

Towards a Typology of Platform Business Models

*A conceptual and empirical research into platform
business model's contribution to sustainability*

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Preface

This master thesis presents the results of my graduation research for the master Business Administration, specialization in Strategic Management at Radboud University Nijmegen. This paper was written during the curious times of the corona pandemic affecting all of humankind globally. Unfortunately, the pandemic had shifted a half year of frequent planned face-to-face meetings with my mentor and fellow students, towards a time of self-quarantine and working exclusively from home, while relying mostly on videoconference meetings. It has been an extraordinarily peculiar time for most of us. However, I truly believe we collectively made the best of the situation and managed to get through it as best as we could.

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Abstract

The surge of the sharing economy has seen the emergence of transformative new ways for consumers and businesses to communicate, trade, share and collaborate with one another. Businesses known as platforms provide value to their userbase by facilitating the connections between supply and demand, with minimal effort and maximum effectiveness, which is the added value of platforms that most agree on. However, innovations are only as good as the political and social context in which they are employed. Improvements to environmental sustainability facilitated by platforms, therefore, rely on the gap between users and the habits supported and promoted by such services. The existence of platforms and the business models they incorporate seem to be of great importance for contributing to sustainability.

This qualitative research presents a first attempt in constructing a typology of platform business models, as well as determining their contributions to sustainability, by means of extended literature review and illustrative case analysis. A typology for platform business models is proposed, inspired by earlier classifications of product-service systems. The results showed a total of nine archetypes for platform business models (PBMs) to be distinguished, namely: Collaborative consumption PBMs, asset management PBMs, commodity management PBMs, product related service PBMs, bartering-based PBMs, pay per service unit PBMs, result-based PBMs, availability-based PBMs. The dimensions of the PBM typology can be interpreted as follows: each archetype has value orientation that is leaning functional content, performance content, or a mix in between both. PBMs that lean towards more functionality are classified as product oriented PBMs. On the other side, PBMs leaning towards performance are classified as performance oriented PBMs. Between these two classifications one can find servitization-oriented PBMs. Clustering based on transaction type and content can be either based on transfer of ownership or based on demand-fulfilment.

In order to shed light onto the contribution of platform business models to sustainability, each archetype of the PBM typology is ranked according to a set of R-strategies. The hierarchy of the R-strategies from highest to lowest is refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle and recover. The hierarchy of the 9R strategies in the framework corresponds to varying degrees of resource value retention. Each illustrative case got labeled by the employed 9R strategy to determine levels of circularity. Illustrative cases employing strategies R0 through R2 are considered as business models with high levels of circularity. In conclusion to the R-strategy hierarchy: collaborative consumption PBMs, pay per service unit PBMs and availability PBMs, with their employed ‘rethink’ R-strategy, have the greatest contribution to sustainability of the nine identified archetypes in the PBM typology. Thereby, a direction is given for the degree to which platforms can contribute to sustainability.

Keywords: Platform business models, sharing economy, circular economy, circular business models, typology, sustainability

Table of Contents

Preface	ii
Abstract	iii
1 Introduction	1
1.1 New business model trends	1
1.2 Sustainability	5
1.3 Problem Statement	6
1.4 Research Objective and Research Question	7
1.5 Outline of this Paper	8
2 Literature review on business models	9
2.1 Business models	9
2.2 Conventional business models	9
2.2.1 Value creation	10
2.2.2 Business models for sustainability	11
2.2.3 Multiple value creation	12
2.3 Collective business models	12
2.4 The difference between conventional- and collective business models	13
2.5 Platform business models	14
2.6 The difference between collective- and platform business models	15
3 Literature review on platform related typologies	17
3.1 Typology	17
3.2 Literature review on platform related typologies	17
3.2.1 Product-service systems	17
3.2.2 Servitization	20
3.2.3 Nature of value creation	20
3.2.4 Platform business model attributes	22
3.3 Synthesis of platform related typologies	23
3.4 Developing the preliminary typology framework of platform types	25
3.5 Reflection and limitations	26
4 Research Methodology	27
4.1 Research Objective	27
4.2 Research Methods	27
4.2.1 Literature study	27
4.2.2 Typology development	28
4.3 Research design	28
4.4 Data analysis method	28

4.4.1	Illustrative case selection method.....	29
4.4.2	Illustrative case analysis method	29
4.5	Limitations	30
5	Analysis of illustrative platform business model cases	33
5.1	Illustrative case analysis approach	33
5.1.1	PSS types.....	33
5.1.2	Operationalizing sustainability contributions for platform business models	35
5.2	Illustrative case analysis of platform business models	37
5.2.1	Illustrative case for PBM 1: FLOOW2.....	37
5.2.2	Illustrative case for PBM 2: Zipcar	39
5.2.3	Illustrative case for PBM 3: Excess Materials Exchange.....	39
5.2.4	Illustrative case for PBM 4: Snappcar.....	40
5.2.5	Illustrative case for PBM 5: Fiverr.....	41
5.2.6	Illustrative case for PBM 6: Bookmooch	42
5.2.7	Illustrative case for PBM 7: De Kringwinkel.....	43
5.2.8	Illustrative case for PBM 8: MUD Jeans.....	44
5.2.9	Illustrative case for PBM 9: Hello Tractor	44
5.3	Synthesis of illustrative case analysis.....	45
5.4	Reflection and limitations on the illustrative case analysis.....	47
6	Discussion and concluding remarks	49
6.1	Research questions and intentions.....	49
6.2	Research process and findings.....	49
6.3	Towards a typology for platform business models.....	51
6.4	Concluding remarks	54
6.5	Reflective Criticism and Limitations.....	56
6.6	Contributions of this Research	59
6.7	Suggestions for future Research.....	60
	References	61
	List of figures	67
	List of tables	67
	Appendix A: Requirement form for longlist of cases.....	68
	Appendix B: List of cases	69
	Appendix C: Illustrative case company profiles.....	71

1 Introduction

The last decades has seen a rise of new ways humans communicate, collaborate, and share with each other. These new ways, accelerated by the Internet and Web 2.0, are now facilitating older forms of sharing on a larger scale (Belk, 2014, p. 199). Another form of internet-facilitated sharing is the transmission of materials and goods between consumers and businesses (Belk & Llamas, 2012). Thanks to platforms, it is no longer required for people to know each other to be able to gain access, sell, resell or exchange demanded materials or goods (Schor & Fitzmaurice, 2015). The success and emergence of this phenomenon, known as platform business models, lies to a certain extent in the technology enabling sharing on sizable scales (Cohen & Kietzmann, 2014). It has been defined as peer-to-peer, business-to-consumer or business-to-business sharing, renting and/or swapping of underused assets enabled by sharing platforms (Botsman & Rogers, 2010; Schor & Fitzmaurice, 2015). Providers offer business models that are able to utilize this technology in such a way that can connect the appropriate parties that supply and demand, thereby decreasing the number required actors. “Compelling user interfaces, big data analytics, reputation mechanisms, and payment handling improve the processes of conventional business models with less resource input” (Kathan, Matzler, & Veider, 2016, p. 8). The providers economize their ability to coordinate the acquisition and distribution of resources in return for a fee or other compensation (Belk, 2014), while consumers use the platform to economize their ownership of underused assets (Schaefer, Lawson, & Kukar-Kinney, 2016).

The upcoming of the sharing economy and thereby its peer-to-peer services that it offers, is by some perceived as the “post-crisis antidote to materialism and overconsumption” (The Economist, 2013). Nonetheless, one should consider the downsides of the sharing economy in order for it to last (Kathan et al., 2016). Possible enhancements to the environment triggered by the sharing economy are highly dependent on the nature of technology that is used, the distance between users and the kind of behavior that occurs on these sharing services (Mont, 2004). Therefore, sharing practices can be sustainable if it is important to the customer base to consume ecologically. However, according to Philip, Ozanne, and Ballantine (2015), the sustainability advantages that come forward from the sharing economy are viewed as a convenient ‘added bonus’, on top of the more highly valued pragmatic advantages.

1.1 New business model trends

Numerous types of new trends are emerging in the changing and ‘new’ economy, known as the WEconomy (Jonker & Faber, 2015). It is of essence to understand these concepts, since platforms have connections with the circular economy, collaborative economy, sharing economy as well as the internet of things. This section goes over the definition of these trends and how platforms are imbedded in them.

The circular economy

The concept of the circular economy (hereafter referred to as CE) is currently promoted by the European Union, as well as numerous other governments across the globe, such as The Netherlands and China

(Korhonen, Honkasalo, & Seppälä, 2018). “The CE is based on the idea of closing loops. Products and materials are re-used, and raw materials retain their physical characteristics and value as far and as long as is possible” (Jonker, Stegeman, & Faber, 2017, p. 6). The traditional system known as the linear economy, wherein production processes are based on extraction, production, utilization, ending with disposal, is unsustainable (Frosch & Gallopoulos, 1989). Although considerable steps have been taken to improve resource efficiency exploring usage of alternative energy, less attention has gone to fundamentally changing systems towards eliminating material waste and leakage. In the meantime, businesses have started to notice that the linear system increases their vulnerability to threats such as production delays and increasing resource prices (MacArthur, 2013), however, the linear economy has been the dominating system until now, which is regarded as an unsustainable approach (Geissdoerfer, Savaget, Bocken, & Hultink, 2017). The CE distinguishes itself from the known recycling systems by emphasizing “product, component and material reuse, remanufacturing, refurbishment, repair, cascading and upgrading as well as solar, wind, biomass and waste-derived energy utilization throughout the product value chain and cradle-to-cradle life cycle” (Korhonen et al., 2018, p. 37).

For the purposes of this research, the CE is defined according to the definition of Korhonen et al. (2018, p. 39): “Circular economy is an economy constructed from societal production-consumption systems that maximizes the service produced from the linear nature-society-nature material and energy throughput flow. This is done by using cyclical materials flows, renewable energy sources and cascading-type energy flows. Successful circular economy contributes to the economic, social and environmental dimensions of sustainable development. Circular economy limits the throughput flow to a level that nature tolerates and utilizes ecosystem cycles in economic cycles by respecting their natural reproduction rates”.

The collaborative economy

The collaborative economy consists of a wide variety of definitions across academics and the internet overall. It offers a new way of thinking about society, trade, exchange and business. Collaborative economy activities can be recognized by utilization of idle assets, offered on all sorts of (digital) marketplaces (Stokes, Clarence, Anderson, & Rinne, 2014). The collaborative economy is an economic model where ownership and access are shared between corporations, startups, and people. This results in market efficiencies that bear new products, services, and business growth (Owyang, Tran, & Silva, 2013, p. 4). The European Commission (2016) has also established a definition that provides characteristics that could be used in research and policy: “The term ‘collaborative economy’ refers to business models where activities are facilitated by collaborative platforms that create an open marketplace for the temporary usage of goods or services often provided by private individuals. The collaborative economy involves three categories of actors: (i) service providers who share assets, resources, time and/or skills—these can be private individuals offering services on an occasional basis (‘peers’) or service providers acting in their professional capacity (‘professional services providers’);

(ii) users of these; and (iii) intermediaries that connect—via an online platform—providers with users and that facilitate transactions between them (‘collaborative platforms’). Collaborative economy transactions generally do not involve a change of ownership and can be carried out for profit or not-for-profit”.

The collaborative economy leverages the abilities of internet technology to connect the right groups of people together in order to use skills and goods more optimally. Thereby, it allows peer-to-peer communication, user rating and transactions (Stokes et al., 2014). Organizations that operate in the collaborative economy can be categorized into four sections: collaborative consumption, collaborative production, collaborative learning and collaborative finance (Botsman & Rogers, 2010).

The sharing economy

An alternative to the current way society consumes and behaves, known as the linear economy, is a shift to the so-called sharing economy. New ways of communication brought forward by the Internet and Web 2.0 have facilitated human beings to be able to share on vast, unseen scales (Belk, 2014). The transmission of materials and goods between businesses and consumers was also enabled by this movement (Belk & Llamas, 2012). To be able to exchange, sell or resell products that are in demand, it is no longer necessary for people to know each other (Schor & Fitzmaurice, 2015). Sharing models have been successful thanks to the technology enabling them to operate on large scales (Cohen & Kietzmann, 2014). The difference between the traditional concept of sharing and the concept of the sharing economy lies in the use of information technology (Belk, 2010).

Changes in consumption patterns have emerged since the upcoming of the sharing economy (Botsman & Rogers, 2010). To offer a clear definition of the ‘sharing economy’ is a true challenge, as it is used in such a wide variety of ways (Schor, 2016). The sharing economy can be described as a “broad concept or idea used loosely to encompass and account for a set of diverse phenomena” (Acquier, Daudigeos, & Pinkse, 2017, p. 2). Although there is no common definition for the sharing economy, it has been defined as peer-to-peer, business-to-consumer or business-to-business sharing, renting and/or swapping of underused assets enabled by digital platforms (Botsman & Rogers, 2010; Schor & Fitzmaurice, 2015). Moreover, in a report of the PwC, the sharing economy is used in the following manner: “Sharing economies allow individuals and groups to make money from underused assets” (PricewaterhouseCoopers, 2015, p. 5). Looking at the PwC’s definition, there is a clear emphasis on the utilization of excess resources.

Our current socio-economic model is generally structured in such a manner that the entity of an organization is the central building block. Property, capital and profit are directly linked to this architecture, contributing to competition and mistrust as the core mode of activity. The sharing economy is set up differently, as the collective is placed as the centerpiece of the economy. By placing the collective on a more vital part of the economy, it lessens the emphasis on solely profit, but includes importance of participation, creating care and involvement on top of welfare. Hence, the sharing

economy works on the principle of trust and partnership, as well as collective governance (Jonker & Faber, 2015).

The sharing economy has been recognized for being a possible sustainable alternative to today's economy (Heinrichs, 2013). Advocates of the sharing economy, including leaders within the space, claim the sharing economy to have the capacity to bring forward an equal, sustainable economy. However, research shows that it is still debatable whether the sharing economy has the ability to change current wasteful patterns of consumption, as it depends heavily on each segment of the sharing economy as well as the sharing platform's business model (Zvolska, 2015).

The Internet of Things

Over two billion people around the world have access to the internet, with even more people are expected to gain access over the next decade (Miorandi, Sicari, De Pellegrini, & Chlamtac, 2012). The Internet of Things (IoT) is paradigm wherein devices and everyday objects around the world are connected to the (internet) network and also interconnected among each other. IoT technologies will cause communication and information systems embedded in business practices such as platform technology, to be seamlessly embedded in the environment surrounding us (Gubbi, Buyya, Marusic, & Palaniswami, 2013). The term 'Internet-of-Things' is used to refer to "the resulting global network interconnecting smart objects by means of extended internet technologies and the set of supporting technologies necessary to realize such a vision" (Miorandi et al., 2012, p. 1), as well as the plethora of services and applications using the technologies to open new business opportunities (Atzori, Iera, & Morabito, 2010). The IoT is appearing as one of the major developments that forms technical growth in the ICT industry at large (Buckley, 2006). Moving away from an era of only connecting end-user devices and shifting to an internet used to interconnect everyday devices and objects, requires the need to reconsider some of the traditional methods of providing and managing services and products (Miorandi et al., 2012).

IoT functions by enabling devices and machines to communicate with one another, occurring without the need for human interaction. These interconnected devices serve as a network of smart devices that can be leveraged as extensions or improvements to services in the industry that they operate in (GSM Association, 2014). IoT will help strategies for businesses that improve decision-making and profitability in the manufacturing, banking, agriculture and other industries. For consumers, IoT has the ability to provide innovations that significantly enhance energy efficiency, protection, education and health among other facets of everyday life (GSM Association, 2014).

