determined discount zones.

To operate this solution, Go Sharing needs to establish a *collaborative network* where the capabilities of multiple stakeholders must be leveraged. This involves collaboration among a number of network actors, including e-vehicle producers and maintenance providers. The municipalities also have a critical role in the network (*nl.go-sharing.com/en/voor-steden/)*, as many cities aim to offer their residents an ecologically sustainable alternative to conventional modes of urban transportation.

As the focal actor, it is crucial for the Go Sharing service operator to articulate the business model for this solution through the lens of a collaborative network. This model should clearly delineate the central value proposition offered to travelers (as the primary customers of the solution) and outline the roles and required capabilities of each network actor in contributing to the realization of this proposed value. Defining these elements explicitly is essential for aligning expectations, building trust among network actors, and establishing a foundation for effective negotiation.

As a digital solution aiming to be an ecologically sustainable alternative to conventional urban transportation, Go Sharing shared micromobility service provides an excellent case for exemplifying a collaborative business model for a sustainable digital solution. Other cases of similar solutions have been reported in the literature, highlighting the need for taking a collaborative perspective to overcome challenges [26]. Below, we outline its model for this purpose.

2.1 Describing the Business Model for the Go Sharing Solution

To describe the business model for the Go Sharing solution, we use the dimensions proposed by Al-Debei and Avison [27]. These dimensions include *value proposition*, *value network*, *value architecture*, and *value finance*. We have chosen this ontology as it explicitly addresses the role of value networks in business models, aligning well with the multi-stakeholder nature of the Go Sharing solution. However, to provide a more neutral perspective on what constitutes value - whether financial or non-financial- we modify value finance to *value capture* (aligned with [28, 29]).

Value Proposition and Value Network Aspects:

The value proposition tailored for a specific customer (segment) of an organization constitutes the essential foundation of a business model [30]. However, in the context of collaborative networks, the view for value proposition definition needs to transition

from a firm-centric perspective to a network-centric one, representing the value that the collaborative network collectively proposes to a specific customer [31]. We can refer to this as the *network value proposition*, denoting the overarching goal of joint value creation by the actors involved in the collaborative network [16].

For the Go Sharing solution, the network value proposition is "flexible shared transport via e-bikes and e-scooters in urban areas". This is offered to the traveler through the high availability and widespread coverage of these e-vehicles across the city. This enables travelers to take an e-vehicle and travel around the city at any time without the concern of managing or maintaining the vehicle.

As indicated above, the collaborative network comprises e-vehicle producers, maintenance providers, municipalities, and Go Sharing as the service operator. Additionally, the *traveler*, as the customer targeted by the network value proposition, plays a crucial role in the co-creation of value and is integral to the value co-creation [32]. Go Sharing's role in the network is also special. It acts as the *orchestrator* that facilitates the interactions [33], establishes the alignment between the actors in the network taking a leadership role [34], and organizes the operation of the solution [19].

Each actor listed above can justify its participation in the collaborative network of the sharing solution by the *unique value* proposition it contributes to the network value proposition [12]. The Go Sharing service operator ensures effective platform management, e-vehicle producers provide customized and durable e-vehicles suitable for shared services, maintenance providers guarantee e-vehicle availability and longevity, and municipalities offer legal feasibility in their urban spaces, as well as financial support in certain cases. In addition, travelers, as the primary beneficiaries of the service, also contribute to the value co-creation by sharing their profile and service usage data, as well as providing feedback and reviews.

Value Capture Aspects:

The sustained engagement of these parties is crucial for the sustainable operation of the Go Sharing solution. Each actor joins this network and continues to offer the value propositions listed above due to the *benefits* it expects to receive [35], which should outweigh the *costs* associated with joining the network for this solution [16].

However, these actors engaging in this business have a range of motives beyond purely economic incentives [22]. Particularly in the context of sustainability, these motives include reducing negative impacts on society and the environment, in addition to (or instead of) pursuing financial gains [36].

