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Article

# Digital Platforms That Do Well and Do Good. Platform Architecture for Sustainability

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**Abstract:** The rise of multi-sided digital platforms has transformed the global economy, enabling individuals and companies to create, deliver, and capture value through innovative connections and network effects. While scholars have studied the core strategy concepts and proposed platform architectures, less attention has been paid to the long-term sustainability of these platforms. This paper addresses this gap by examining the relationship between sustainability and platform architecture. Specifically, it asks what mechanisms characterize digital platforms for sustainability, and whether there are design choices that optimize the business model for sustainability. Using a mixed-methods approach that draws on platform literature, business models, and sustainable innovation, the paper develops an integrative framework to identify elements and design choices in platform businesses which support sustainability outcomes. The framework is then used to classify the business models of the identified platforms, revealing specific design choices for platform architecture that can optimize their business models for sustainability. This contribution to existing literature provides an artifact that allocates key decisions on value creation, delivery, and capture that are key to platforms and includes an additional layer to optimize them for long-term sustainability. As digital platforms continue to drive the economy, this research is relevant not only to platform practitioners, but also to policy makers and society at large.

**Keywords:** Digital platforms 1; sustainability 2; business model design 3; business models for sustainability 4.

## 1. Introduction

Multi-sided platforms enabled by digital technologies are a dominant business model in the global economy. They have enabled new ways for individuals and companies alike to create, deliver and capture value by facilitating connections between two or more sides and fostering innovation [1].

Their widespread adoption across industries, such as transportation (Uber, blablacar), accommodation (Airbnb), food (TooGoodToGo) and technology (Amazon AWS) can be attributed to network effects, an inherent characteristic of platforms, which arise when users create value for other users [2]. The economic value they create is evidenced by their positioning in the global market, where four out of the top five most valuable companies are digital platforms with data-driven business models [3].

Scholars within economics, innovation and information systems seeking to understand the ubiquitous platforms, have studied the core strategy concepts [4–8] and proposed different platform architectures [9–11]

While platform research has largely focused on the strategic decisions for successfully launching and scaling a business platform in the economic sense, this paper finds that the sustainability angle of platforms has so far been overlooked.

When looking into sustainable business models [12], business models for sustainability BMfS [13] and business models for sustainable innovation [14] literature, efforts have been dedicated to understanding what kind of sustainable business models exist where the value creation logic integrates a social or ecological value at its core. Yet, their study focusing on designing platform business architectures in more sustainable ways is not clear. Therefore, this paper takes an integrated perspective combining both phenomena answering two questions: *What are the available business model design choices of platforms for sustainability? Are there fundamental design parameters which characterize platforms for sustainability in comparison to platforms without a sustainability angle?*

The paper proceeds as follows. It starts by providing an overview of the methodology, followed by a review of platform literature as well as sustainable business research. In a third step, it presents the results of the morphological analysis which allocates key decisions on value creation, delivery and capture that are key to platforms. In a fourth step, it classifies the identified cases employing a qualitative content analysis and codifies them with regard to the selected variables. Finally, design strategies supporting the development of platforms for sustainability are discussed.

## 2. Materials and Methods

Utilizing a mixed-methods approach that draws on a wide range of literature streams, this paper aims to construct an integrative framework that effectively identifies key elements and design choices in platform businesses to foster sustainability outcomes. The research amalgamates essential concepts from platform literature, business models, and sustainable innovation, incorporating morphological analysis as a powerful tool to discern the crucial components and design alternatives in platform businesses, particularly concerning sustainability.

Following the three dimensions of business model design, as conceptualized by Teece (2010), this study systematically categorizes the extracted elements into three distinct areas: i) value creation, ii) value delivery, and iii) value capture. This chosen approach allows for a comprehensive qualitative analysis of multidimensional objects while offering the added advantage of reducing complexity, thereby accommodating diverse combinations of attributes [15]. Employing the MAXQDA software, the individual design choices identified are meticulously assigned to their respective business model dimensions.

In order to validate and exemplify the proposed framework, the study extensively analyzes the business models of 50 identified platforms against the identified elements, utilizing qualitative content analysis as the primary methodological tool. To ensure relevance and appropriateness, a set of stringent criteria is applied, leading to the selection of 20 cases that meet the following criteria: 1) digital platforms, 2) possessing a sustainable value proposition, and 3) currently operational.