Numerous opportunities for businesses, manufacturers and users arise from IoT innovations, with applications within various industries, as they form the building blocks to move towards unified communication and information technology platforms for a wide array of applications (Huckle, Bhattacharya, White, & Beloff, 2016). Accordingly, there has been considerable interest in sharing economy applications whereby people could monetize their belongings and to exploit idle assets (Loper, 2016).

1.2 Sustainability

This paragraph provides a general definition for sustainability to be used in this thesis. The most commonly accepted initial understanding of sustainability is the definition of Brundtland, Khalid, Agnelli, Al-Athel, and Chidzero (1987, p. 41): “Development that meets the needs of the present without compromising the ability of future generations to meet their needs”. At a later stage, Elkington (1998) continued by introducing the triple bottom line (TBL), in which the role of companies and organization are included, thereby transferring the debate to the business level. The TBL considers three main elements for organizational sustainability: The natural environment, society-, and economic performance. When acknowledging planet and people along with profit, environmental and stakeholder impacts will be integrated while considering alternatives, leading to more balanced result (Elkington, 1998). The environment (or ‘planet’) pillar of Elkington’s TBL is related to environment, climate change, biodiversity and renewable resources. The social (or ‘people’) pillar is related to health, well-being and equality. The economic (or ‘profit’) pillar is related to profitability, growth and economic development (Elkington, 1998). The three pillars are systematically interwoven and affect each other by mutual positive feedbacks (McKelvey, 2002), this means that enterprises need to solve a mutually interdependent collection of issues (Sartori, Witjes, & Campos, 2017) that can be tailored to a wide variety of situations and time horizons (Wise, 2016). Based on these arguments, the definition of sustainability can be framed as: “the balanced and systemic integration of intra and intergenerational economic, social, and environmental performance” (Geissdoerfer et al., 2017, p. 5).

Corporations, particularly multinationals, have become the main focus of attention when it comes to the sustainability debate over the last fifteen years, as they are considered to be responsible for a major portion of environmental and social impacts (Dunphy, Griffiths, & Benn, 2003). Companies have shown interest in sustainability by showing some voluntary efforts developed by and for organizations (Ny, 2009). In the early stages up until the beginning of the new century, most of these efforts consisted of end of pipe solutions, which are mostly perceived as inefficient and expensive (Porter & Van der Linde, 1995). At a later stage more systematic advancements started to gain traction, wherein (almost) closed loops were created by modifying goods, processes and systems in order to reduce waste and utilize capital more effectively and efficiently (McIntosh, Leipziger, & Coleman, 2003).

Almost 25 years later, Elkington (2018) reflected on rethinking his work on the triple bottom Line. The TBL was picked up widely by organizations such as Global Reporting Initiative (GRI) and Dow Jones Sustainability Index (DJSI), however, the TBL was never intended to be just an accounting tool: “Thousands of TBL reports are now produced annually, though it is far from clear that the resulting data are being aggregated and analyzed in ways that genuinely help decision-takers and policy-makers to track, understand, and manage the systemic effects of human activity”. Moreover, Elkington adds: “Fundamentally, we have a hard-wired cultural problem in business, finance and markets. Whereas CEOs, CFOs, and other corporate leaders move heaven and earth to ensure that they hit their profit targets, the same is very rarely true of their people and planet targets. Clearly, the Triple Bottom Line

has failed to bury the single bottom line paradigm”. The writer of the TBL advocates for a new wave of TBL innovation and deployment where business and society start moving towards a “triple helix for value creation, a genetic code for tomorrow’s capitalism, spurring the regeneration of our economies, societies, and biosphere” (Elkington, 2018).

Lorek and Spangenberg (2014) argue that humanity, in the past 25 years, is barely getting close to the concept of sustainable development. One of the key issues with the concept's current position that they mention is the dependence on innovation and growth, that has contributed to this stalemate situation. The need for solving root causes of problems calls for action and fundamental changes (Tukker, 2004).

Contesting the various divergent views on the basic definition of sustainability science or sustainable development is outside the scope of this paper. While it is clear there is an ongoing debate around social, economical and environmental sustainability, this research does not hold the objective to address those altogether. Sustainability within this research is about fulfilling demands with reduced use of resources, material and emissions. Sustainability depends on whether actors can be less material intensive, and whether chain players have opportunities to reduce material volume any further (Tukker, 2004). Therefore, for the scope of this research, the term ‘sustainability’ is narrowed down to environmental sustainability also known as the ‘planet’ pillar of Elkinton’s TBL.

1.3 Problem Statement

The potential of platform business models is twofold. On one hand, it can be viewed as a unique opportunity for the economy to move towards more sustainable production and consumption practices. On the other hand, it might be another way to fortify the unsustainable economic behavior that is already being exploited. This is why there is considerable demand for research diving into how the sharing economy could be guided into a more sustainable pathway (Martin, 2016).

Lately there has been significant amounts of support surrounding utilization of platform business models for promoting sustainable consumption practices. Botsman and Rogers (2010) argue that the unsustainable hyper-consumption patterns that drive capitalist economies will be disrupted, while Heinrichs (2013) proclaimed the sharing economy to be the ‘potential new pathway to sustainability’. The former argument is that the sharing economy allows to move away from a society in which the consumer has its own assets, to a culture in which consumers share access to assets, propelled by peer-to-peer platforms that connect the right people, empowering them to make better use of underused assets (Martin, 2016). “By shifting the paradigm away from individual ownership to collectivity and sharing, less demand for consumer goods may give way to a new economy that could help take on problems such as pollution and excessive energy usage” (Prothero et al., 2011, p. 36).

Martin (2016) suggests that the way economic opportunity is currently represented within platform business models has a dominant position within the debate. The discourse follows famous success stories of Uber, Airbnb and alike, wherein it presents the rise of sharing platforms as an innovation with

enormous value for the digital marketing space. However, the representation of its potential to steer towards more sustainable consumer patterns seem to be substantially weaker, because these are far more complex and consequently not accompanied by similar success stories. Sometimes, the sharing economy is portrayed as a series of developments related only by the widespread use of digital technologies (Martin, 2016). Therefore showing that it is still debatable whether the sharing economy has the ability to change current wasteful patterns of consumption, as it depends heavily on each segment of the sharing economy as well as the platform's business models (Zvolska, 2015). Additionally, the early philanthropic status of platforms might fade away once they become integrated into the business-as-usual market (Schor, 2016).

Numerous platform businesses have arisen in the last decade. The most notable platforms emerged in the U.S., though meanwhile, the platform business model phenomenon has become well known globally. Especially across Europe, practices of sharing are becoming an integral part of major cities (Schor, 2016). The upcoming of peer-to-peer (P2P) communities that exchange resources and services could be the basis of a new household paradigm in which individuals are less dependent, and able to diversify their access to these resources and services. However, scholarly research towards gaining deeper understanding of platform business models, by means of a typology, is still lacking.

The simplicity with which people can now communicate, trade, share information and collaborate with, including strangers, accelerated by new technology, has been truly revolutionary. Nevertheless, as Schor (2016, p. 12) puts it: "technologies are only as good as the political and social context in which they are employed". The premises of platform business models give us powerful tools for building a society for sustainable consumption. Nonetheless, whether platform business models will trigger a movement to take advantage of that power is still unclear.

1.4 Research Objective and Research Question

Whereas many publications have been written about the circular-, collaborative- and sharing economy, scholarly research about platform business models is limited, since publications aimed towards a typology of platform business models is lacking. To gain deeper insight into the platform business model ecosystem, the following main research question is defined:

What does a typology of platform business models look like?

The explosive emergence of platforms has been significant, but their contribution to a society with more sustainable consumer patterns is scarce. Consequently, as described in the problem statement, the question remains unanswered whether platform business models contribute to a more sustainable society. Hence, the main research question is supported by the following sub question:

To what degree do platform business models contribute to sustainability?

1.5 Outline of this Paper

Primarily aiming to answer the research questions, this thesis unfolds with a literature review of concept creating the body of knowledge of this research. The literature review consists of two parts, the first being a literature study on business models in chapter 2, the second being a literature study on platform related typologies in chapter 3. Next follows the research methodology in chapter 4. Chapter 5 presents an analysis of underlying business models incorporated by platforms, which is followed by synthesis leading towards a typology of platform business models presented in chapter 6. Finally, the conclusions and discussions are proposed in chapter 7.

2 Literature review on business models

This chapter covers central definitions that collectively form the body of knowledge regarding business models within the scope of this research. The definitions in question are business models, conventional business models, collective business models and platform business models.

2.1 Business models

The topic of business models is widely discussed in management studies. The first notion of interpretation of business models dates back to Ferdinand (1954), however, the definition has frequently evolved over the last decades. Magretta (2002) mentions that there is no definition of the phenomenon that is generally accepted, but defines the business model as stories that explain how enterprises work, wherein managers should ask themselves the question “how does our business make money?”. Zott, Amit, and Massa (2011, p. 42) describe business models as “a system of interconnected and interdependent activities that determine the way the company does business with its customers, partners, and vendors”. The next sections discuss the various perspectives on business models from literature. For the sake of this research, three main topics are distinguished: conventional business models, collective business models and platform business models. Furthermore, the difference between these forms of business models is discussed.

2.2 Conventional business models

The first logical perspective on the topic is that of conventional business models, which pose the more traditional view on business models. Shafer, Smith, and Linder (2005, p. 202) define a business model as “a representation of a firm’s underlying core logic and strategic choices for creating and capturing value within a value network”. Furthermore, Casadesus-Masanell and Zhu (2013, p. 464) provide the definition of “search for new logics of the firm, new ways to create and capture value for its stakeholders, and focusing, primarily, on finding new ways to generate revenues and to define value propositions for customers, suppliers, and partners”. A companies’ business model allows it to organize the mechanism by which the organization aims to provide value to its stakeholders (Lee & Patel, 2019). According to Johnson, Christensen, and Kagermann (2008) a business model consists of three elements. Firstly, a customer value proposition which defines the target customer, offering and job to be done. Secondly, the profit formula composed of revenue model and cost structure. Third and lastly, the key resources and processes, which can vary from people, technology and information to rules, metrics and norms that allow the customer value proposition to be repeatable.

Business models “have the potential to bridge the gap between radical and systemic sustainable innovation and firm strategies” (Boons & Lüdeke-Freund, 2013, p. 3), furthermore, do they “serve [as] a positive and powerful role in corporate management” (Shafer et al., 2005). The way organizations are able to make profit through services or products is determined by their business model (Rauter, Jonker, & Baumgartner, 2017). According to Osterwalder (2004, p. 15) the definition of business models is

described as: “a conceptual tool that contains a set of elements and their relationships and allows expressing a company's logic of earning money. It is a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams”. Herein the main focus up till now has lied mostly on creating and commercializing (economic) value (Gordijn, Akkermans, & Van Vliet, 2000).

Many scholars have attempted to map and conceptualize business models, therefore, the exact elements of what makes a business model are quite inconclusive (Casadesus-Masanell & Ricart, 2010; Johnson et al., 2008; Osterwalder, 2004). The business model canvas developed by Osterwalder, Pigneur, Oliveira, and Ferreira (2011) is a widely accepted and dominant template for business models which maps the building blocks of a business model. The template outlines a comprehensive overview of key activities, resources, partners resulting in a value proposition highlighting the company’s possible trade-offs and core decisions. Additionally, monetary elements of the business model are covered in the revenue streams and cost structure and the bottom of the template (Osterwalder et al., 2011; Osterwalder, Pigneur, & Tucci, 2005).

The business model canvas has enjoyed a highly dominant position in business for several years, nevertheless, it has received criticism in the last years, since actions of firms and their underlying business models have been subject to change. Criticism on the business model canvas is based on the fact that the model its focus on value creation lies merely on financial gain, while it oversees other effects of value creation. In order to fully grasp the definition of business models, one must gain a deeper understanding of the concept of value creation.

2.2.1 Value creation

Central to most of the definitions of business models is the creation of value. Haksever, Chaganti, and Cook (2004, p. 292) define value as follows: “the capacity of a good, service, or activity to satisfy a need or provide a benefit to a person or legal entity”. Most companies are organized around the idea of capturing value, therefore, value creation is often represented as the primary objective of business models (Zott et al., 2011). Researchers refer to the distinctive business model dimensions of (1) value creation (2) value delivery, and (3) value capture (Teece, 2010). As Teece (2010, p. 191) puts it: “a business model describes the design or architecture of the value creation, delivery and capture mechanisms employed. The essence of a business model is that it crystallizes customer needs and their ability to pay, defines the manner by which the business enterprise responds to and delivers value to customers, entices customers to pay for value, and converts those payments to profit through the proper design and operation of the various elements of the value chain”. Value creation can be defined as “the relative amount of value that is subjectively realized by a target user (or buyer) who is the focus of value creation whether individual, organization, or society and that this subjective value realization must at

least translate into the user's willingness to exchange a monetary amount for the value received” (Lepak, Smith, & Taylor, 2007, p. 182).

The creation of value in conventional business models is focused entirely on the organization-centric viewpoint, meaning it is the company who determines what the added value to consumers is (Prahalad & Ramaswamy, 2004). For many organizations in the current linear economy, the only central value that is represented is money, by relying primarily on persuading consumers to purchase more of the goods and services that they provide (Jonker, 2012).

Companies have seen their former role in society change, which is to merely be an organization that aims to maximize profits and to satisfy their shareholders. Organizational impact on the sustainability of the TBL have become evident to the public (Lüdeke-Freund, Massa, Bocken, Brent, & Musango, 2016; Stubbs & Cocklin, 2008). In addition, organizations have gained a more extensive role in society, therefore, the conversation about the function of companies and their business models have fundamentally changed with respect to sustainability.

2.2.2 Business models for sustainability

Many of the common sustainability programs of today, such as reduction of pollution and emissions, addressing of social issues and corporate social responsibility (CSR), are perceived as inadequate to bring about the necessary structural transition of industries towards meaningful sustainable development (Kramer & Porter, 2011; Wells, 2013). These programs aim to reduce and limit the negative impact of organizations to society (Kramer & Porter, 2011), while they are still employed within the current framework of conventional business models. Consequently, the business model as they are presented in the current business field, are not fundamentally modified (Jonker, 2012). Employing said sustainability programs within the current frameworks will most likely result in insufficient impact on resolving all global social, economic and environmental issues, since business logic and decisions stays within the perimeter of current systems and paradigms (Rauter et al., 2017). The business model sits between operational activities and strategy of the company. Therefore, description how a firm's strategy is put into practice is the main goal of any business model. Altering existing- or creating new business models is one way of implementing a strategy that leads to more sustainability (Rauter et al., 2017), in which case the business model must be suited to incorporate environmental and social issues (Stubbs & Cocklin, 2008). This, consequently, requires organizations to be organized in a radical different way, increasing the need and demand for fundamentally new business models (Wells, 2013), which asks for a new definition of what value is and how business models generate it (Rauter et al., 2017).

Business model innovation (Chesbrough, 2007) towards sustainability has emerged in the form of organizations incorporating both their shareholders as well as their stakeholders view into account. This form of business model innovation builds towards sustainable development as a central aspect, wherein attempts are made to provide service based products or to reduce the ecological footprint of their operations (Rauter et al., 2017). These attempts at business model innovation stretch as far as business

models incorporating circular manufacturing processes, known as circular business models. Circular business models aim to increase circularity of materials in supply chains and products, which means that lower quantities of natural resources are needed for production. To achieve this, numerous business model strategies have been developed, known as R-strategies, to achieve lower resource and material consumption in supply chains, working towards an economy more circular. The R-strategies usually pose a spectrum of circularity techniques ordered from high (low R-number) to low (high R-number) circularity (Potting, Hekkert, Worrell, & Hanemaaijer, 2017). Business models for sustainability also strive for adoption of open innovation practices, as well as the creation of ‘win-win’s’ by means of cooperation (Kramer & Porter, 2011), known as multiple value creation.