For instance, the municipalities' primary motivation is to offer their residents an ecologically sustainable urban transportation option, expecting the solution to result in a *decrease in emissions and congestion* in urban areas. In certain cases, they offer a *subsidy* to Go Sharing to support the solution's financial viability, aligning with their vision of becoming a 'green city'. Similarly, travelers choose to use and *pay* for this service not only for the *convenience* and *flexibility* it offers but also due to its positive impact on *wellbeing* (as riding e-bikes is seen as a form of exercise).

The other actors, namely the Go Sharing service operator, e-vehicle producer, and maintenance provider, are profit-seeking entities that maintain their engagement as long as the financial benefits outweigh their operating costs. Yet, they also expect their involvement to enhance their brand image as environmentally friendly, particularly the

Go Sharing service operator and e-vehicle producer. They also expect to gather valuable data on user behavior and transportation patterns for further business opportunities.

Value Architecture Aspects:

As a digital solution enabled by collaboration between multiple stakeholders, the value is not solely created by a single entity (e.g., the Go Sharing service operator) but is *co-created* by the collaborative network, which also includes the traveler. In this context, we can distinguish *co-creation processes* and *capabilities (services)* that each actor needs to deploy in these processes.

The *co-creation processes* span multiple actors, connecting them. These processes reflect the necessary collaborations among actors, collectively realizing (operationalizing) the network's value proposition. For instance, the traveler interacts with the service operator via the mobile app to book an e-vehicle. Hence, *booking an e-vehicle* is a process that involves both the traveler and service operator interacting (in this case, via the mobile app). If issues, such as damages, arise with the e-vehicle during a trip, the maintenance provider can engage with the traveler to *handle the damage*. This is in addition to the *e-vehicle maintenance* it performs at the request of the operator. At predefined intervals, the service operator negotiates and manages the concerns regarding the *subsidy* and *legal* aspects with the municipality. Additionally, the service operator collaborates with the e-vehicle producer, using user feedback and maintenance records to inform *requirements* and changes for new or existing vehicles.

Various activities are performed within these processes, ranging from fully-automated activities to semi-automated ones supported by IT. For instance, confirming a reservation is typically automated and handled by the service operator's IT system, while tasks such as picking up an e-vehicle involve traveler interaction with the mobile app. These activities are specific to each actor and reflect the unique *capabilities* that they need to possess in order to realize their value propositions.

For instance, the service operator needs several capabilities, such as processing a reservation, resolving an issue, and monitoring a trip. Maintenance providers need to be able to maintain e-vehicles and charging infrastructure, and repair damages. Similarly, the traveler should have the capability (and should be provided with the IT features) to book, pick up, or use an e-vehicle, end a trip, and pay for it.

We can consider these capabilities as *actor services*, as the actor value proposition is realized when an actor leverages its capabilities within the collaborative network to offer *services* visible to other network actors [37, 38], including the customer [39]. Accordingly, an actor's services collectively realize the actor's value proposition and define how the actor participates in the value co-creation processes [40].

3 Discussion on the Existing Approaches to BM Design

As mentioned in the Introduction, there are several approaches to designing and representing business models in visual forms [15].[30] We select three prevalent approaches to discuss their applicability in representing the business model of the Go Sharing solution. These are Business Model Canvas (BMC), e3-value [41], and Value Mapping Tool (VMT) [20]. We chose BMC as it is widely known both in research and practice [30] as a firm-centric approach to business model design. We chose e3-value and VMT

as they are network-centric approaches to business model design, which makes them well-suited for the Go Sharing case. The e3-value is prominent for its ability to represent business models for *digital solutions* in complex, multi-stakeholder environments. It visualizes economic transactions and dependencies between different actors involved in delivering the solution. VMT is well-known in the domain of *sustainable business models* and facilitates the identification of value exchanges among stakeholders. Its emphasis on capturing non-financial benefits, such as environmental and social value, aligns with the collaborative and sustainability-driven nature of Go Sharing.