The ultimate objective of this research is to unveil specific design choices for platform architecture that have the potential to optimize their business models in favor of sustainability.

### 2.1. Theoretical framework

This section discusses and summarizes the most important features of digital platforms and business models for sustainability (BMfS) to prepare the foundation for the morphological analysis.

#### 2.1.1 Digital platform organizations – a socio-technical construct

Digital platforms hold a predominant place in today's economy. The combined market capitalization of the top four platforms by market capitalization, Apple, Amazon, Microsoft and Alphabet/Google was US\$5,7 trillion in 2023, exceeding Germany's GDP. These four companies, and digital platforms in general, share an underlying business model which leverages digital technologies to facilitate matchmaking and innovation. Scholars from both information systems and management have studied this phenomenon from diverging perspectives.

While on the one hand management and economics literature looks at platforms from a market-based perspective, where their ability to mediate complex transactions between two or more groups of agents [6,7,16], and creating value by leveraging network effects [17] are key.

On the other hand, information systems literature studies platforms from a technical perspective. Scholars in this field have focused on the layered architecture and modularity that distinguishes digital platforms. They define them as a set of stable components that provides functionalities in a system by constraining the interfaces through which they operate [8,18]. The interfaces dictate the degree of openness and control which creates value for the platform sides in terms of innovative outcomes.

Furthermore, a socio-technical perspective of digital platforms is being increasingly adopted from scholars on both ends [19] taking a more unified view that incorporates elements from both economics and information systems. Here, platforms are market intermediaries between two or more sides and digital, modularly-architected entities.

By adopting the socio-technical view, this paper sees platforms as an IT artefact which exists within a network of stakeholders that interact in complex ways, and whose existence and evolution

is influenced by a broader set of external forces with implications for its long-term sustainability [20]. As such, platforms rarely exist in isolation and are part of an ecosystem which contributes to its functioning [6].

### 2.2.2 Platform and their ecosystems as a collaboration environment for sustainability

The platform ecosystem is referred to in the literature as a set of interdependent and interconnected components, including firms, developers, users, and other stakeholders, that interact with each other and with the platform owner to create value [21]. Inherent to digital platforms, and as a result to platform ecosystems, are network effects where the value of the platform increases as more users join and more complementary products and services are offered [17]. The ecosystem can also be affected by platform governance, which includes policies, rules and interfaces that determine how the platform and its participants interact.

Platform ecosystems play a critical role in promoting sustainable development by facilitating collaboration and increasing the pace of innovation which would otherwise not be possible [20]. There is a growing body of literature which links platform ecosystems, viewing them as a multi-stakeholder collaboration framework for sustainability [22], as interactions between stakeholders to facilitate collective efforts towards increased societal impact [23,24] and from a socio-technical perspective where the ecosystem is composed of interdependent technical, social, political and spatial components [20] which together have an impact on sustainable development.

In their work, Hellemans et. al (2020) highlight the role of digital platforms for sustainability as they facilitate joint action by lowering the barriers to access and reach [25] by means of technology. The increasing ubiquity as well as decreasing cost of digital technologies has enabled previously unconnected people and organizations in distant places to exchange and share information [20]

For instance, eKutir in India is a digital platform joining farmers, retailers and consumers to share information and resources to tackle food waste [26]. The ecosystem that results from the platform players and interactions has the potential to facilitate collective efforts towards increased societal and environmental impact [23].

However, digital platform firms can generate unwanted outcomes and paradoxical effects [20,27], such as citizen surveillance, questionable work practices, increased pollution and the rise of monopolistic powers [28]. Understanding how digital platforms can be designed to encourage positive outcomes and minimize their paradoxical effects is still unresolved [23]

### 2.1.3. Business models for sustainability (BMfS)

Scholars from economics and management have increasingly put their attention into business models due to their importance in determining the fundamental logic of a company [29]. With the term first appearing in the twentieth century in management theory [30], it has expanded to business informatics and strategy theories and has become an integrated management concept [31]. In practice, a successful implementation of a business model signifies the success of a business. It describes a firm's logic of creating, delivering and capturing value [30]

In this view, social and environmental value is seen as subordinate to economic value [12], and organizations are seen as purely economic entities. However, sustainability scholars have increasingly adopted business models as a unit of analysis and are looking to understand the triple bottom line value creation [32]. This phenomenon has been studied under the labels of sustainable business models (SBMs) and business models for sustainability (BMfS) and, in essence, extend the purely economic view of business models including the natural environment and society [33].