2.2.3 Multiple value creation

The phenomenon of business models focusing on creating a more balanced value is referred to as multiple value creation (Simanis & Hart, 2011), which is more than just a new approach, it is a new collaborative ability (Jonker, 2012). Multiple value creation shifts to a model of collective value where customers follow a participating role of the value chain, instead of just being the consumer (Simanis & Hart, 2011). Inside the model of multiple value creation, four types of values can be distinguished: First off ‘associational value’, which is value created by cooperating with another organization. Secondly, ‘transferred resource value’ which is the value resulting from acquisition of another’s party resources. Thirdly ‘interaction value’ which is the benefit that can be gained through processes which are used to collaborate with partners. Lastly, ‘synergistic value’, this value is based on the principle that both parties in a partnership achieve more collaboratively than they might independently have accomplished (Austin & Seitanidi, 2012).

When bringing the concept of multiple value creation to business practice, operational problems are faced when one attempts to concurrently establish different forms of value (Jonker & van der Linden, 2013), since the key to multiple value creation is striving for balance between consumption and usage, thereby automatically balancing between destruction and creation of value (Jonker, 2014). As value destruction is quite common in the capitalist economy, this goal can be difficult to accomplish.

Since the contemporary system of business models has primarily had emphasis on solely economic value, shifting to a business model with equal emphasis on multiple values can be a true challenge for most organizations (Kamm, Faber, & Jonker, 2016). Newly generated collective business models can arise from strategic partnerships, that consequently allow development of value co-creation platforms (Romero & Molina, 2009). The next section will provide more detailed description on collective business models.

2.3 Collective business models

Within the diverse set of phenomena arising from the circular-, collaborative- and sharing economy, we discover the presence of collective business models (CBM). The CBM concept can be interpreted as part of a wide range of definitions, such as cooperative business models or collaborative business

models. The collaborative business model is most likely the definition of the three with the most precise definition available. Its concept is linked to collaborative entrepreneurship (Miles, Miles, & Snow, 2005) and open business models (Chesbrough, 2006).

The concept of CBMs emerged from the perception that companies, individually, are unable to achieve sustainability goals, since these objectives consist of complicated spatial interdependencies (Johnson & Suskewicz, 2009). The main issue with a linear economy is that it is not built to be entirely co-creative, it is designed on an organization-centric viewpoint in which one company is taken as a starting point (Jonker et al., 2017). For this reason, this organization-centric perspective does not stimulate complete cooperation within a value chain, and should shift to a network-centric perspective for joint coordinating activities between various parties (Schenkstoff, 2017). Therefore, new business model concepts are required, emphasizing interrelationships between companies and the environment, to overcome the complex sustainability challenges (Loorbach, van Bakel, Whiteman, & Rotmans, 2010). Collective business models are an example of these new business model concepts that follow a network-centric perspective which implies engagement in an continuously evolving ecosystem of individuals and companies in any industry that strives for optimal achievement (Schenkstoff, 2017). CBMs build on networks with a shared vision, connecting multiple actors with the right alignment of expectations. The networks can consist of numerous organizations from different types and industries and value chain positions, collectively creating value (Rohrbeck, Konnertz, & Knab, 2013). These collectives can join forces to collaborate on development for achieving sustainability objectives, by coming up with radical innovations they otherwise most likely would not have (Johnson & Suskewicz, 2009; McDowall & Eames, 2006).

The overarching goal of CBMs is to create multiple value by overcoming obstacles in innovation that include inadequate progressive thought and inability to collaborate with external stakeholders, thus lack of perseverance in pushing innovation (Rohrbeck, Döhler, & Arnold, 2009). Organizations participating in CBMs overcome these barriers, as they are in the midst of unique perspectives due to their variety in organizational or industry type, unlocking the ability to come up with out-of-the-box, forward thinking innovations (Rohrbeck et al., 2013). Thanks to building a collective, CBMs allow to tackle societal problems collectively and thereby outweighing the ability of mere individual organizations to effectively overcome challenges (Austin & Seitanidi, 2012).

2.4 The difference between conventional- and collective business models

Business models are an adequate tool for organizations to achieve their strategic objectives. Consequently, business models have been getting attention towards driving sustainability management (Schaltegger, Hansen, & Lüdeke-Freund, 2016). However, up until now the role of conventional business models on sustainable development has mostly been based on CSR and reducing environmental impacts (Proka, Beers, & Loorbach, 2018), since literature has mainly focused on corporate performance and sustainability at the organizational level (Bansal & Gao, 2006). This is referred to as an organization-

centric approach, at which the first difference between conventional and collective business model can be identified: conventional business models follow an organization centric perspective, as opposed to a network-centric perspective typical for CBMs.

As mentioned before, value creation is a central theme among business models. One can identify the second difference between conventional business models and collective business models by examining the way value creation is defined and realized by the respective business models. Conventional business models operating in a linear economy fail to create multiple values, since a linear economy is based on 'take, make and dispose' flow (MacArthur, 2013) which promotes maximum output and consumption (Schenkoff, 2017). An important characteristic of CBMs, on the other hand, is multiple value creation achieved through collaborative action. A CBM differentiates from a conventional business model by being able to organize itself in a co-creative manner, wherein multilateral actions allow for the generation of new kinds of value.

Value within conventional business models on the consumer side is defined as a good or service capable of fulfilling an unserved need (Allen, 2012). Therefore, a significant part of this fulfillment of an unserved need is the consent of the consumer to pay for the service or product provided (Chesbrough & Rosenbloom, 2002). Accordingly, mainly financial value is at the center of conventional business models, which brings up the third difference between conventional and collective business models. Whereas conventional business models prioritize financial value above all other types of value, CBMs advocate for the generation and preservation of value of goods, materials and services throughout the whole value chain or loop (Schenkoff, 2017).

Among collective business models a business variant known as platforms can be identified, which will be further elaborated on in the next section.

2.5 Platform business models

The theme of platforms has gained significant traction of the past years, as success stories of companies such as AirBnB, Uber and Deliveroo have become the central topic of discussion when talking about platform business models (from here on referred to as PBMs). All these businesses share something in common, since they do not make the goods, nor conduct the operation on their website or app. Rather, these businesses put together the supply and demand side of a market. The organization serve as a forum or marketplace that link users to each other. Technological developments, such as widespread use mobile apps or novel search and matching algorithms, have allowed the emergence of innovative business models on the market targeting different customer segments (Täuscher & Laudien, 2018).

A companies' business model allows it to organize the mechanism by which the organization aims to provide value to its stakeholders (Lee & Patel, 2019). For PBMs, companies aim to create value to its stakeholders by facilitating the process of exchange between at least two participants, usually the demanding and supplying party of a certain product or service (Kim & Yoo, 2019). The platform allows the direct engagement between the stakeholders, and each stakeholder has an affiliation with the

platform. This means the stakeholder, not the platform, maintains control over the transaction conditions such as pricing, bundling and marketing (Hagiu & Wright, 2015). However, the platform might still decide to promote its platform in various ways, in order to stimulate the supply and demand parties to use the platform. Affiliation with respect to platforms means that all participants of the platform make an investment for use of the platform, usually in the form of a variable or fixed fee.

Activities of PBMs, according to Schor (2016), be classified into four categories: recirculation of goods, increased utilization of durable assets, exchange of services, and sharing of productive assets. Platforms can be described as websites on which services and/or goods are exchanged between the users on the platform, on a temporary or permanent basis, for a price or free of charge (Kilhoffer, Lenaerts, & Beblavý, 2017). Furthermore, platforms can be defined as businesses that facilitate transactions, wherein they serve as a mediator in such transactions, but can also function simultaneously as primary interactors by engaging in the transaction itself. Under the umbrella of these platforms we find sharing economy websites, online portals, search engines, social media websites e-commerce and various other websites (Zarra et al., 2019). Codagnone, Biagi, and Abadie (2016, p. 12) provide a more narrowed down definition: “The digital platforms operate as two-sided markets, which match different groups of users and enable to increase the scale and speed of transactions. At its core, platforms offer intermediation, lowering transaction costs. The intermediation may be business to business, business to consumer, or consumer to consumer”.

Platforms can have positive impacts for environmental sustainability if they are able to exploit unused assets. A positive environmental impact is made when consumers or businesses access goods from each other, rather than purchasing those goods. Positive, because this would have a beneficial effect on the economy as sharing leads to a more effective use of resources and more optimally use of idle capacity. In addition, the use of sharing channels enables these platforms to grow and scale up, thereby increasing the environmental benefit they build (Ciulli & Kolk, 2019).

2.6 The difference between collective- and platform business models

The concept of PBMs is closely linked to the sharing economy. This business model “provides a platform to connect product owners with individuals or organizations that would like to use them. Rather than accepting that products sit idle, the platform boosts their productivity by allowing co-access or co-ownership” (Lacy, Keeble, & McNamara, 2014, p. 84). PBMs allow users to participate in collaborative consumption, which is described as “people coordinating the acquisition and distribution of a resource for a fee or other compensation. By including other compensation, the definition also encompasses bartering, trading, and swapping, which involve giving and receiving non-monetary compensation” (Belk, 2014, p. 1597).

PBMs can be considered as a variant of collective business models. In order to classify organizations as platforms, Täuscher and Laudien (2018) propose four conditions. First, platforms connect independent actors, individuals or organizations, via a digital network of demanders and suppliers (Bakos, 1998).

However, individual actors do have the possibility to engage in the market on both the supply and demand side, and thus do not automatically serve as separate classes of participants. Secondly, these participants engage in direct interactions to facilitate and carry out commercial transaction with one another. Thirdly, the platform allows for transactions through an administrative and regulatory frame for transactions (Parker & Van Alstyne, 2014). Fourth and lastly, the platform does not substantially generate, produce or trade goods or services itself. This requirement excludes producer or retailer business models which also allow other parties to sell products through their digital platform (Hagiu & Wright, 2015).

Since platforms are characterized by interactions of supplier and demander, platforms can experience network effects. If engagement and participation occur on the supplier side of the platform, participation of demanders will also increase on that specific platform. This is called the network effect and is important for survival of the platforms, as the effectiveness of platforms increases the more users the platform has (Boudreau & Hagiu, 2009). Platforms are defined by their open business models which rely inherently on the cocreation of value by independent participants (Täuscher & Laudien, 2018). As they induce network effects between supply and demand, they are especially correlated with rapid growth and the ability to dominate a market thanks to their winner-takes-it-all dynamics (Hagiu & Wright, 2015).

The uniqueness and strength of PBMs lies in their use of idle capacity and assets. For conventional business models, success is determined by their assets and the interplay between them (Osterwalder et al., 2011). Traditionally, resources are purchased properties that are required to achieve that what the company offers in its value proposition, such as personnel, facilities and goods owned by the company. (Johnson et al., 2008). PBMs find and facilitate ways to utilize idle capacity more efficiently and effectively. Idle capacity is defined as collective term for unused or underused goods, resources and services, but also underused property and knowledge or skills (Botsman, 2015). Usage of idle capacity aims at controlling wealth and maximizing possible efficiency of existing resources by optimizing the usage and purpose of goods and services (Stahel, 1997). Jonker (2014) classifies the notion of idle capacity into the following four categories: [1] social assets, such as skills, knowledge, and services, [2] material assets, such as material waste streams, [3] institutional assets, such as leftover products/services coming from organizations, [4] spatial assets, such as unused spaces and property.

Researchers of various disciplines have become interested in the organization form of PBMs, thanks to the belief that they might become a central concept for the modern economy. PBMs come in different shapes and forms. Nevertheless, to date, there is a lack of understanding about platforms' distinctive business model classifications (Täuscher & Laudien, 2018) and how value is created in them. For that reason, the next chapter continues to narrow the scope further to shed light on platform related typologies.

3 Literature review on platform related typologies

This chapter covers a literature review on platform typologies. The first paragraph covers the idea behind setting up the typology in general. The second paragraph is a review of existing platform related typologies, followed by a synthesis. The third paragraph is the result of a preliminary typology framework for PBMs, followed by reflections and limitations. The goal of this typology chapter is to combine elements from different studies to create a preliminary typology framework for PBMs, which ultimately helps development towards the final PBM typology.

3.1 Typology

The term typology refers to a study, analysis or classification based on types or categories (Merriam-Webster, 2020). More specifically: “A typology most often classifies people or things by certain commonalities or classifies them by certain differences. Using typology helps researchers and others to better understand certain conditions or factors” (Your Dictionary, 2020).

To create a typology of PBMs, the following steps are undertaken: [1] Definition of typologies, [2] research into existing platform typologies by exploring literature surrounding the topic, [3] determining attributes of a typology for PBMs by means of synthesis of elements from the literature study of the previous part, [4] development of a preliminary PBM typology framework, formed using visual aids.

3.2 Literature review on platform related typologies

This section reviews exiting platform related typologies in literature. The paragraphs are clustered into the manner of classification, which are product-service systems, servitization, nature of value creation and PBM attributes. This paragraph forms the basis of literature that later determines the dimensions used in the Platform typology, which will be summarized in the synthesis paragraph.

3.2.1 Product-service systems

Platforms can be classified based on the nature of value creation. Value creation by platforms is closely related to product-service-systems (PSS), which can be defined as consisting of “tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs” (Tukker & Tischner, 2006, p. 1). The PSS concept can be classified into three categories, each consisting of multiple PSS types (Tukker, 2004): [1] Product-oriented services which are business models focused around selling products. [2] Use-oriented services which are business models wherein products are made available for consumers, but the ownership remains with the provider. [3] Result-oriented services which are business models where consumer and provider agree on result, there is no product involved. The result-oriented PSS aims for greater dematerialization of products by adding services (Beuren, Ferreira, & Miguel, 2013).

PSSs can be seen as a suitable models for improving competitiveness while fostering sustainability at the same time, or as Beuren et al. (2013, p. 225) puts it: “in addition to yielding economic gain, the PSS

solutions are assumed to aid in reducing environmental impact and providing a better social balance because a greater number of people can use the same product while paying less for it”.

In the typology of Tukker (2004), displayed in figure 1 below, the main and subcategories of PSS are laid out. A PSS business model permits organizations to create alternative streams of added value and profitability.

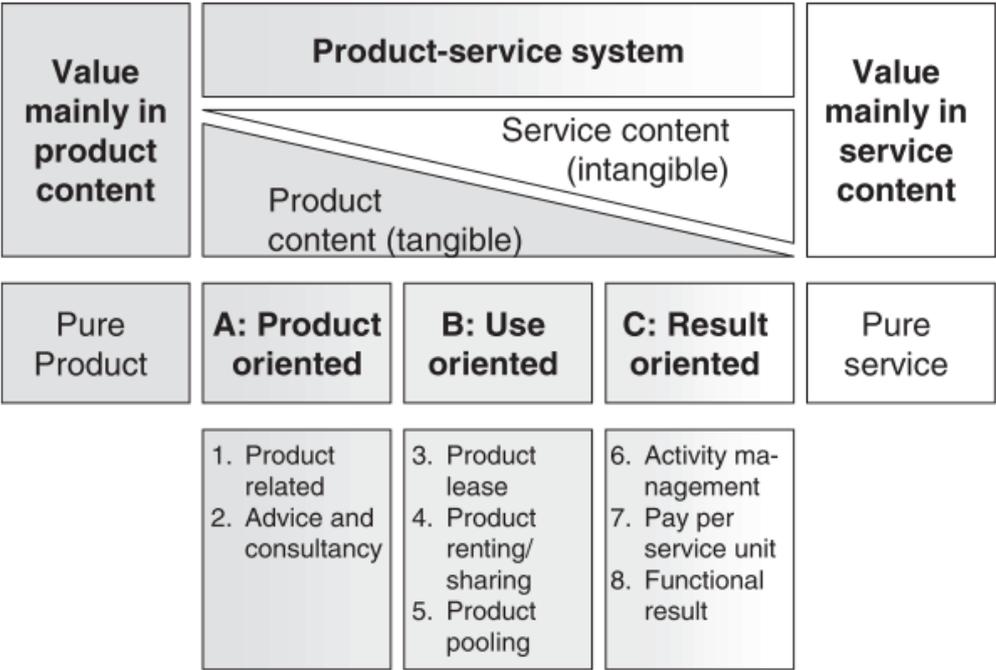


Figure 1 Main and subcategories of product-service systems

Source: Tukker (2004)

Following the PSS typology of Tukker (2004), 8 archetypes can be distinguished which fall under the three categories. This next section goes over the eight archetypes with definition.