The BMC represents the business model of a single firm with nine components: customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure. As such, it can serve as a foundational tool to represent the business model of the Go Sharing solution by capturing essential elements such as value proposition, customer segments, and key partnerships. However, the firm-centric nature of BMC makes it less suitable for representing the dynamic and collaborative aspects of the Go Sharing solution. The BMC would focus on the perspective of the orchestrator, i.e., the Go Sharing service operator, missing the network value proposition that spans multiple actors and the underlying reasons for other actors' sustained engagement, such as their unique value propositions, costs, and benefits. Using BMC, it would be challenging to depict the evolving nature of collaboration and value co-creation [16]. Additionally, BMC does not fully address broader sustainability goals and non-economic incentives, such as environmental sustainability and social well-being. These limitations in representing network-centric and dynamic interactions, as well as non-financial value aspects, suggest the need for supplementary tools or modifications to fully encompass the complexity of collaborative business models in sustainable digital solutions.

The *e3-value* [41] approach focuses on mapping the value exchanges between organizations collaborating within a network for a particular solution. This approach addresses the need to represent the financial aspects of value capture while also covering value creation within the network to some extent. However, it does not emphasize the network and actor-specific value propositions that bring and keep the network together. Additionally, focusing solely on financial transactions overlooks non-monetary benefits like environmental sustainability and social well-being, which are crucial for Go Sharing.

The *Value Mapping Tool (VMT)* [20] is designed to help a firm identify and balance multiple types of value, including economic, social, and environmental benefits and burdens (costs). It encourages the firm to explore value creation, value destruction, and missed value opportunities for all stakeholders involved, thus promoting more sustainable business models. The VMT effectively emphasizes multi-dimensional value creation, which aligns well with Go Sharing's goal of providing sustainable urban transportation. By identifying positive and negative value aspects, the VMT can help in understanding the broader impacts of the Go Sharing solution. However, the VMT takes the *firm* as its unit of analysis and is not aimed at representing *solutions* enabled by collaborations in a network. For instance, while the VMT can be useful for uncovering missed value opportunities and highlighting areas for improvement in sustainability practices for the Go Sharing service operator, it would lack the precision in detailing the specific

financial exchanges and economic incentives for each actor, which are crucial for maintaining the engagement of profit-seeking entities like e-vehicle producers and maintenance providers. Additionally, it may fall short of providing detailed insights into the specific capabilities and services each actor needs to deploy in the co-creation processes, which is essential for understanding the operational dynamics of the Go Sharing solution.

In summary, existing design approaches fall short in various aspects and require a holistic view to effectively represent the primary components of collaborative business models for sustainable digital solutions. Current research calls for a more robust conceptualization of such models [5, 24].

4 Collaborative Business Model Matrix (CBMX)

Fig. 1 depicts the business model of the Go Sharing solution as described in Section 2. The figure features a table structure with the core concepts (listed in the left column) and corresponding examples for the case of the Go Sharing solution. We refer to this structure as the Collaborative Business Model Matrix (CBMX), which represents an initial step toward a robust conceptualization of the core elements of such models.

Network Value Proposition	***FLEXIBLE SHARED TRANSPORT VIA E-BIKES AND E-SCOOTERS IN URBAN AREAS***									
Actor Type	*Customer*		*Orchestrator*		-		-			
Actor	**Traveler**		**Go Sharing Service Operator**		**Municipality**		**Maintenance Provider**		**E-Vehicle Producer**	
Actor Value Proposition	User profile, service use data, and reviews		Effective platform management		Legal and financial feasibility		E-vehicle availability and longevity		Customized and durable e-vehicles	
Actor Cost & Benefits:	*Costs*	*Benefits*	*Costs*	*Benefits*	*Costs*	*Benefits*	*Cost*	*Benefits*	*Cost*	*Benefits*
Financial	**- Service fee**		**-Operating costs, -Insurance -Maint. fee**	**+Service fee, +Subsidy**	**-Subsidy**		**- Operating costs**	**+Maint. fee**	**- Operating costs**	**+ Increased sales**
Environmental						**+Decrease emission & congestion**				
Social		**+Convenience +Flexibility +Wellness**								
Other Non-Financial				**+Enhanced brand image (i.e., green) +Data insights**		**+Data insights +City image**				**+Enhanced brand image (i.e., green) +Data insights**
Actor Services	Book e-vehicle, Pickup e-vehicle, Use e-vehicle, End trip, Pay for the trip, Review trip, Report issue		Process reservation, Resolve issue, Monitor trip, Manage platform, ...		Provide legal support, Determine zones, Provide subsidy, Analyze use data, ...		Maintain e-vehicle, Maintain charging infrastructure, Repair damage, ...		Manage e-vehicle (re)design, Integrate IT, ...	
Co-creation Processes	Booking e-vehicle, Payment and billing, Trip management, Damage handling, E-vehicle maintenance, Subsidy handling, E-vehicle requirements management, ...									