Schaltegger et. al (2016) provide a definition of BMfS where "A business model for sustainability helps describing, analyzing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries". This view integrates the most prominent literature on sustainable business models [12,14,34] taking both the creation of customer and social value and the integration of social, environmental, and business activities into the definition.

Furthermore, attempts to conceptualize BMfS are relatively scarce. Scholars in this field have researched the potential of BMfS in different industries and use cases (Kien & Raharso, 2017; Rosen

2017)[20], network and stakeholder ecosystem [35], and the different typologies [36–38] which greatly contribute to better understanding business models for sustainability.

This paper defines digital platforms for sustainability (DPfS) as a socio-technical construct where:

*“DPfS are an i) IT artefact which exists within a network of stakeholders that interact in complex ways, and ii) creates, delivers and captures economic value while maintaining or regenerating natural, social and economic capital beyond its organizational boundaries”.*

### 3. Results

#### 3.1. Morphological analysis and typology of digital platforms for sustainability

The theoretical review shows that there is room for further development in both platform and sustainability literature to design platform business architectures with sustainability in mind.

By adopting Teece’s (2010) business model framework, this paper aims at identifying the core elements of platform design, clustered under i) value creation, ii) value delivery and iii) value capture. The selection of elements follows the design principles of morphological analysis. This method has been chosen as it allows to accommodate multiple configurations of platform design elements given its flexibility to choose different combinations of attributes.

Table 1 gives an overview of the selected business model dimensions that are derived from the literature review.

**Table 1.** Business model dimensions used in the analysis.

Major dimensions	Subcategories	Contributors
Value creation	Market Structure	Lüdeke-Freund et al. 2018; Täuscher
	Platform Ownership	and Laudien 2018; Hagiu 2013;
	Platform type	Baldwin and Woodard 2008; Otto and
	Key activity	Jarke 2019; Hein et al. 2020; Lüdeke-
	Price discovery	Freund, Breuer, and Massa 2022;
	Access control	Bonina et al. 2021; Schaltegger,
	Trust system	Hansen, and Lüdeke-Freund 2016;
Value delivery	Supply chain	Cusumano et. al 2019; Choudary
		2015; Soto, Guerreiro Augusto, and
		Salomo 2023; Evans 2012; Rochet and
		Tirole 2003.
	Key value proposition	Schaltegger, Hansen, and Lüdeke-
	Transaction asset type	Freund 2016; Gawer 2021; Parker and
	Transaction content source	Van Alstyne 2014; Evans and
Value capture	Digital interface	Schmalensee 2016; Hagiu 2013;
	Participants / stakeholders	Tukker 2004; Ciulli, Kolk, and Boe-
		Lillegraven 2020; Boudreau 2017;
	Geographic scope	Lüdeke-Freund et al. 2018; Tukker
Value capture	Key revenue stream	2004.
	Pricing Mechanism	McIntyre et al. 2021; Evans and
	Revenue side	Schmalensee 2016; Lüdeke-Freund et
	Subsidy side	al. 2018; Bonina et al. 2021; Zuboff
	Multihoming costs	2015; Lüdeke-Freund, Breuer, and
	Switching costs	Massa 2022; Osterwalder, 2004;
		Tukker 2004; Hagiu 2009; Eisenmann,
		Parker, and Van Alstyne 2006;
		McIntyre et al. 2021; Soto, Guerreiro
		Augusto, and Salomo 2023.

##### 3.1.1. Value creation



Whether a business can be viable and also create ecological and social value is a paradigm shift that challenges the traditional view of purely financial value creation [37]

For digital platforms, creating value lies in the architecture and mechanisms which regulate interactions between sides [39] and orchestrate resources and processes [40]. The identified dimensions for value creation are market structure, platform ownership, platform type, key activity, price discovery, access control, trust system and supply chain.