First is the *product related service* archetype, in which case the vendor not only provides a product, but also offers services which are necessary during the product’s usage period, such as a maintenance contract. Second is the *advice and consultancy* archetype, where the supplier provides recommendations on the most effective application on the product that is sold, such as optimizing logistics in a factory. Third is the *product lease* archetype, in which the ownership of the product is not transferred. The provider keeps ownership including responsibility over maintenance. The renter usually pays a regular fee for unlimited access to the product. Fourth is the *product renting and sharing* archetype, where similar to the previous archetype, the provider holds ownership over the product and is responsible for maintenance. However, in this archetype the lessee does not have unlimited or individual access since the product is sequentially used by different users. Fifth is the *product pooling* archetype, which is similar to the previous archetype, however in this case the product is simultaneously used by different users. Sixth is the *activity management* (outsourcing) archetype, in which a portion of a company’s operation is outsourced to a third party. Provided that most outsourcing contracts include performance

metrics that track the quality and efficiency of the outsourced operation, this archetype is listed under result-oriented services. Seventh is the *pay per service unit* archetype. This archetype still has a product as basis, but the consumer does no longer purchase the product, only the output of the production based on degree of use, similar to pay-per-print services used by copier providers. Eighth is the *functional result* archetype, in which the consumer and provider agree on the delivery of a result. The difference with the activity management archetype is that the agreement on a result is specified in rather abstract terms, allowing the provider to be entirely free on how deliver the result (Tukker, 2004).

The PSS model in figure 1 can be interpreted as follows: moving from the first to the last of the archetypes (from left to right), the dependency on the product as the basis of the PSS decreases, and the need of the customer becomes more abstractly articulated, thus, increasing the freedom of the provider if one moves more to the right of the model. The downside of moving more to the right end, however, is interpretation of abstract consumer demands, which might be challenging to translate into specific criteria. Lewandowski (2016) provides an overview of circular business model types, in which it classifies some of the PSS archetypes proposed by Tukker (2004) as sharing models, which are the archetypes that are relevant for a platform typology.

Tukker's typology is frequently cited among scholars and generally considered to reflect the PSS viewpoints most accurately. Nonetheless, additional exploration on the topic may be necessary. According to Beuren et al. (2013), academia could identify business models as part of the PSS, after which businesses can propose applications (or archetypes) appropriate for the PSS categories presented. Consequently, these archetypes must be further developed in order to contribute to the PBM typology, as they need investigation whether they meet the PSS principles. Future PSS typologies should take the consumer (demand) into consideration as well as benefits for the producer (supplier) in addition to the limitations of society and the environment. Therefore, a proper PSS is not distinguished by a singular focus on economic values (Beuren et al., 2013). In addition, the predominant classification of PSS into product-, use- and result-oriented types fails to grasp the complexities of PSS business models encountered in practice. Firstly, it confuses use-oriented logic with the transfer of ownership. Secondly, it fails to differentiate between availability and use. Thirdly, it does not distinguish between functional results on different abstract levels (Van Ostaeyen, Van Horenbeek, Pintelon, & Duflou, 2013).

Based on above mentioned critique, additional PSS types can be identified. Further refinements on Tukker's PSS typology are further elaborated in chapter 5.

3.2.2 Servitization

Services are taking a more dominant presence in businesses, while consumer preferences are also steered more towards the use of services. According to Vandermerwe and Rada (1988), distinctions between products and services are no longer valid: they develop into a combination of both. Moreover, they describe the potentials of added value by attaching services to core products. The phenomenon of combining products and services is known as servitization (Doni, Corvino, & Martini, 2019; Vandermerwe & Rada, 1988; Zhou, Yan, Zhao, & Guo, 2020). Reasons for transitioning towards business models incorporating servitization range from technological improvements to competition pressure. Organizations from all parts of the distribution chain are more focused on the end user than ever before, PBMs are no exception on this matter. The driving force of servitization is therefore the customer, who increasingly demands for services (Vandermerwe & Rada, 1988). The introduction of servitization generated a constant dialogue between suppliers and consumers. Consequently, it creates several incentives and advantages, such as financial incentives since services have higher profit margins and income stability. Moreover, there are strategic incentives, since offering a ‘complete package’ with servitization could offer more value (Baines et al., 2009). Lastly, servitization has implications for sustainability, specifically environmental sustainability (Neely, 2008). Servitization could be beneficial for the production systems, since adding maintenance and repair services to core products are prolonging the lifetime of the products that are offered (Doni et al., 2019). All details about servitization considered, one can conclude that servitization offers business model elements to the table that have implications for sustainability and therefore have an important role in business model innovation.

3.2.3 Nature of value creation

Another perspective of viewing platforms is their nature of value creation. Business models for platforms are described as business models where the platform takes a central position in bringing together consumers (demand) and suppliers (supply), in which value creation takes place. From the perspective of value streams, three primary forms of platforms can be distinguished: ‘producer-oriented platform’, ‘consumer-oriented platform’ and the ‘both-oriented platform’ (Kim & Min, 2019).

First, the producer-oriented platform, is the platform type that focuses on the supplier delivering products and/or services to the demander. The value that this business model generates is primarily for the producer. Value streams in traditional business models are typically closed and limited to the boundaries of the organization. However, with platforms, the value stream is expanded since it includes consumers and suppliers at both ends of the business model. The benefits of this expansion are that, for one, greater numbers of consumers and suppliers are connected with each other. And two, information sharing is realized more efficiently within cooperation. Furthermore, the process of using a platform has the potential to significantly reduce operation, inventory and processing costs (Kim & Min, 2019).

Second, the consumer-oriented platform, is the platform type that focuses on consumers who can demand products and/or services and have them delivered to them. In this model, the consumer takes the foreground in the use of the platform and the suppliers are up to the task to meet the demands of the

consumers. Services and products requested by the customers are tailor-made according to the specific aspects the consumer prefers. However, the suppliers are still able to modify their own offerings to a certain extent (Kim & Min, 2019).

Third, the both-oriented platform, is the platform type where all participants are called “prosumers”, meaning all users on the platform are both producer and consumer. On this platform type, there is a blurred boundary between the parties that interact with each other the platform. These platforms can be characterized by business models where users on the platforms supply content, products and/or services, while at the same time will be consumers on the same platform. The creation of value originates from both sides of the spectrum, which has the potential for tremendous growth of the platform due to high traffic (Kim & Min, 2019). The classification based on value stream analysis is visualized in figure 2 below, including appropriate value streams.

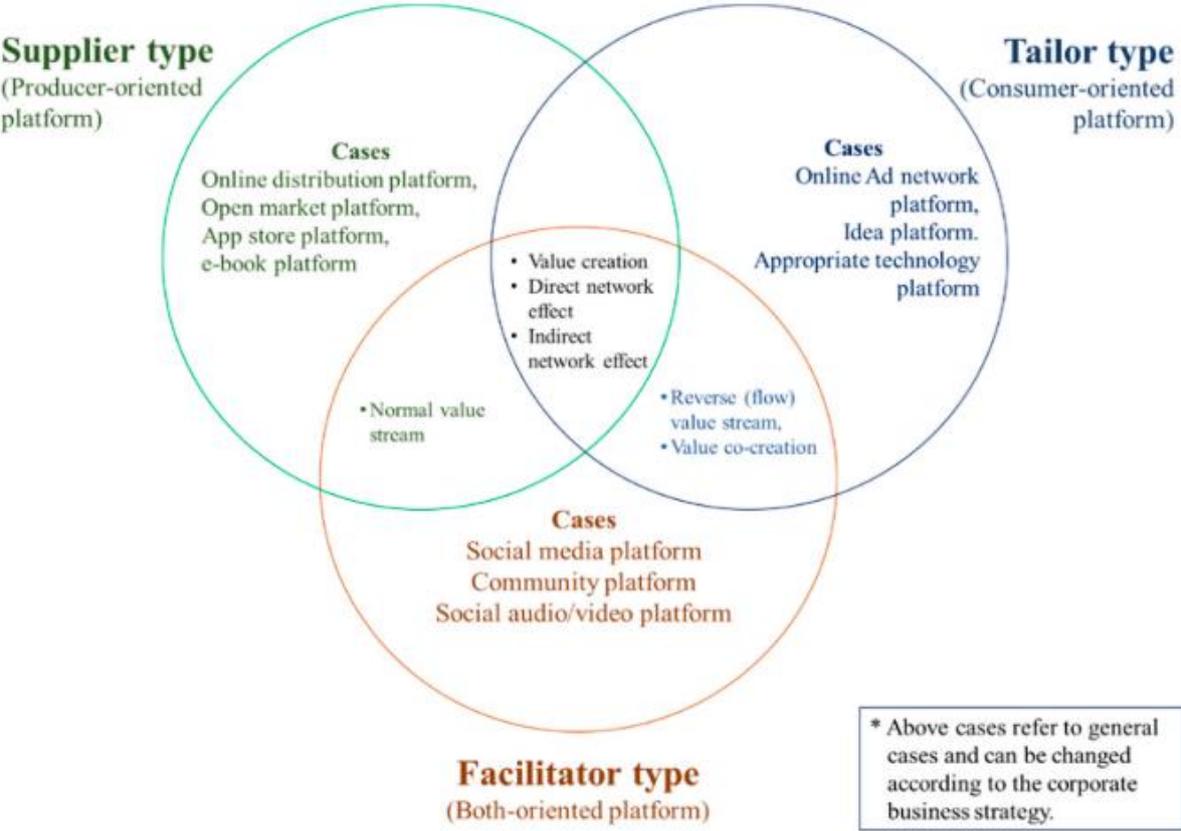


Figure 2 Platform orientation accordance with the value stream.

Source: Kim and Min (2019)

The typology proposed by Kim and Min (2019) offers a clear perspective for categorizing platforms, looking at a value-orientation point-of-view among different actors. Therefore, the actors and value orientations from this typology are suitable for the preliminary typology framework.

3.2.4 Platform business model attributes

Another perspective of approaching platforms is considering their business model attributes. Platforms can be classified in different ways, ranging from informal networks and community groups to foundations and for-profit organizations. Scholars show diverging views on the ways platforms can be classified. If we follow the interpretation of Botsman and Rogers (2010), the sector may be described as consisting of four sectors: vehicle and ride sharing platforms, accommodation sharing platforms, peer-to-peer labor markets and resource circulation platforms. Whereas, according to Evans et al. (2017), four platform types can be distinguished: Transaction platforms, innovation platforms, integrated platforms and investment platforms. While these interpretations do give an idea of the platform spectrum, they are defined too vaguely in order to fit in a typology. Täuscher and Laudien (2018) offer a broader clustering based on transaction type and content. The distinction is made between offerings of product and service, and digital (online) and physical transaction types. These last two attributes combined clarify whether the platform offers physical products, digital products, digital services and/or physical services. This classification is useful in a more general way for developing a platform typology. The way revenue is generated on these platforms also differs per category. While B2C platforms strive for maximum profit, similar to the ‘business as usual’, C2C platforms earn revenue through charging commission on each transaction occurring on the platform (Schor, 2016). According to Schor and Fitzmaurice (2015), operation and long-term impacts of platforms are shaped by market orientation (for-profit (FP) vs. non-profit (NP)) and market structure (peer-to-peer vs. business-to-peer). This classification is displayed in table 1 below.

Table 1 Platform business models: Market orientation vs market structure

		Market structure	
		Peer-to-peer	Business-to-peer
Market orientation	Non-profit	P2P non-profit sharing	B2P non-profit sharing
	For-profit	P2P for-profit sharing	B2P for-profit

Source: adapted from Schor and Fitzmaurice (2015)

These indicators define the platform’s concept of exchange, therefore, the dimensions of market structure and market orientation are relevant for the typology. However, above classification is not complete, as it does not include business-to-business (B2B) as a cluster. Täuscher and Laudien (2018) refer to this dimension as ‘marketplace participants’ instead of market structure. They also refer to the ‘consumer’ instead of ‘peer’, which will be used for the purpose of this paper. The dimensions of business-to-business (B2B), business-to-consumer (B2C), consumer-to-business (C2B) and consumer-to-consumer (C2C) are added as relevant for the typology for completeness. The business model attributes combined are displayed in table 2 below.

Table 2 Platform business models: marketplace participants

	Targeted to consumers	Targeted to businesses
Initiated by business	B2C (business-to-consumer)	B2B (business-to-business)
Initiated by consumer	C2C (consumer-to-consumer)	C2B (consumer-to-business)

Source: adapted from Täuscher and Laudien (2018)

Besides the classification of market orientation and participants, there are additional attributes that determine platforms (Täuscher & Laudien, 2018). Firstly, the main type of technology the platform is primarily based on, be it web-based or on mobile app. Activities of the platform vary from data services (such as visualization data for sellers), community building to content creation such as improving the layout and profiles of the platform users. Mechanisms for price discovery may rely on [a] the supplier, [b] the demander or [c] the platform setting the offered price, while auctioning or negotiation remains a viable option as well (Bakos, 1998). Review systems are vital to platforms to generate trust among participants before they engage in transactions, since the parties generally do not know each other (Pavlou & Dimoka, 2006) and are therefore commonly used on platforms. Users can either mutually review each other while other platforms arrange their own reviewing mechanisms based on algorithms or standardized metrics. Furthermore, platforms can have an industry scope that indicates whether the platform offers horizontal or vertical market integration into the value chain (Dai & Kauffman, 2001), besides a geographic scope ranging from local to global. Revenue stream choices for platforms can range from commissions, subscriptions, advertisements and service sales (Schlie, Rheinboldt, & Waesche, 2011). Furthermore, the pricing model distinguishes fixed pricing, market pricing and differentiated pricing, as well as price discrimination based on feature, location or quantity (Osterwalder, 2004). Lastly, platforms are characterized by their option to monetize the sellers (supply), buyers (demand) or third parties on the platform (Täuscher & Laudien, 2018).

While these attributes are relevant to platforms and their business models internally, the contents are too specific for an overall typology. Therefore, these additional attributes are not included in the typology framework.

3.3 Synthesis of platform related typologies

This paragraph serves as a synthesis of reviewed literature on platform related typologies. Key elements from the literature study in the previous paragraph form the building blocks for developing a preliminary PBM typology framework. These elements are referred to as ‘dimensions’ of the typology.

First, the work of Tukker (2004) is used as a starting point to develop the typology of PBMs. The reason for using Tukker’s work is because it holds value content as a central aspect to the typology. Value content (producer and consumer value) are therefore included in the framework. The literature on

servitization, however, is not yet included in the preliminary PBM framework, since its place is unclear at this stage of the research. Servitization will be further analyzed in the analysis chapter (chapter 5) to be included in the final typology.

Next, the typology framework further builds upon the actors and their value orientation proposed by Kim and Min (2019). This enables the typology framework to display where platforms are producer-oriented, consumer-oriented or both.