Fig. 1. Go Sharing's solution represented using *Collaborative Business Model Matrix (CBMX)*.

These elements include the network value proposition, actors in the collaborative network, services they need to deploy for other actors to enable value co-creation, and

the costs and benefits of different types involved in doing so. CBMX emphasizes network-centricity and clearly delineates the roles and contributions of each actor. It differentiates between the economic, social, environmental, and other non-financial costs and benefits. By capturing both financial and non-financial aspects, it aligns with Go Sharing's sustainability goals, ensuring a holistic representation of value co-creation within the collaborative network. Additionally, it details co-creation processes and actor-specific services, which help reflect Go Sharing's multi-stakeholder setting.

Table 1 presents the limitations of the selected business model design approaches, and how CBMX addresses these limitations.

Table 1. Existing BM design approaches vs. CBMX for representing collaborative business models.

BM Dimension	BMC	e3-value	VMT	CBMX
Value Proposition	Firm-centric, missing network value proposition	Focuses on value transfers (actor transactions), missing network and actor value propositions	Attention to both network and actor value propositions	*Attention to both network and actor value propositions*
Value Network	Firm-centric, supports defining partners, but misses the network perspective	Supports network-centricity	Supports network-centricity with special network roles	*Supports network-centricity with special network roles (orchestrator, customer)*
Value Architecture	High-level support with key activities for the focal actor, missing the processual aspects	High-level support with actor activities	Falls short of providing detailed insights into the specific capabilities and services each actor needs to deploy in the co-creation processes.	*Emphasis on multi-actor co-creation processes and actor capabilities (services)*
Value Capture	Focuses only on financial aspects	Precision in detailing the specific financial exchanges, but focuses only on financial aspects	Supports representing both financial and non-financial costs and benefits but lack the precision in detailing the specific exchanges and economic incentives for each actor	*Both financial and non-financial (economic, environmental, social, and others) with support to detail exchanges*

5 Conclusions

This paper aims to outline the initial steps in developing a design approach for collaborative business models tailored to sustainable digital solutions. To achieve this, we employed an inductive methodology, using a specific business case as our foundation. We begin by explaining the necessity of shifting from a firm-centric to a network-centric perspective in business model design. Subsequently, we identify the network and actor value propositions in the Go Sharing shared micromobility service and describe how value is co-created and captured within this collaborative network. In doing so, we address foundational concepts such as the collaborative network, and identify core elements of a collaborative business model, including the network value proposition, the services each actor must deploy in value co-creation processes, and the various nature of costs and benefits involved. Such a model outlines how a network of actors works together to co-create value for the customer and generates mutual benefits for all network actors [42].

Our work contributes to the field of business model design by offering a preliminary foundation for researchers and practitioners seeking to design collaborative business models for sustainable digital solutions enabled by collaborations between multiple stakeholders.

The work presented in this paper is conceptual and inherits some inherent limitations common to inductive research studies. Primarily, these conceptualizations are based on the authors' perspectives and interpretations, potentially introducing bias and limiting their generalizability [43]. Building upon existing research on business models and a real-life business case helps alleviate these limitations. However, future research should prioritize applying the method in additional business cases and empirically assessing its validity and utility for its intended users. The theoretical foundations for the conceptualization should also be strengthened.

Future efforts should also aim at developing methods and tools to aid in comprehensively assessing the viability and feasibility of collaborative business models, considering both economic factors and environmental and societal impacts [14]. To achieve this goal, various methods and techniques should be employed at different stages of the business model lifecycle, including defining and refining relevant performance indicators [44–46]. Such evaluations should also consider how a balance between economic, environmental, and social dimensions can be maintained, how they can be measured, and how relevant decisions can be supported [47]. Future research should also investigate how the design of the business model informs and shapes its implementation [27, 48], with a particular focus on its operating model [49, 50], including the business processes [51, 52] and the required IT infrastructure [53].

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