Platforms have a modular architecture with a central node and a periphery [18]. The periphery, also known as platform sides, has a direct implication in the market structure. There are two basic forms of digital platforms: two-sided platforms and multi-sided platforms [19], depending on the number of users brought together. In their BMfS taxonomy, Lüdeke-Freund et. al (2022) highlight the role of two-sided social businesses as a platform matching two social groups with each other. They give the example of the German venture 'Was hab ich' where medical students translate medical terms to patients into easier-to-understand language. In this example, one side needs a product that is unaffordable or unavailable (demand) and the other side wants to engage in a social mission meaningfully (supply).

Whether building a two- or a multi-sided platform impacts the firm's value creation [40]. While more sides could potentially lead to larger cross-side network effects, it could lead to higher complexity which can cause a 'lowest common denominator issue' hindering the platform's ability to innovate.

Furthermore, the governance mechanisms will be the result of platform ownership. Whether it is owned by a single firm (keystone), multiple (consortia), decentralized, by individuals (cooperative) or as a public-private partnership will affect the distribution of power and decision-making processes taking place amongst actors [19,20,41,42].

In the case of cooperative ownership, stakeholders are empowered as proactive decision makers which together act towards a common goal with equal benefits for each member. Cooperatives are more likely to create triple-bottom-line value for all stakeholders engaged in the platform [42] compared to other ownership structures. Another interesting platform ownership mechanism for sustainability are public private partnerships which aid at transcending narrow for-profit and profit-maximizing models [13].

When considering which type of platform to build, platform owners need to carefully consider their capabilities and strategic goals and must ensure effective governance to sustain the platform overtime. Cusumano et. al (2019) identify three main types of platforms: innovation, transaction, and hybrid platforms (that combine features of both innovation and transaction platforms).

Bonina et. al (2021) discuss the role of innovation and transaction platforms for development (ICT4D). They find that transaction platforms are a useful matchmaking mechanism to remove considerable market frictions, e.g., to information, pricing, and other user groups, however, they warn that platforms can also aggravate inequality if the right technology and governance mechanisms were not carefully implemented. For the case of innovation platforms, they highlight the role of the firms in the Global North as core enablers for innovators in the Global South to build local applications and platform complements.

Choudary (2015) further distinguishes the platform's key activity into three layers: data services, network-community building, and complementary innovations. According to him, platforms can function across these three layers, but the degree to which each layer dominates can vary. In the case of sharing economy platforms like Gojek in Indonesia, the dominant layer is community-building where it connects self-employed with consumers of a wide range of services (e.g. transportation, food, entertainment) and two sub-dominant layers of data and complementors using the data generated from community building to tailor their offer with payments and business management [43]

Building on the morphological analysis of digital platforms [9], this paper adopts price discovery, access control and trust system from this framework. Mechanisms for price discovery indicate who sets the price, which can either be the platform provider, the supply side, the demand side or via competitive pricing (e.g., auction).

By limiting access to the platform the owner can reduce the risk of negative network effects [44]. The available mechanisms include selective exclusion and social behavior. Furthermore, to build up trust within the platform and incentivize users to join, platforms can signal trust through a review system which can be enforced either between members or by the platform itself [7]

Lastly, resource orchestration is key for value creation in platforms. More specifically in the case of transaction platforms, the supply chain can radically affect its sustainability as it is responsible for much of its social and environmental impact, both positive and negative [42]. This dimension includes a broad set of activities which platform owners can implement such as short supply chain (reducing the complexity of the supply chain by reducing the geographical scope), produce on-demand, inclusive sourcing (including disadvantaged groups as suppliers) and green supply chain management (implementing and developing supplier codes of conduct which comply with social and environmental standards).

### 3.1.2. Value delivery

The value delivery dimension describes the elements which generate value for the platform sides. As the aim of this paper is to provide the architecture for a digital platform for sustainability, the conventional view of delivering value to customers only is extended to a broad range of stakeholders and the natural environment [13]

This dimension includes the strategic decisions over the platform's scope and digital interfaces [1]. Conventionally, the key value proposition of platforms has been to reduce transaction costs [45], search costs [46] and/or product development costs via programming interfaces and digital resources [40]. However, an additional value adding activity in the context of sustainability is reducing ownership costs and environmental risk.