Finally, with respect to market orientation, structure and participants, the contributions of Schor and Fitzmaurice (2015) and Täuscher and Laudien (2018) are combined to propose the following dimensions to further classify platforms: [1] Market orientation (FP, NP) [2] Marketplace participants: (B2B, B2C, C2B, C2C). [3] clustering based on transaction type and content [Physical products, digital products, digital services, physical services).

Summing it all up, the reviewed platform related typology literature forms the basis for the platform typology framework. The dimensions in the platform typology framework are based on different authors. In table 3 below an overview of the used dimensions are laid out. Furthermore, the table includes the literature source(s) that were used for each dimension, as well as the corresponding attributes.

Table 3 Dimensions of the preliminary platform business model typology framework

Dimension	Literature source(s)	Attributes
1. Value content	Tukker (2004)	Value in producer content (producer value), value in consumer content (consumer value)
2. Actors	Kim and Min (2019)	Producer (supplier), consumer (demander)
3. Value orientation	Kim and Min (2019)	Producer-oriented, consumer-oriented, both-oriented
4. Market orientation	Schor and Fitzmaurice (2015)	For-profit, non-profit
5. Marketplace participants	Schor and Fitzmaurice (2015), Täuscher and Laudien (2018)	Business-to-business (B2B), business-to-consumer (B2C), consumer-to-business (C2B), consumer-to-consumer (C2C).
6. Clustering based on transaction type and content	Täuscher and Laudien (2018)	Physical products, digital products, digital services, physical services
7. PSS types	-	To be determined in chapter 5

The PBM archetypes that end up in the bottom of the platform typology are to be determined in chapter 5, therefore, these are not included yet in the table and framework presented in this chapter. Moreover, each presented dimension in table 3 is subject to change for the final typology, since the analysis phase could result in necessary changes to the overall framework.

3.4 Developing the preliminary typology framework of platform types

In this section, the developed typology framework for platforms presented. This preliminary typology displays the dimensions of the typology that were synthesized in the previous paragraph. The typology framework of platforms displayed below in figure 3.

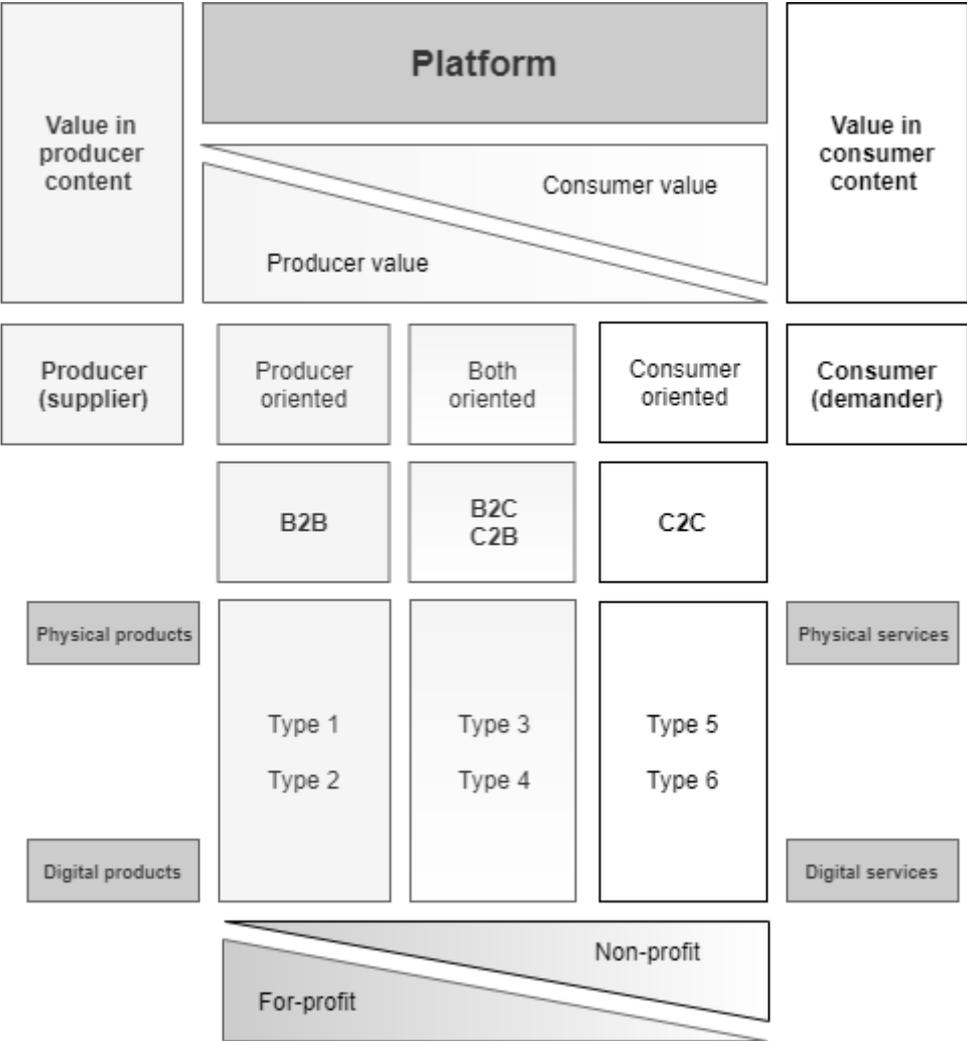


Figure 3 Typology framework of platforms

Source: adapted from Tukker (2004)

As mentioned previously, the PBM archetypes (in the bottom of the framework) have yet to be determined in chapter 5. Therefore, the PBM archetypes as well as the number of archetypes remain as placeholder in the bottom of the framework. Lastly, the dimensions of the preliminary framework are subject to change since the illustrative case analysis in chapter 5 will help to improve the robustness of the overall model. The empirical data could provide insights and complexities that ask for changes to be made, hence why this chapter proposes a framework that is preliminary. Consequently, the dimensions that are displayed in the image above might be erased or altered in the final version of the typology.

3.5 Reflection and limitations

This chapter proposed a platform typology framework based on existing typologies found in literature. The literature study on existing typologies laid the foundation for the dimensions used in the typology framework. While this typology is based on thorough literature analysis, its robustness is not yet addressed with empirical comparisons. Therefore, this typology framework of platforms has limitations since it is solely based on theoretical considerations at this stage of the investigation. Moreover, the framework is based on a set of selected theoretical perspectives. Viewing the PBM framework from different theories and authors could have provided different results. The purpose of chapter 5 is to increase the robustness of the typology by using illustrative cases and learning from empirical information gathered from the analysis phase.

4 Research Methodology

This chapter discusses the methodology applied for this research. The chapter starts with the research objective. Next, in the second paragraph, the research methods are described. The research design is described in the third paragraph, followed by the data analysis method in the fourth paragraph. Lastly, limitations are notated in the final paragraph.

4.1 Research Objective

The goal of this thesis is to investigate platform business models and to develop a typology of platform business models, as well as to provide insight into the degree to which these business models contribute to a sustainability. The nature of this thesis research is based on qualitative investigations. The use of qualitative research is suitable for investigating such business models (Bleijenbergh, 2013), since this type of research approach is suitable for examining complex structures that can include several dimensions and interconnections between these dimensions (Yin, 2015). These structures include business model dimensions such as value content, value orientation and transaction types.

Researchers of various disciplines have become interested in the organization form of PBMs, thanks to the belief that they might become a central concept for the modern economy. PBMs come in different shapes and forms. Nevertheless, to date, there is a lack of understanding about platforms' distinctive business model classifications (Täuscher & Laudien, 2018) and how value is created in them. For that reason, this paper aims to develop a typology for PBMs and seeks to validate how these PBMs work in practice.

The main research question of this thesis is: *“What does a typology of platform business models look like?”* In order to support the main research question, the following sub question is formulated: *“What is the contribution of platform business models to sustainability?”*

4.2 Research Methods

This paragraph provides justification of the research methods applied in this thesis. Two methods that form the primary methodology of this thesis are described, namely literature study and typology development. The next subparagraphs provide an overview of the methodology of these research methods.

4.2.1 Literature study

A literature study can be described as “a systematic, explicit and reproducible method for identifying, evaluating, and synthesizing the existing body of completed and recorded work produced by researchers, scholars, and practitioners” (Fink, 2019, p. 6). Literature research holds two objectives for describing the current state of research. Firstly, issues and topics surrounding the research field are summarized. Secondly, theoretical starting points are identified and analyzed (Meredith, 1993). Reviews of literature reflect a well-established approach to collect current information within an area of interest. For this thesis, a systematic literature review approach is used, which is characterized by explicit procedures and

conditions to minimize bias (Bryman, 2016). Besides thorough literature review, the development of a typology for PBMs is a vital part of this research, which is further described in the next section.

4.2.2 Typology development

The second main research method in this thesis is typology development. A typology is a method to classify various types under an umbrella definition, in this case platform business models, based on characteristics and dimensions that differentiate the types. The goal of the typology is to create 'subtypes' based on the general definition. The method of establishing a typology consists of definition creation, outlining dimensions and features for categories, and lastly construction of the classification. The goal of the typology is to distinguish between different subtype forms, known as archetypes, which are different combinations of dimensions which make up the platform business model definition.

The typology in this paper considers only those elements which are relevant to the ecosystem of platforms. The development process involves an iterative approach of evaluating literature on business models, business models for sustainability, collective business models and platform business models. The result is a typology of the researched phenomenon by analyzed literature on platforms (Kim & Min, 2019). The typology work of the product-service system of Tukker (2004) is used as a starting point for development of a framework for the PBM typology. After having developed a preliminary framework for the PBM typology, the robustness of the typology is validated by comparing the framework to empirical data. Therefore, exploratory qualitative research is appropriate for this study, since it seeks to understand how a specific phenomenon takes place and how it works out in practice (Ritchie, Lewis, Nicholls, & Ormston, 2013). Through implementing such a procedure, the product of the research enters a confrontation phase in which the preliminary typology framework may be changed based on realistic practical conclusions.

4.3 Research design

For this study, an extensive literature research was conducted, spread out over two chapters (chapter 2 and 3). This research is primarily based on literature research. However, empirical data in the form of cases are used to serve as illustrative examples, to give support to the established literature study. The literature that is consulted covers articles and books published between the years 1987-2020. The first part of the literature study reviewed existing literature about business models, business models for sustainability, collective business models and platform business models, as well as literature on (multiple) value creation. In the second part of the literature study, a preliminary typology framework of PBMs is developed based on theory. In addition to the literature, cases were used to obtain insight into the researched PBMs. These cases act as illustrative examples to the studied literature.

4.4 Data analysis method

The data analysis method is primarily focused on analyzing current literature about the phenomenon of platform business models and topics that surround the body of knowledge of this research topic. While some cases are selected and used as illustration to support the literature study, this research does not

take the form of a full (multiple) case study, therefore no thorough case analyses are conducted. As mentioned, this part of the research acts as a confrontation phase to increase robustness of the typology framework. The analysis of illustrative cases provides support for the proposed typology of PBMs, to explore how the proposed typology comes out in practice and whether it needs to be adapted accordingly. This step is conducted merely for illustrative purposes, to demonstrate how the typology of PBMs work out in practice. The next sections explain the methodology regarding illustrative case selection and analysis.

4.4.1 Illustrative case selection method

The selection of illustrative cases is determined in two steps. For the first step, a longlist of cases is created based on a set of criteria. The criteria are based on the literature study conducted in chapter 2 and 3. Cases must follow the description of PBMs established in chapter 2. This mainly comes down to the following description: platforms do not make their own goods, nor conduct the operation on their website or app. Rather, these businesses bring together the supply and demand side of a market. The organizations serve as a forum or marketplace that link users to each other (Täuscher & Laudien, 2018). Furthermore, PBMs find and facilitate ways to utilize idle capacity more efficiently and effectively. Idle capacity is defined as collective term for unused or underused goods, resources and services, but also underused property and knowledge or skills (Botsman, 2015). Another criteria is that the selected cases consist of sufficient amounts of secondary research material to properly conduct analysis on the cases. A selection of 9 cases coming from the various industries were selected. Cases were selected using index websites such as justpark.com/creative/sharing-economy-index/ where platform are listed based on certain characteristics. Furthermore, cases that were encountered along the way of the literature study were also included. For instance, some of the selected cases came from the work from Lewandowski (2016) (Table 3. An overview of circular business model types). The longlist for cases that is created during this research is based on key searching terms such as “platform businesses”, “sharing platforms”, “sharing economy” and “sharing marketplaces”. All criteria combined are put together in a requirement checklist which can be found in appendix A. If all questions can be answered with “yes” in the requirement form, the case makes it to the longlist. The longlist of cases that were selected can be found in appendix B. The last step consisted of selecting the best cases to analyze from the longlist. This was handled based on criteria that were elaborated per case. The cases that were selected for illustrative purposes are selected during the course of the extended literature study.

4.4.2 Illustrative case analysis method

The selected cases were analyzed based on elements identified in the literature study on platform related typologies. First, based on the literature review, a set of PSS types are identified in this first paragraph. The PSS concept is used as a foundation for the illustrative case analysis. The typology framework inspired by the typology originally proposed by Tukker (2004) is be used as a starting point for identifying PSS types. Each case is analyzed on the basis of the underlying business model. The purpose

of the analysis is to determine which adjustments and refinements are needed for the typology to become a more accurate classification of PBMs.

Besides identifying underlying business models for the illustrative cases, the contribution to sustainability of each individual platform is assessed in the following manner. Since this research is narrowed down to environmental sustainability, the decision was made to use the 9R framework as presented by Kirchherr, Reike, and Hekkert (2017) to conduct this part of the analysis. The 9R framework consists of nine R-strategies for business models contributing to sustainability, which are refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle and recover. The 9R framework by Kirchherr et al. (2017) is deemed suitable for the operationalizing of sustainability contributions of PBMs, since its conceptualization offers a hierarchy in the level of circularity achieved by each business model strategy. The hierarchy of the 9R strategies in the framework corresponds to varying degrees of resource value retention. Each illustrative case will be classified based on the 9R framework. The highest strategy in the framework (R0: refuse) corresponds to the highest levels of value retention, while the lowest strategy in the framework (R9: recover) corresponds to the lowest levels of value retention. For each identified PBM will be determined which 9R strategy is employed by the platform, which automatically sheds light on the level of circularity by that strategy (following the hierarchy of R-strategies). The higher R-strategies in the hierarchy are business models working on circularity, which are therefore PBMs making greater contribution to sustainability than the lower ranked PBMs.

Data for the illustrative case analysis was collected using three main sources: Firstly, open to the public from companies' websites and social media as well as related press articles. Secondly, case studies describing companies in existing literature. Thirdly, publicly available interviews, used to achieve a better understanding of the platform organizations and business models they implement.

4.5 Limitations

This paragraph describes limitations to the research caused by methodological decisions that are made during the process.

There are limitations to the results given the nature of this research. This research is primarily based on literature research with little empirical additions. Although cases are analyzed for illustrative purposes, the empirical material of the research remains minor. This research utilizes cases as illustrative examples to support the body of knowledge from existing literature. The illustrative cases that have been observed should be a representation of the object one intends to assess and draw conclusions from (Yin, 2018). Since the results of this research do not enjoy the thoroughness of a well-executed multiple cases study, the results from observing at the illustrative cases might have a one-sided perspective. For that reason, this thesis does not offer empirical justifications, but instead illustrative examples of the way the typology operates in practice. Therefore, it is impossible to eventually test the validity of the typology since it lacks objective proof. Furthermore, with respect to the methodology, the selection of illustrative

cases is determined by setting up a longlist of cases is created based on a set of criteria. This arbitrary selection procedure could pose limitations as opposed to a more systematic selection approach typically seen on a traditional case study. Another limitation to the study was the number of cases to be examined for the analysis in the time allocated. Since there were 9 cases consisting of large amounts of information, it was not possible to fully analyze each case in-depth. Additionally, this thesis has narrowed its focus down to a limited set of cases from different industries for analysis of platform business models. Future research may offer insights into a broader view by including different sectors in the research field, as well as by integrating more analytical and empirical content in the form of case studies. Finally, given that the claims in this study are qualitative, a more quantitative approach to the field of science might offer valuable empirical insights into the main research question.

Next are some limitations worth noting regarding the use of the concept of sustainability. The deliberate choice was made for the scope of this research that the term ‘sustainability’ is narrowed down to environmental sustainability, which means the researched construct in this thesis is narrowed down to environmental impact, leaving social and economic sustainability impacts out of consideration. This limits the research since sustainability is a broader concept and the decision leaves out implications for social and economic sustainability. Moreover, in relation to the established definition of PBMs, their ability for valorization of idle capacity and assets is a characterization strongly connected to the definition. However, as the illustrative case analysis demonstrates, there are also varieties of PBMs that do not take advantage of facilitating the valorization of idle capacities, leaving it somewhat questionable that all PBMs within the proposed typology are contributing towards optimizing idle capacity and therefore sustainability.

Secondly, with respect to the analysis phase and the use of the 9R framework to determine PBM contributions to sustainability: For the analysis phase the, choice was made to use the 9R framework by Kirchherr et al. (2017) as a data analysis method. While the 9R framework is deemed as highly suitable for measuring contributions towards a more circular economy by PBMs, other theories might be applicable and suitable for the analysis as well. Moreover, the use of the 9R framework, while being suitable for capturing circularity contributions, might fail to grasp the full spectrum of sustainability contributions provided by PBMs. Circularity focuses on PBM resource cycles, while sustainability is more broadly related to the triple bottom line of environmental, social and economic sustainability. Therefore, analyzing the illustrative cases according to a different framework could yield different results. Due to these limitations, lack of understanding of the true contribution towards sustainability of each identified platform business model is a limitation linked to this study. Therefore, hypotheses on the effectiveness of sustainability performance for PBMs might not be adequately backed by objective and representative indicators.

In addition to academic limitations to the research of this thesis, there are additional practical limitations involving the crisis of the corona virus spread happening globally in the time of writing this thesis. Consequently and directly related to the researcher: The Dutch government is advocating citizens to stay within homes for as much as possible, while social gatherings of above 3 people are banned (Rijksoverheid, 2020). Furthermore, university is closed and access to professors is exclusively possible by video conference. These conditions apply for over the entire period of writing of this master thesis. While progress on this research has primarily been able to continue working from home, the current crisis poses limitations to the results of the research. Firstly, no face-to-face contact with the thesis supervisor is possible during the larger part of the research. Secondly, no face-to-face contact can be facilitated with platform organizations or other relevant cases related to the empirical side of the thesis. In collaboration and agreement with the thesis supervisor has been decided to base this research primarily on extended literature review and solely illustrative cases, given the context of this pandemic situation. Furthermore, the researcher has stuck to digital alternative ways of communication. All of the above considered might pose a negative impact on the results of this thesis.

5 Analysis of illustrative platform business model cases

This chapter aims to further build on the theoretical framework of platform business models proposed in chapter 3. The goal of this chapter is to identify underlying business models of the analyzed platforms.

5.1 Illustrative case analysis approach

The illustrative case analysis approach is laid out as follows. First, based on the literature review on platform related typologies in chapter 3, multiple PSS types are identified in this first paragraph. The PSS concept is used as a foundation for the illustrative case analysis. The typology of Tukker (2004) is used as a starting point for identifying PSS types. Additionally, contributions from Lewandowski (2016) and Van Ostaeyen et al. (2013) to the PSS concept are added. A synthesis of these PSS concepts is described in the next section. Thereafter, the contribution of platform business models to sustainability is operationalized in the following section.

In the second paragraph, the illustrative case analysis is conducted. The goal is to identify underlying business models that arise from analyzing empirical examples from the PSS typology, which would result in a set of platform business models to be used in the final PBM typology. Consequently, the PSS concept is compared with empirical illustrative cases to find a set of platform business models. Moreover, each case is analyzed based on contributions to sustainability, using the established operationalization.

The third paragraph provides a synthesis of the analysis. The fourth and last paragraph reflects on the analysis approach of this chapter and discusses limitations.

5.1.1 PSS types

In this section a set of PSS types are described which will lay foundation for the illustrative case analysis to identify underlying PBMs. Besides a brief description per PSS type, a classification for value orientation per type is included.

The main takeaway from the typology of Tukker (2004) relevant towards development of the final PBM typology are the following PSS archetypes: product renting, sharing, leasing and pooling. Derived from the work of Lewandowski (2016), the PSSs of product renting, sharing and pooling are combined together with collaborative consumption and sharing platforms as a single PSS type. This is the case since sharing platforms allow users to participate in collaborative consumption related to product sharing/renting or product pooling. Within this PSS type, the provider holds ownership over the product and the consumer does not have unlimited access since the product is sequentially used by different users (Lacy et al., 2014). Value orientation in this type of PSS is purely based on providing functionality by offering certain products to the consumer, making this a product-oriented PSS.

The PSS of product leasing is placed in its own category. Product leasing is similar to renting/sharing/pooling in the sense of the provider holding ownership. However, unlike renting/sharing/pooling, consumers that participate in leasing have unlimited exclusive access to the

product. Value orientation in this type of PSS is based on both providing functionality as well as performance. These PSS types achieve this mixed value orientation by offering servitization-oriented business models, in which service elements are attached to product offerings.

On top of Tukker's proposed PSS types, Lewandowski (2016) proposes additional PSS types that are derived from the PSS refinements suggested by Van Ostaeyen et al. (2013) in their overview of circular business model types. Van Ostaeyen et al. (2013) offer a more refined typology of the PSS concept, which provide additional relevant takeaways for the platform typology. The refined typology proposes three additional PSS mechanisms that are relevant for platforms, which are explained in the next few paragraphs.

Firstly, the PSS: input-based, in which revenue is transferred from consumer to the producer based on inputs provided to fulfill the role of the product or service. Following the work of Lewandowski (2016), this type is combined with asset management, a model that adopts a sustainable approach to asset management that guarantees the most efficient internal procurement, re-use, refurbishment and re-sale of goods and materials and decreases the amount of raw materials needed to satisfy consumer needs (Lewandowski, 2016). Value orientation in this type of PSS is purely based on providing functionality by offering certain input in the form of products to the consumer. Consequently, this PSS type has a business model (BM) orientation that is product-oriented.

Secondly, the PSS: performance-based, which indicates that revenue is generated based upon the product or service's practical performance. Value orientation in this type of PSS is purely based on providing functionality by offering products or services to the consumer, making this a PSS with a BM orientation that is performance-oriented. Performance has different levels of abstraction and can therefore be based on a certain solution, effect or demand-fulfilment (based on consumer satisfaction).

Thirdly, the PSS: availability-based, which ensures that revenue is passed from the customer to the supplier related to the time during which the product or service is available to the consumer, regardless of how often or actively they are being used in that time period. This model is typically monetized in the form of a monthly fee for a product. For a service, this results in a set recurring payment to be charged for which the company agrees to deliver the service to the consumer whenever demanded. Value orientation in this type of PSS is purely based on providing functionality by offering products or services to the consumer, making this a PSS with a BM orientation that is performance-oriented.

Summing it all up, a set of five PSS types are defined from literature, which will be used to identify underlying platform business models during the illustrative case analysis. In table 4 below, an overview of the PSS types is laid out, including value orientation and BM orientation. Furthermore, the table includes the literature sources that were used for each PSS type.

Table 4 Overview of PSS types

PSS type	Value orientation	BM orientation	Literature source(s)
1. PSS: product renting, sharing, pooling Collaborative consumption, sharing platforms,	Purely functionality	Product-oriented	Belk (2014), Lacy et al. (2014), Tukker (2004)
2. PSS: product leasing	Both functionality and performance	Servitization-oriented	Tukker (2004)
3. PSS: input-based, Asset management,	Purely functionality	Product-oriented	Lewandowski (2016), Van Ostaeyen et al. (2013)
4. PSS: performance / result based	Purely performance	Performance-oriented	Van Ostaeyen et al. (2013)
5. PSS: availability based	Purely performance	Performance-oriented	Van Ostaeyen et al. (2013)

As mentioned before, the purpose of the next section is to increase the robustness of the preliminary typology by using illustrative cases and comparing it with input from the typology framework (chapter 3) and platform types proposed in this paragraph. The PBM archetypes and business model dimensions proposed in this paragraph are subject to change and are to be refined in a later synthesis paragraph.

5.1.2 Operationalizing sustainability contributions for platform business models

Besides analyzing the PSS types for underlying business models to form a typology for PBMs, the sub question of this research: “*To what degree do platform business models contribute to sustainability?*” needs to be answered. The goal of this section is to operationalize the concept of sustainability to determine which PBM promote sustainability and to what degree. Next, by analyzing the cases, can be determined to what degree the analyzed PBMs contribute to sustainability.

Based on literature reviews conducted in chapter two and three can be concluded that PBMs can contribute to sustainability when they are able to generate multiple value by valorizing idle assets and capacities on their platform. There are various ways PBMs facilitate this valorization. To track progress towards an improved contribution to sustainability, indicators must be established to provide manageable units of economic, environmental and social conditions (Böhringer & Jochem, 2007). This means that companies seek to solve interdependent collections of problems: the Triple Bottom Line (TBL), integrating economic, social and environmental issues (Elkington, 1998).

In order to shed light onto the contribution of PBMs to sustainability, the cases analyzed in this chapter will be evaluated based on their employed strategies towards striving for sustainability. Since this research is narrowed down to environmental sustainability, the decision was made to use the 9R framework as presented by Kirchherr et al. (2017) for its operationalization. Discussions around circularity focus mostly on environmental quality and these same discussions are done from an environmental impact perspective (Geissdoerfer et al., 2017; Lieder & Rashid, 2016). Since this research has narrowed the sustainability concept down to environmental sustainability, the operationalized sustainability statements coming forward are aimed at environmental impacts. The 9R framework consists of nine strategies for business models striving for more circularity, thereby contributing to environmental sustainability. The 9R framework is described in table 5 below.

Table 5 The 9R framework for operationalizing sustainability for PBMs

9R hierarchy	R-Strategy	Definition	
 Increasing circularity	R0	Refuse	Make product redundant by abandoning its function or by offering the same function with a radically different product
	R1	Rethink	Make product use more intensive (e.g. by sharing product)
	R2	Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources or materials
	R3	Reuse	Reuse by another consumer of discarded product which is still in good condition and fulfils its original function
	R4	Repair	Repair and maintenance of defective product so it can be used with its original function
	R5	Refurbish	Restore an old product and bring it up to date
	R6	Remanufacture	Use parts of discarded product in a new product with the same function
	R7	Repurpose	Use discarded product or its parts in a new product with a different function
	R8	Recycle	Process materials to obtain the same (upcycling) or lower (downcycling) quality
R9	Recover	Incineration of material with energy recovery	

Source: adapted from Kirchherr et al. (2017)

The 9R framework by Kirchherr et al. (2017) is suitable for the operationalization of sustainability contributions of PBMs, since its conceptualization offers a hierarchy in the level of circularity achieved

by each employed R-strategy. The hierarchy of the R-strategies in the 9R framework corresponds to varying degrees of resource value retention. The R-strategies pose a spectrum of circularity techniques ordered from high (low R-number) to low (high R-number) circularity. The highest strategy in the framework (R0: refuse) corresponds to the highest levels of value retention, while the lowest strategy in the framework (R9: recover) corresponds to the lowest levels of value retention (Potting et al., 2017). Value retention of resources in this context means: “Conservation of resources closest to their original state, and in the case of finished goods retaining their state or reusing them with a minimum of entropy as to be able to give them consecutive lives” (Reike, Vermeulen, & Witjes, 2018, p. 256). R-Strategies that directly deal with resource streams following usage of the product (recycle, recover) are therefore ranked the lowest in the hierarchy, since their activities tend to eliminate parts of the original product structure.

R0 through R2 are considered as business models with high levels of circularity, striving for smarter product use and manufacturing. R3 through R7 are considered business models with medium levels of circularity, operating strategies focused on extending the lifespan of products and its parts. Lastly, R8 through R9 are considered as business models with low levels of circularity, with strategies finding useful applications of materials. It is possible that cases employ a mix of multiple 9R strategies within their business model.

In the next section, the illustrative case analysis of PBMs will be discussed. For each identified PBM will be determined which 9R strategy is used, which automatically sheds light on the level of circularity by that strategy if the hierarchy is followed.

5.2 Illustrative case analysis of platform business models

The goal of this paragraph is to analyze platform types that were identified from paragraph 1 and to compare them to real world examples, serving as illustrative cases. The goal of this chapter is to identify underlying business models of platforms. Additionally, the PBMs are evaluated according to 9R framework by Kirchherr et al. (2017), thereby shedding light onto their contribution to sustainability. A company profile of each illustrative case can be found in appendix C. The cases are presented in no particular order.

5.2.1 Illustrative case for PBM 1: FLOW2

FLOW2 (<https://www.flow2.com/>) is a sharing platform on which companies, organizations, and institutions worldwide from every sector can temporarily offer and rent equipment, services and employees. Furthermore, secondment to fellow companies is possible, also within trusted communities of companies via their private sharing platform known as FLOW2 Community (FLOW2, 2020). For over 25,000 types of assets, the company matches the demand and supply side for various industries such as construction and agriculture (Lacy & Rutqvist, 2016). FLOW2's revenue model is based on a subscription fee, which companies pay to place a number of advertisements on the platform online (Willekes, 2016). Platforms like FLOW2 allow individuals, companies organizations and institutions

to share underused or idle assets. The PSS type of collaborative consumption, sharing platforms, product renting, sharing, and pooling plays a key role for PBMs. A company description of FLOW2 can be found in appendix C.

Thanks to the platform run by FLOW2, every affiliated company has access to a wide range of company assets without owning them, putting emphasis on access over ownership. This type of business model is about setting up a network of individuals and institutions, which allows for vast amounts of assets to become available to a large group of users (Willekes, 2016). These types of PBMs are an important category towards circularity, since the offered products and materials on the platform will be reused by other users on the platform, while raw materials retain their physical characteristics and value for as far and as long as possible (Jonker et al., 2017). For these reasons, FLOW2's business model is a key player in valorization of idle assets by showing three strategies of the 9R framework (Kirchherr et al., 2017), namely rethink (R1), by making product and material use more intensive, reduce (R2) by increasing efficiency by generally facilitating the consumption of fewer natural resources or materials to its userbase, and lastly reuse (R3) by other consumers of discarded products.

The business model facilitates asset management practices, which means that company equipment is used more efficiently, which leads to a reduction in the use of raw materials and energy. FLOW2's activities are set up in a community-centric manner in which companies are connected to one another through networks and communities (Willekes, 2016). Multiple value creation within the FLOW2 ecosystem is about creating valuable connections between company networks, rather than increasing turnover or profit (FLOW2, 2020).

FLOW2 hosts marketplace services for B2B participants. According to the founder, Kim Tjoa, B2B sharing has yet to hit the mainstream partially due to the fact that traditional businesses are not yet comfortable with the phenomenon of sharing excess production resources or properties with other businesses (Lacy & Rutqvist, 2016). The founder of FLOW2 states that the primary barrier for scaling up is the necessary shift to a general different mindset. "Not every employer or employee is open to the introduction of asset sharing in their company. It requires a change of mentality and it requires trust from the userbase" (FLOW2, 2017). Currently, companies are unaccustomed to the renting or sharing of assets to other companies and they view it as a risk rather than opportunity. The opportunities for value, utilization and revenue are not properly recognized as of now (Lacy & Rutqvist, 2016).