One way how platforms can reduce ownership costs is by substituting resource or product ownership with community based access to resources and products [37] and by providing product-as-a-service models which prioritize usage over ownership [36].

Digital platforms facilitate the exchange of goods, services and data by acting as matchmakers and brokers between sides. Additionally, platforms have been identified as circularity brokers [24] fostering waste recovery in the supply chain. This idea of platforms leveraging digital technologies to close the loop further enhances their role in sustainability [37]. For example, online waste exchange platforms match supply and demand and lower transaction and search costs for both sides, thus fostering waste as a valuable resource and "turning one person's trash into another person's treasure" [42].

Managing the relationship between the platform owner and the ecosystem members requires using technological interfaces, such as software tools. These tools act as boundary resources which both delimit the economic activities between sides [47] and specifies the characteristics of the relationship. For platforms enabling complementary innovation, the interfaces are typically Software Development Kits (SDKs) that facilitate efficient development of complementary innovations, and Application Programming Interfaces (APIs) which forge the relationship between application developers and users [44].

Moreover, as digital platforms exist in a socio-technical setting where they interact with an ecosystem of internal stakeholders (e.g., consumers, providers, complementors, advertisers) and a broader set of external stakeholders spanning economical, organizational, institutional, and natural spheres. To govern a platform ecosystem in a sustainable way, platform owners should identify the relationships to their stakeholders and manage them to create value. Major stakeholder groups include private sector, social enterprises, NGOs, government, international organizations, bottom of the pyramid consumers, regular consumers and the natural environment [13]. Additionally, the geographic scope where the platform operates plays a role here.

### 3.1.3. Value capture

This dimension describes the mechanisms by which a platform converts the value created into profitable revenue streams [48]. For platforms capturing value is more complex than for traditional pipeline businesses [46] for two reasons, first, as the revenues are not achieved by unit sold but rather from the interactions that arise, and second, as the demand by one of the sides depends on the number of members on the other sides the platform serves, a careful balance on the optimal pricing strategy should be taken.

A platform's key revenue stream largely depends on the platform type. For instance, transaction platforms capture value through various mechanisms, like charging for access to the platform through membership or usage fees, as well as via fees on the transactions. Innovation platforms on

their part capture value either by charging complementors (third-party developers) for access to the platform, or consumers by selling or renting a service [20].

Charging for access included the so-called ‘subscription’. This has been identified as a good mechanism for platforms to have a predictable and consistent revenue stream, especially those new players with a sustainability mission [37].

In other cases, platforms can be monetized via advertising when the platform is free e.g., search engines, social media. This monetization strategy is a double-edged sword. While it can have a positive impact by satisfying the needs of a social group with free offerings [42], it is a risky line to cross as the continuous tracking of data could enable social discrimination and behavioral influence [27].

The most common mechanism to put a price to a firm's offerings are fixed pricing, market pricing or differentiated pricing (Osterwalder, 2004). The latter has been identified by Lüdeke-Freund et. al (2022) in their 45 patterns of sustainable business model design to foster sustainability by charging different prices to different groups based on income –or what they can afford to pay. Furthermore, the authors suggest additional pricing and revenue patterns which also apply to platforms, such as freemium and performance-based pricing [36].

To maximize economic profit, consumer welfare and ecological wellbeing platform owners must decide which platform sides to subsidize and which to monetize [4]. Generally speaking, multi-sided platforms have a ‘subsidy side’ which is a group of users who pay less than marginal cost and is highly valued by the ‘money side’ –who pays above the marginal cost (Eisenmann, Parker, and Van Alstyne 2006). This decision is crucial for the platform’s long-term sustainability.

Lastly, by facilitating the interaction across sides, platforms can control other aspects of the platform’s competitive outlook such as switching and multi-homing rules [9,48].

### 3.2. A morphology of digital platforms for sustainability (DPfS)

Describing a digital platform’s business model along the dimensions shown in Table 2, is in line with other major frameworks (e.g., “Marketplace Morphology” [39]; “Business Model Canvas” [29]) and widely accepted theoretical concepts (e.g., Teece, 2010; Van Alstyne, Parker and Choudary, 2016). This alignment increases the number of users who can comprehend and use the DPfS model and design options. The horizontal axis shows the 74 design options which are available, these are distributed per dimension (value creation, value delivery and value capture) and the different subdimensions.