In conclusion, FLOW2 incorporates a business model that specializes on the management and optimization of assets. The value generated by this company lies mainly in functional content. FLOW2, therefore, is a product oriented PBM which primarily focuses on functionality by means of transactions based on transfer of ownership. Furthermore, the PBM shows medium to high levels of circularity since its R-strategies focus on smarter product use, causing FLOW2 to score relatively high on the 9R hierarchy for its contributions to sustainability.

5.2.2 Illustrative case for PBM 2: Zipcar

Zipcar (<https://www.zipcar.com/>) is a car sharing platform active in North America and several major European cities. Users on the platform pay a fee to be able to book cars electronically and unlock them using their subscription ID. The vehicle needs to be returned to the initial location after use for several hours. Users do not have to worry about petrol, security, parking or repair costs, since there is a credit card inside each car if required (Zipcar, 2020). A company description of Zipcar can be found in appendix C.

Users on the Zipcar platform pay a fee for the hours they drive in the offered vehicles. This is known as a pay per service unit style business model. Zipcar's business model focuses on optimizing the use of vehicles, causing the vehicles from their portfolio to spend less time sitting idle. This form of valorization can be classified as rethink (R1) in the R9 framework (Kirchherr et al., 2017), since the platform makes product use more intensive by sharing the cars among multiple users.

In conclusion, Zipcar incorporates a business model that offers a certain demand-fulfilment based on a pay per service unit model, wherein travel time in the form of driving hours is the unit of measurement. The value generated by this company lies mainly in performance content. Zipcar, therefore, is a performance oriented PBM which primarily focuses on performance by means of transactions based on demand fulfilment (rather than transfer of ownership). Furthermore, the PBM shows high levels of circularity since its strategies focus on smarter product use, causing Zipcar to score high on the 9R hierarchy for its contributions to sustainability.

5.2.3 Illustrative case for PBM 3: Excess Materials Exchange

Excess Materials Exchange (<https://excessmaterialsexchange.com/>), also known as EME, is a facilitated, digital marketplace where companies can exchange any type of excess materials (components, materials, products) and commodities among other businesses. Clustering based on transaction type and content (Täuscher & Laudien, 2018) on these types of platforms are solely physical products. EME aims to reinstate commodities and waste as a valuable resource (Excess Materials Exchange, 2019). A company description of EME can be found in appendix C.

EME's business model reveals a range of methods all contributing to the same core principles of transparency, reliability, scalability, and reduction of impacts. EME seeks to create environmental value by reducing impacts, with their other core values enabling and supporting EME to achieve the environmental goals. Transparency is required to collect data on the origin and composition of the materials that circulate on the platform. The importance of the reliability principle ensures that the data obtained is reliable. The synthesis of both these principles allows the resource to be valued as accurately as possible.

At the heart of EME's business model lies the matchmaking tool. EME's marketplace participants consist of businesses, making it a B2B platform. Through using their valuation data, this matchmaking tool blends the needs of participants with excess materials among businesses. Therefore, they promote the sale of excess resources from supplier participants to demanding participants. EME utilizes a

valuation module that quantifies the impacts of excess materials in categories of financial, social, and environmental impacts, which indicates the ability for multiple value creation. The environmental impact is calculated by values like water use, distance of transportation and CO₂ emissions. In addition to the generic financial impact based on second-hand value, EME uses ‘eco-cost’, which reflects the costs associated with prevention of a product’s environmental burden. This burden may consist factors such as pollution, contamination, and resource degradation. Furthermore, relevant burdens range from resource degradation due to a commodity being manufactured and shipped as well as end-of-life care. Eco-costs can be categorized as external costs because they are not yet incorporated into the existing supply chain costs, such as life cycle costs (Excess Materials Exchange, 2019).

In the business model of EME, two types of value creation can be distinguished, first, associational value, which is value generated by cooperation with another organization. Second, transferred resource value, which is value generated through the acquisition of resources from another party (Austin & Seitanidi, 2012). The value generated lies mainly in functional content by means of transactions based on transfer of ownership.

The contribution of the EME business model to environmental sustainability has reportedly been substantial, recording reductions in CO₂ emissions, freshwater usage, and energy consumption. Reductions are ranging from 55 to 75 percent of total reductions for companies part of the platform during their pilot (Excess Materials Exchange, 2019), all due to valorization of assets in the form of waste and/or commodities. EME facilitates the management of commodities owned by other businesses, a model that guarantees the most efficient internal procurement, re-use, refurbishment and re-sale of goods and materials and decreases the amount of raw materials needed for businesses to complete their business activities (Lewandowski, 2016). EME’s valuation tool especially proofs their abilities for valorization of idle or even excess materials. Since users on the EME platform can use the exchanged materials in various ways, the PBM of EME can be classified as a hybrid strategy on the 9R framework (Kirchherr et al., 2017). The materials exchange tool can facilitate forms of reuse (R3), remanufacture (R6), repurpose (R7) and recycle (R8).

In conclusion, EME incorporates a business model that specializes on the management and optimization of commodities and waste. The value generated by this company lies mainly in functional content. EME, therefore, is a product oriented PBM which primarily focuses on functionality by means of transactions based on transfer of ownership. Furthermore, the PBM shows low to medium levels of circularity since its strategies focus on extending lifespan of products and its parts, as well as useful application of materials, causing EME to score medium on the 9R hierarchy for its contributions to sustainability.

5.2.4 Illustrative case for PBM 4: Snappcar

Snappcar (<https://www.snappcar.nl/>), is a platform that facilitates the rental of personal vehicles among users. Car owners can offer their own vehicles for rent on the platform, while consumers can request access to available vehicles. Snappcar launched with a vision of a profitable startup with economic,

social and ecological impact (Snappcar, 2020). Participants on the Snappcar platform are consumers exchanging access to vehicles, making it a C2C oriented platform. A company description of Snappcar can be found in appendix C.

Availability based platforms ensure that revenue is passed from the customer to the supplier on the basis of the time during which the product or service is available to the consumer, regardless of how often or actively they are being used in that time period. Thus, the consumer pays for a certain performance, rather than functionality. Availability-based business models are similar to product sharing and leasing in the sense of the provider holding ownership over the offered product. However, it distinguishes from other platform types like sharing and leasing, since consumers do not have unlimited access and pay for a certain availability of a product or service (Van Ostaeyen et al., 2013). This type of PBM type is often seen in the mobility sector. Car sharing platforms lately have attracted a lot of attention, partly due to their green image. Frequently car sharing companies promote their platforms as environmentally beneficial, as they help reduce CO₂ emissions in the mobility sector (Nijland & van Meerkerk, 2017). Car sharing platforms have positive impacts for environmental sustainability when their services can valorize idle assets, or as for this case: decrease car ownership and car use of the overall public. This PBM shows the R-strategy of rethink (R1) on the 9R framework (Kirchherr et al., 2017), since the main focus of the platform is intensifying product use by facilitating car sharing.

According to Nijland and van Meerkerk (2017), car ownership among users of car sharing platforms is 30% lower than before car sharing started. Some car sharers even tend to dispose of their privately owned car, since car sharing substitutes their vehicle. Furthermore, car sharers drive about 15 to 20% fewer kilometers than they did before car sharing began. Lastly, participants on car sharing platforms emit 240 to 390 kilograms less CO₂ emission per user, per year. This reduction is partially thanks to the reduction in car ownership facilitated by the platform, and can overall be attributed to less car use by the userbase (Nijland & van Meerkerk, 2017). For these reasons, Snappcar is a platform that successfully allows for valorization of idle assets.

In conclusion, Snappcar incorporates a business model that specializes on services which are made available to the user for a certain time window. The value generated by the platform lies mainly in performance content. Snappcar, therefore, is a performance oriented PBM which primarily focuses on performance by means transactions based on demand-fulfilment. Furthermore, the PBM shows high levels of circularity since its R-strategies focus on smarter product use, causing Snappcar to score high on the 9R hierarchy for its contributions to sustainability.

5.2.5 Illustrative case for PBM 5: Fiverr

Fiverr (<https://www.fiverr.com/>) is a global, online freelancing platform that hosts virtual jobs such as website design, programming, and video production (Fiverr, 2020). Fiverr distinguishes itself from other platforms by only promoting virtual tasks which can be carried out entirely online (Hannák et al., 2017). A company description of Fiverr can be found in appendix C.

Business models based on providing a certain desired performance is a unique form of PBMs, which can typically be found on labor marketplaces. The scale and value of online, on-demand labor marketplaces has evolved in recent years. Oftentimes, these marketplaces are collectively referred to as the ‘gig economy’ since workers are classified as freelancers or independent contractors. Whereas in pre-digital days, independent employees were challenged to efficiently advertise their services, and consumers to find willing staff, platforms such as Fiverr dramatically simplify the process of matching consumers and employees. This type of marketplace allows employees the flexibility to choose jobs during timeslots they desire, while employers are able to request simple to complex jobs on demand (Hannák et al., 2017).

Fiverr can be classified as a PBM that generates invoice based on the result of the service provided, more specifically demand fulfillment-oriented performance, in which revenue is created according to subjective functional performance based on how well a consumer need is satisfied (Van Ostaeyen et al., 2013). Fiverr could be classified as reduce (R2) on the 9R framework (Kirchherr et al., 2017), since their platform increases process efficiency (thereby consuming fewer natural resources or materials). However, should be noted that Fiverr does not show direct signs of direct resource value retention considering product and/or material use. Therefore, the classification on the 9R framework for this specific illustrative case poses limitations (further elaborated in the last paragraph).

In conclusion, Fiverr incorporates a business model that specializes in offering services based on a certain result. The value generated by this company lies mainly in performance content, since job exchanges on the platform are valued based on performance content. Fiverr, therefore, is a performance PBM which primarily focuses on performance by means of transactions based on demand-fulfilment. Furthermore, the PBM shows high levels of circularity since its R-strategies strive for smarter consumer use, causing Fiverr to score high on the 9R hierarchy for its contributions to sustainability.

5.2.6 Illustrative case for PBM 6: Bookmooch

Bookmooch (<http://bookmooch.com/>) is a book swapping/bartering platform for exchanging used books. The platform allows for users to provide books to other users on the platform. Offering books earns the user points, which can be spend on acquiring books from other users (Bookmooch, 2020). A company description of Bookmooch can be found in appendix C.

Bartering is a timeless practice which is becoming ever more popular thanks to the convenience of the internet, using business models that require to accurately narrow down user preferences of the items that they consume (Rappaz, Vladarean, McAuley, & Catasta, 2017). Within this business model, users act as both consumer as well as supplier and there is a highly dynamic trading environment in place. An effective model of bartering therefore allows one to consider not only the desires of consumers but also the social dynamics of who trades with whom and the temporal dynamics of when trades occur (Rappaz et al., 2017). Bookmooch’s business model allows for valorization of idle assets, since users exchange products in the forms of books on the platform, which would mostly be sitting idle on bookshelves. This

PBM can be classified in the R9 framework (Kirchherr et al., 2017) as rethink (R1) for intensifying the use of books, as well as reuse (R3) for facilitating reuse by another consumer. While revenue for the platform is generated from users' voluntary donations and from commissions offered by bookstores, Bookmooch's business model is that of a non-profit platform and therefore only facilitating the transactions among users, while not profiting themselves from user transactions.

In conclusion, Bookmooch incorporates a business model that focuses on valorizing (idle) assets in a bartering exchange ecosystem. The value generated by this company lies in both functional and performance content content. Bookmooch, therefore, is a servitization oriented PBM which focuses on both functionality and performance by means of transactions based on transfer of ownership as well as transactions based on demand-fulfilment. Furthermore, the PBM shows medium to high levels of circularity since its R-strategies focus on smarter product use as well as extending lifespan of products, causing Bookmooch to score relatively high on the 9R hierarchy for its contributions to sustainability.

5.2.7 Illustrative case for PBM 7: De Kringwinkel

De Kringwinkel (<https://www.dekringwinkel.be/>) is a platform where users can acquire and dispose of second-hand goods. On top of the basic product offering of goods, the platform also offers services such as furniture pick up services, clothing rental and a circular hub for exchanging and hosting workshops, repair services and material reuse (De Kringwinkel, 2020). A company description of De Kringwinkel can be found in appendix C.

De Kringwinkel's business model facilitates the exchange of goods between users while incorporating services on top, making this a product-related service platform business model. PBMs incorporating both product- and performance-oriented elements to their business model are known as servitization-oriented business models. This PBM can be classified in the R9 framework (Kirchherr et al., 2017) into different R-strategies, since there are various approaches users on the platform can have to the offered products. First and foremost, the PBM focuses on reuse (R3) for facilitating reuse of products by other consumers. However, the PBM also shows elements of additional services showing R-strategies such as repair (R4), refurbish (R5), remanufacture (R6), repurpose (R7) and recycle (R8). Therefore, the platform clearly employs a hybrid set of R-strategies.

In conclusion, De Kringwinkel incorporates a business model built around the product-service system concept, since services are incorporated into their product offerings. The value generated by this company lies in both functional and performance content. De Kringwinkel, therefore, is a servitization oriented PBM which focuses on both functionality and performance by means of transactions based on transfer of ownership as well as transactions based on demand-fulfilment. Furthermore, the PBM shows medium levels of circularity since its wide array of R-strategies focus on smarter product use, extending lifespan of products as well as useful application of materials, causing De Kringwinkel to score medium on the 9R hierarchy for its contributions to sustainability.

5.2.8 Illustrative case for PBM 8: MUD Jeans

MUD Jeans (<https://mudjeans.eu/>) is a platform where users can choose to lease jeans (besides traditional purchasing). The company has a clear and specific vision about circularity, which has been a widely discussed topic within the fashion industry known for its significant environmental impact on the industry. Their portfolio consists of both recycled jeans (40%) and bio-organic cotton (60%). Moreover, the company offers secondhand products (worn and leased jeans) in the form of vintage jeans. The business model incorporates free repairs if required as part of their leasing service. MUD Jeans has access to a wide range of strong industry partners with similar circular vision, allowing them to execute their circular business model most effectively (MUD Jeans, 2020). A company description of MUD Jeans can be found in appendix C.

The leasing model of MUD jeans has a positive impact on environmental sustainability thanks to their included repair services, thereby guaranteeing longevity of their product offerings. On top of the leasing model, users can return their worn-out jeans for recycling purposes. Leasing business models such as the one employed by MUD Jeans valorize idle assets by optimizing the lifespan of products and taking responsibility of the end-of-life of their products by offering recycle services. This PBM shows elements of rethink (R1) on the 9R framework (Kirchherr et al., 2017), since the leasing model allows for more intensive product use. Moreover, the company offers additional services that focus on R-strategies such as reuse (R3), repair (R4), remanufacture (R6) and recycle (R8). Therefore, the platform clearly employs a hybrid set of R-strategies.

In conclusion, MUD Jeans incorporates a leasing-based business model. The value generated by this company lies in both functional and performance content. MUD Jeans, therefore, is a servitization oriented PBM which focuses on both functionality and performance by means of transactions based on transfer of ownership as well as transactions based on demand-fulfilment. Furthermore, the PBM shows medium levels of circularity since its R-strategies focus on smarter product use as well as extending lifespan of products, causing MUD Jeans to score medium on the 9R hierarchy for its contributions to sustainability.