**Table 2.** DPfS business model morphology.

Value creation	Subcategories	Elements					
	Market Structure	Two-sided			Multi-sided		
	Platform Ownership	Single firm	Alliance / Consortium	Decentralized	Cooperative	Public-private	
	Platform type	Transaction		Innovation		Hybrid	
	Key activity	Data services		Network-community building		Complementary innovations	
	Price discovery	Fixed priced	Set by sellers	Set by buyers	Auction		Negotiation
	Access control	Selective exclusion		Social behavior		None	
	Trust system	User reviews		Review by platform		None	



	Supply chain	short supply chain		produce on demand		Inclusive sourcing		green supply chain management	
Value delivery	Key value proposition	Product development costs		Transaction costs	Search costs		Ownership costs		Environmental risk
	Transaction asset type	Tangible					Intangible		
	Transaction content source	Primary					Secondary		
	Digital interface	API		SDK			None / other		
	Participants / stakeholders	private sector	social enterprise	international org.	NGO	Government	BoP consumers	Consumers	Natural environment
	Geographic scope	Global		Regional			Local		
	Key revenue stream	Membership / access fee		Usage fee		Transaction fee		Advertising	None
Value capture	Pricing mechanism	Fixed pricing		Market pricing		Differentiated pricing		Freemium	Result-oriented
	Revenue side	Provider		Consumer		Third party		None / other	
	Subsidy side	Provider		Consumer		Third party		None / other	
	Multihoming costs	Allowed		Partially allowed			Forbidden		
	Switching costs	Low				High			

The morphological box shown in Table 2 efficiently organizes the available information about design options gathered from literature and provides a holistic understanding of the business model of a digital platform for sustainability, its attributes and specifications [49]. The resulting artefact can aid in identifying innovative platform business models through various combinations of elements.

This figure also points to those design choices found in the sustainability literature which are unique to business models for sustainability [42], such as the stakeholder view integrating internal and external parties in the value delivery dimension. These elements are highlighted in grey and span across the three business model dimensions of value creation, value delivery and value capture.

From the three dimensions, the elements which appear to have a larger impact on the sustainability of a platform business model is the value delivery one with three subcategories in comparison to two for the remaining dimensions. Namely, 'key value proposition' which extends to include the reduction of ownership costs [20] and environmental risk [25], 'transaction content' including waste as an option fostering circular business models [37] and a stakeholder dimension which signal to the holistic view of actors when conducting business sustainably [22].

### 3.2.1. The DPfS business model morphology applied

This paper aims to empirically validate the findings from the literature review by employing a morphological analysis to classify existing digital platforms for sustainability within the proposed framework. These selected platforms align with the previously stated definition of DPfS, which characterizes them as IT artifacts existing within a complex network of stakeholders. Furthermore, DPfS create, deliver, and capture economic value while concurrently ensuring the preservation or regeneration of natural, social, and economic capital beyond the confines of their organizational boundaries.

To identify these platforms, a systematic search was conducted using Google's search engine. The search yielded 59 companies, from which 20 platforms were selected in the initial round of analysis. The selection process involved excluding companies with identical business models or inactive status. Individual data on the selected platforms was meticulously curated from multiple sources, including the firm's websites, online databases, and relevant online articles.

The 20 platforms demonstrate diverse representation across several industries, with the highest shares found in transportation (20%), food (15%), agriculture (10%), energy (10%), and sustainability (10%). The majority of the firms in the sample were established between 2005 and 2018, with only two firms founded before 2005. Among the selected platforms, fifteen belong to the category of transaction platforms, while the remaining five can be classified as innovation or hybrid platforms. The unequal distribution of platform types can be attributed to the significant resource-intensive capabilities required to develop innovation platforms in comparison to transaction platforms [20].

The primary focus of the sampled firms centers around building an active community of users, thereby affirming the fundamental characteristic of a platform's social network functions, which leverage network effects to foster engagement and promote sustainability.

The core value proposition shared among all the platforms revolves around mitigating environmental risk, which manifests in diverse ways contingent upon the industry in which the firm operates. For instance, specific platforms are dedicated to promoting green agriculture, exemplified by companies like GoodEggs and FarmDrop. On the other hand, other platforms serve as facilitators for shared-vehicle schemes, as seen with BlaBlaCar and Uber. Additionally, there are platforms that enable investments in climate projects, such as Pachama and Triodos Bank. The foundation of this value proposition rests on the platform's ability to effectively reduce search costs, employing matchmaking capabilities that provide consumers with convenient and cost-efficient access to various services, including transportation options, sustainable carbon projects, food, and more.

Furthermore, certain platforms act as circularity brokers, exemplified by entities like TooGoodToGo. These platforms adopt a pivotal role in the circular economy by leveraging digital technologies to recover excess food from the supply chain. In this process, restaurants with surplus food are seamlessly connected to consumers, demonstrating the platforms' facilitation of sustainable practices and responsible resource management [24].

In contrast to the findings in existing literature, the present sample exhibits a notable divergence, with 50% of firms deriving value through transaction fees rather than subscription-based models as described by Lüdeke-Freund et al. (2018). This could be explained by the dominance of transaction platforms in the sample, where firms monetize the value proposition –reduction of search costs– by charging a percentage on every transaction instead of membership or usage fees which are more typically employed by innovation platform firms. As a result, a majority of the platforms impose charges on the demand side (consumers) rather than on the supply side.

In sum, the elements encompassed within the DPfS morphological box offered a comprehensive framework that adequately accounted for the design choices observed among the selected sample. The framework proved to be exhaustive in capturing the diverse range of approaches adopted by these platforms.

#### 4. Discussion

The role of current and future entrepreneurs in promoting sustainable development is significant. A paradigm shift towards fostering value not solely for financial objectives but also for social and ecological purposes challenges the conventional notion of business, where ethical considerations and profitability may not necessarily align. For digital platforms, this transformation entails harnessing their network effects and market influence to create economic value while

simultaneously preserving or regenerating natural, social, and economic capital beyond their organizational boundaries.

In view of the winner-take-all nature intrinsic to platform businesses, their profound impact on society entails a corresponding importance to act responsibly and equitably. Presently, numerous instances underscore the need for platforms to be held accountable for their actions, as they face scrutiny for imprudent practices and unintended negative consequences. Such instances may encompass social networks propagating misinformation and polarization, food delivery platforms with negative employment practices, and short-term rental platforms exacerbating gentrification in urban centres.

This research contributes to the existing literature on sustainability and platforms by introducing a morphological box, which serves as a valuable instrument for platform practitioners to identify, validate, and implement sustainable practices within their platform architecture. Adopting an integrated perspective that combines sustainability and platform theory, this study reveals specific design choices for platform architecture that empower platform practitioners to optimize their business models for sustainability. The ensuing paragraphs expound upon the architecture of the principal business model dimensions and the fundamental design parameters that characterize digital platforms for sustainability (DPfS).

First, digital platform businesses create value through the deliberate design of architecture and mechanisms that regulate interactions between different sides of the platform, as well as orchestrate resources and processes. The process of building a platform requires careful consideration of its type, governance, and capabilities to ensure its effective and sustainable operation over time. In this regard, mechanisms like cooperative ownership and public-private partnerships play a vital role in transcending narrow for-profit and profit-maximizing models, contributing to platform sustainability. However, it is important to note that effective governance remains a critical factor for ensuring the long-term sustainability of a platform.

Interestingly, the research findings indicate that transaction platforms are more prevalent in the sustainable business landscape, not necessarily because they inherently produce more sustainable outcomes, but due to the resource-intensiveness associated with innovation platforms. This insight sheds light on the factors influencing the distribution of platform types in the context of sustainability.

In terms of pricing, we observed that prices for goods and services on platforms are typically determined by the supply side, whether it's for a ride, an egg carton, or a ton of CO<sub>2</sub>. Notably, we did not find evidence of pricing being set by the demand side or through direct negotiations between parties. However, consumers can ensure fair prices through competition amongst suppliers on the same side of the platform. Additionally, trust mechanisms play a significant role, where consumers can review products or services, or the platform itself assumes the role of a reviewer to ensure quality across the supply side.

Moreover, the value delivery dimension of platforms should extend beyond traditional customers and incorporate a broader range of stakeholders. This requires a comprehensive understanding of the major stakeholder groups, including private sector, social enterprises, NGOs, government, international organizations, bottom of the pyramid consumers, and the natural environment. Platforms rarely exist in isolation and are the foundation for a multi-stakeholder collaboration which facilitates collective efforts towards increased impact. A sustainable platform architecture requires a conscious effort to balance the interests of these various stakeholders while simultaneously promoting social and environmental sustainability.

Technological interfaces, particularly software tools, play a crucial role in facilitating and managing the relationship between the platform owner and its ecosystem, thereby creating value. The level of complexity in these digital interfaces varies based on the platform type, with innovation platforms generally being more technologically intricate compared to transaction platforms. However, both types rely on IT infrastructure and gather valuable data to function effectively as socio-technical constructs.

The openness and accessibility of data and digital interfaces have a significant impact on various aspects, including innovation, transparency, and privacy. Depending on the platform's approach to data sharing and interface availability, these factors can either hinder or foster value delivery within the platform ecosystem. Additionally, the degree of openness can also influence the platform's potential for practicing and promoting sustainability.

Capturing value in multi-sided platforms, particularly those deemed sustainable, presents an added layer of complexity. Platform owners face the challenge of striking a delicate balance in devising an optimal pricing strategy that simultaneously maximizes economic profit, enhances consumer welfare, and promotes ecological well-being. To achieve this delicate balance, platforms employ a range of monetization mechanisms, including subscription models, transaction fees, advertising revenue, differentiated pricing, and performance-based pricing.

The adoption of sustainable business model design patterns further contributes to fostering sustainability. Examples of such patterns include charging different prices to various groups based on their income levels and implementing freemium pricing models, where basic services are provided for free, with additional premium features offered for a fee.

In the context of transaction platforms, our sample data indicates that subscription fees are relatively uncommon. Instead, platform owners predominantly rely on transaction fees charged to consumers. In this role, the platforms function as matchmakers, facilitating transactions between different sides of the platform.

In conclusion, this study highlights the significant role of current and future platform owners in promoting sustainable development, challenging traditional business notions by emphasizing value creation for social and ecological purposes. Digital platforms have the competitive characteristic of creating network effects and market influence to generate economic value while preserving or regenerating natural, social, and economic capital beyond organizational boundaries. However, platform businesses' winner-take-all nature necessitates responsible and equitable actions to address their profound societal impact. The research contributes to the literature through a morphological box that empowers platform practitioners to identify and implement sustainable practices throughout their value creation, capture and delivery chains.

#### *Managerial implications*

The resulting morphological box can aid platforms owners to identify sustainable business model elements, review their current businesses and innovate towards platforms that do well and do good and remain competitive.

Platforms should embrace the paradigm shift towards fostering value for social and ecological purposes alongside financial objectives. Aligning ethical considerations with profitability can lead to more sustainable business practices and enhance the overall impact of digital platforms. Employing effective mechanisms such as effective governance, prioritizing sustainable design patterns, engaging multiple stakeholders and leveraging technical interfaces is encouraged.

As platform owners use the proposed framework to design their platforms' value creation, delivery and capture mechanisms, we expect new business models to arise and platform owners to adjust their business strategy according to the design choices.

#### *Future research and limitations*

The digital economy is increasingly being driven by platforms and further research on this phenomenon is relevant both to platform practitioners, policy makers and society at large. While this paper advances research on the implementation of business models for sustainability (BMfS) in the context of digital platforms, the author acknowledges that the research gap can be further developed.

The morphological box was empirically tested with selected cases and a relatively small sample (20). Digital platforms for sustainability are in continuous growth across the globe and entrepreneurs are finding innovative ways to design their business models which may not have been captured within the proposed artefact. Therefore, the author acknowledges the limitations of the empirical approach and encourages researchers to continue the identification of additional elements which could be included.

Furthermore, this research has taken one of the existing business model frameworks [30] as a guide to classify the dimensions, subdimensions and individual elements of the morphological box, however, there are other ways to structure digital platforms when using a different theoretical lens which can help further the sustainability and digital platform agendas.

Lastly, this work did not focus on specific industries or geographies to build the morphological box. By taking one industry type as a focal point of digital platforms, the design choices which

optimize the business model for sustainability may appear clearer and could extend the model into more verticals.

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