5.2.9 Illustrative case for PBM 9: Hello Tractor

Hello Tractor (<https://hellotractor.com/>) is a sharing platform for farmers, connecting tractor owners and smallholder farmers for equipment sharing. Farmers can collaboratively gain access to a portfolio of farming equipment provided by the userbase (Hello Tractor, 2020). Hello Tractor depends on matching tractor owners and farmers who are active at the same location. Some generated networks have a notably small spatial coverage, sometimes as small as a neighborhood (Kolk & Ciulli, 2020). The company uses blockchain technology to give users on the platform real-time information about their product offerings. Hello Tractor also partnered up with industry leader John Deere, which provides tractor suppliers with training and equipment and thereby supports more smallholder farms. Collaboration with existing multinationals enables quick replication of operations elsewhere and enables the spread and

development of innovations even towards developing countries (Kolk & Ciulli, 2020). A company description of Hello Tractor can be found in appendix C.

Hello Tractor facilitates optimization of asset use by means of collaborative consumption, since a larger pool of farmers need fewer machines to execute the same number of tasks, resulting in less idle time for farming equipment. This R-strategy corresponds to rethink (R1) in the R9 framework (Kirchherr et al., 2017).

In conclusion, Hello Tractor incorporates a business model that specializes on the management and optimization of (idle) assets by letting users collaboratively access assets by means of product renting, sharing and pooling. The value generated by this company lies mainly in functional content. Hello Tractor, therefore, is a product oriented PBM which primarily focuses on functionality by means of transactions based on transfer of ownership. Furthermore, the PBM shows high levels of circularity since its R-strategies focus on smarter product use, causing Hello Tractor to score high on the 9R hierarchy for its contributions to sustainability.

5.3 Synthesis of illustrative case analysis

The analysis of multiple PBMs from a range of different industries provides insight in their underlying business models, as well as the way their business models contribute to sustainability. The first part of this synthesis goes over the identified dimensions of PBMs. Aiming to investigate and develop a sound final typology of PBMs, this analysis section explored the value orientation, transaction type and transaction content of PBMs. The second part of this synthesis describes some PBM archetypes resulting from the analysis.

Starting with the dimension of transaction content, platforms appear to be either product-oriented (Hello Tractor, FLOOW2, EME) or performance-oriented (Zipcar, Fiverr, Snappcar). Hence, the platform facilitates transactions consisting of either products or services (which are valued based on performance). Platforms with business models leaning towards product-oriented contents are classified as facilitators of ‘purely functionality’, while business models leaning towards performance are classified as facilitators of ‘purely performance’. However, platforms also appear in between these ends of the spectrum, following a servitization-oriented (De Kringwinkel, MUD Jeans, Bookmooch) transaction content, which is a mix between product and performance-oriented contents. The dimension of transaction content therefore forms the three primary categories for the classification of PBMs.

The basis of PBMs towards purely functionality and/or purely performance indicate the dimension of value orientation of the business model. Value orientation refers to the type of content wherein value is generated. PBMs purely based on functionality allow for value creation in the functional content, while PBMs purely based on performance allow generation of value in the performance content.

Continuing with the dimension of transaction type, two contradicting ends of the spectrum can be identified in the analyzed illustrative cases. Since platforms offer either products or performance-oriented contents, their transaction type is focused on that specific content. Therefore, platforms either

facilitate transactions based on transferring ownership (in the form of products) or based on demand-fulfilment (in the form of performance-oriented services).

Next in this synthesis, the identified archetypes of PBMs are discussed, based on the three primary dimensions of transaction content. The employed R-strategies are also included per archetype.

Product-oriented PBMs

The first set of platforms incorporate the valorization of product-oriented assets as key element to their business model. The assets come in the form of products, assets, commodities and waste. For product-oriented platforms, the following PBM classifications were identified per analyzed illustrative case (table 6):

Table 6 Product-oriented platform business models

PBM archetype	Illustrative case	Employed 9R strategies
1. Collaborative consumption	<i>Hello Tractor</i>	Rethink (R1)
2. Asset management	<i>FLOW2</i>	Rethink (R1), reduce (R2), reuse (R3)
3. Commodity management	<i>EME</i>	Reuse (R3), Remanufacture (R6), Repurpose (R7), Recycle (R8)

Servitization-oriented PBMs

The second set of platforms incorporate valorization of assets by facilitating servitization business models on their platform. For servitization-oriented platforms, the following PBM classifications were identified per analyzed illustrative case (table 7):

Table 7 Servitization-oriented platform business models

PBM archetype	Illustrative case	Employed 9R strategies
4. Product related service	<i>De Kringwinkel</i>	Repair (R4), refurbish (R5), remanufacture (R6), repurpose (R7), recycle (R8)
5. Leasing-based	<i>MUD Jeans</i>	Reuse (R3), repair (R4), remanufacture (R6), recycle (R8)
6. Bartering-based	<i>Bookmooch</i>	Rethink (R1), reuse (R3)

Performance-oriented PBMs

The third set of platforms facilitate transactions based on demand fulfillment, which are established on the ground of a certain desired performance. For performance-oriented platforms, the following PBM classifications were identified per analyzed illustrative case (table 8):

Table 8 performance-oriented platform business models

PBM archetype	Illustrative case	Employed 9R strategies
7. Pay per service unit	<i>Zipcar</i>	Rethink (R1)
8. Result-based	<i>Fiverr</i>	Reduce (R2)
9. Availability-based	<i>Snappcar</i>	Rethink (R1)

Following the R-strategies by Kirchherr et al. (2017), the following hierarchy can be concluded about PBMs contributing to sustainability (table 9). The hierarchy is based on the R-scores, an average R-score is calculated for PBMs employing multiple R-strategies.

Table 9 Hierarchy of platform business model's contribution to sustainability

9R strategy hierarchy	PBM archetype	Average R-score
#1	Collaborative consumption PBMs, pay per service unit PBMs, availability-based PBMs	1
#2	Asset management PBMs, bartering-based PBMs, result-based PBMs	2
#3	Leasing-based PBMs	5.25
#4	Commodity management PBMs, product related service PBMs	6

In conclusion, collaborative consumption PBMs, pay per service unit PBMs and availability PBMs have the greatest contribution to sustainability of the nine identified archetypes in the PBM typology, since they score the highest on the 9R framework hierarchy (Kirchherr et al., 2017).

5.4 Reflection and limitations on the illustrative case analysis

This paragraph describes reflections and limitations on the illustrative case analysis chapter. First to mention is the difference between the typology framework proposed in figure 3 (chapter 3) and the outcomes and synthesis of this illustrative case analysis. The dimensions encountered during the illustrative case analysis in this chapter are predominantly different from the initial proposed typology framework. The typology framework proposed various dimensions coming from the literature study phase of this research. Nonetheless, after analyzing empirical data in chapter 5, some dimensions were no longer deemed relevant or required alterations for the final typology, since the empirical results revealed complexities to the model that needed to be addressed in the final version. Accordingly, the synthesis and archetypes proposed in this chapter has deviated from the typology framework of chapter 3.

While the work of Tukker (2004) was used as inspiration and starting point for the preliminary typology framework, some changes and decisions were made in the process. First, the dimension of clustering based on transaction type and content (physical products, digital products, physical services and digital services) was changed in the development process to better fit the overall spectrum of the offerings that platforms provide. The illustrative case analysis in chapter 5 pointed out that it is more relevant to consider value orientation than merely transaction type and content for this position in the typology. Therefore, the decision was made to change this part of the typology to value orientation (product-oriented, servitization-oriented and performance-oriented). Accordingly, this automatically changed the dimensions of value content to be changed to the new situation as well (value in functional content, value in performance content). Next, this new situation asked for a different approach for evaluation transaction type and content. This dimension was adapted to fit the newly defined dimensions of value orientation and value content. The illustrative case analysis revealed that platforms either facilitate the transactions based on transfer of ownership, demand-fulfilment, or a mix between them. The decision was made to place this dimension in the top of the model, to illustrate the mixed character between product- and performance-oriented business models. This decision resulted in another deviation of the original typology framework. The last dimension that was erased from the preliminary typology framework are the marketplace participants (B2B, B2C, C2C). This decision was once again made based on the illustrative case analysis, which revealed that most identified PBMs can come in every form of marketplace participant orientation. Therefore, since there is no way to classify this dimension in the model while keeping each dimension mutually exclusive, the decision was made to exclude the dimension from the final typology.

In addition to identifying underlying platform business models, the analysis had the secondary goal to shed light onto the contributions to sustainability of each illustrative case. For this part of the analysis, the 9R framework by Kirchherr et al. (2017) was used to consult which strategy different PBMs use to optimize utilization of idle capacities. While the 9R framework is deemed as highly suitable for measuring contributions towards a more circular economy by PBMs, other theories might have been applicable as well. Additionally, the use of the 9R framework, while being suitable for capturing circularity contributions, might fail to grasp the full spectrum of sustainability contributions provided by PBMs. Circularity focuses on PBM resource cycles, while sustainability is more broadly related to the triple bottom line of environmental, social and economic sustainability. Therefore, analyzing the illustrative cases according to a different framework would have yielded different results.

Lastly, the 9R framework turned out to be unsuitable for analyzing illustrative case 5: Fiverr. A PBM that solely focuses on facilitating digital services in the form of freelance labor did not fit the product and material focused orientation proposed by the 9R framework, which therefore poses limitations to this illustrative case study.

6 Discussion and concluding remarks

This final chapter presents the discussion and concluding remarks related to the research questions, as well as contributions and reflections on the research presented. Lastly, suggestions for future research are proposed.

6.1 Research questions and intentions

To arrive at an answer for the main research question: “*What does a typology of platform business models look like?*”, a theoretical approach incorporating a literature study was conducted in order to develop a sound typology on platform business models (PBMs). The literature study explored theory on business models in general, business models for sustainability, value creation and platform business models. With that approach, the initial aim was to create a detailed definition of PBMs that would allow for studying its nature in greater depth. Moreover, the literature study continued by reviewing platform related typologies. By synthesis of the explored concepts, the aim of this thesis was to develop a detailed classification of PBMs. Moreover, the research continued with empirical additions coming from an illustrative case analysis to observe platform’s underlying business models.

To arrive at an answer for the sub question of this research “*To what degree do platform business models contribute to sustainability?*”, a literature study was conducted in combination with empirical additions coming from an illustrative case analysis. The literature study explored the concept of sustainability, therefore, for the scope of this research, this concept was narrowed down to environmental sustainability, with the intention to operationalize sustainability within PBMs, to shed light onto their contributions to sustainability.

All things considered, this thesis had two objectives, namely theoretical objectives by proposing a typology on PBMs derived from theoretical concepts, as well as practical objectives by shedding light on how individual PBMs can contribute to sustainability.

6.2 Research process and findings

This paragraph describes the process and findings of the conducted research, as well as theory and methodology used during the process. The research process towards answering the main- and sub questions of this research consisted of investigating three vital areas of managerial practice which have gained research interest: platform business models, sustainability and business models for sustainability. This study approached these subjects by extensively researching literature on these topics, first by identifying conventional business models, including the widespread use of the business model canvas. The literature study continues to point out that the conventional business models operating on the business model canvas idea have lately received criticism for only realizing singular value in the form of financial value, while overseeing other effects of value creation. The notion was made, that nowadays, business models leaning more towards sustainability have emerged in the form of organizations incorporating both their shareholders as well as their stakeholders view into account and acknowledging

their impacts to the triple bottom line, a phenomenon known as multiple value creation. Moreover, business models known as circular business models are known for contributing to environmental sustainability by employing various kinds of R-strategies with circularity at the core of their business model.

This thesis continued by reviewing literature on platform related typologies. The literature study incorporated the idea of product service systems, servitization, nature of value creation and additional platform business model attributes. The theory that was primarily used was that of the product-service system (PSS) concept of Tukker (2004). The reason for using Tukker's work is because it holds value content of business models as a central aspect to the proposed typology. Therefore, the synthesis of the literature review on platform related typologies revealed that the PSS literature of Tukker (2004) served as a suitable starting point for development towards a typology of PBMs. To build on top of this framework, additional dimensions identified during the literature study on platform related typologies were used, namely: value content, actors, value orientation, market orientation, marketplace participants and clustering based on transaction type and content. Next, a preliminary framework of PBMs was established, in addition to a set of five PSS types, that form the theoretical foundation for the analysis, which consist of: [1] Collaborative consumption, sharing platforms, PSS: product renting, sharing, pooling, [2] PSS: product leasing, [3] Asset management, PSS: input-based, [4] PSS: availability based and [5] PSS: performance based. Finally, an illustrative case analysis of a total of nine PBMs was conducted to identify their underlying business models. During the analysis phase, input from the extended literature study was systematically used to identify business model dimensions to be used for the final PBM typology.

With respect to the methodology on typology development, the following steps were undertaken: [1] definition of typologies, [2] research into existing platform typologies by exploring theory, [3] determining factors of a typology for platforms by means of synthesis of elements from the literature study of the previous part and [4] development of a preliminary platform typology framework, formed using visual aids. The typology development continued with the chosen methodology of an illustrative case analysis. This thesis examined illustrative cases of PBMs by identifying different types of PBMs within the ecosystem. The methodology for the case analysis is based on illustrative case analysis and does therefore follow procedures of a full-sized case study. The selection of illustrative cases was determined by setting up a longlist of cases, created based on a set of criteria. The criteria and description of PBMs are based on the literature study. Each case is analyzed according to a set of dimensions and corresponding attributes also coming from the literature review stage. The purpose of the analysis was to determine which adjustments and refinements to the preliminary typology framework had to be made for it to become a more accurate representation of PBMs, presented in the final typology.

Besides analyzing the PSS types for underlying business models to form a typology for PBMs, the contributions of platform business models towards sustainability have been analyzed. In order to do that,

sustainability was operationalized by using the 9R framework by Kirchherr et al. (2017). The hierarchy of the 9R strategies in the framework corresponds to varying degrees of resource value retention. Each illustrative case was labeled with the employed 9R strategy to determine levels of circularity. Illustrative cases employing strategies R0 through R2 are considered as business models with high levels of circularity, R3 through R7 are considered business models with medium levels of circularity, R8 through R9 are considered business models with low levels of circularity. Each PBM was ranked according to the 9R framework hierarchy at the end of the analysis phase. Additionally, the sustainability contributions rankings were included in the final typology.

6.3 Towards a typology for platform business models

In this section, the developed final typology of platform business models is presented. The final typology is based on input coming from the analysis phase in chapter 5, which determined the dimensions of the typology. The first paragraph gives an overview of identified archetypes of the typology, the second paragraph presents the final typology model, lastly reflections and limitations are described in the third paragraph.

The input gained about PBMs during the analysis in chapter 5 form the building blocks towards a final typology of PBMs. Based on the analysis of illustrative cases, a typology of PBMs contrasting nine main archetypes was established. This section is structured along these nine archetypes. In occurrences where the illustrative cases could be classified into multiple categories, a qualitative assessment was performed to determine the classification based on business model attributes.

In total, nine archetypes of PBMs can be identified, namely: Collaborative consumption PBMs, asset management PBMs, commodity management PBMs, product related service PBMs, leasing-based PBMs, bartering-based PBMs, pay per service unit PBMs, result-based PBMs and availability-based PBMs. Each identified business model has one thing in common, since they include business models that strive for (environmental) sustainability by means of multiple value creation. Subsequently, when properly set up, these business models can produce economic value while contributing to environmental sustainability at the same time (Schaltegger et al., 2016).

In figure 4 below, the final typology of PBMs is displayed. In the figure, the dimensions of the platform business model framework are laid out. The nine archetypes of platform business models are displayed in the bottom of the model (numbered 1 to 9). Moreover, derived from the synthesis of chapter five, the degree to which each archetype contributes to environmental sustainability is visualized in the bottom of the model. PBMs scoring higher on the 9R framework hierarchy (Kirchherr et al., 2017) have been placed at a higher position in the archetypes section of the typology.

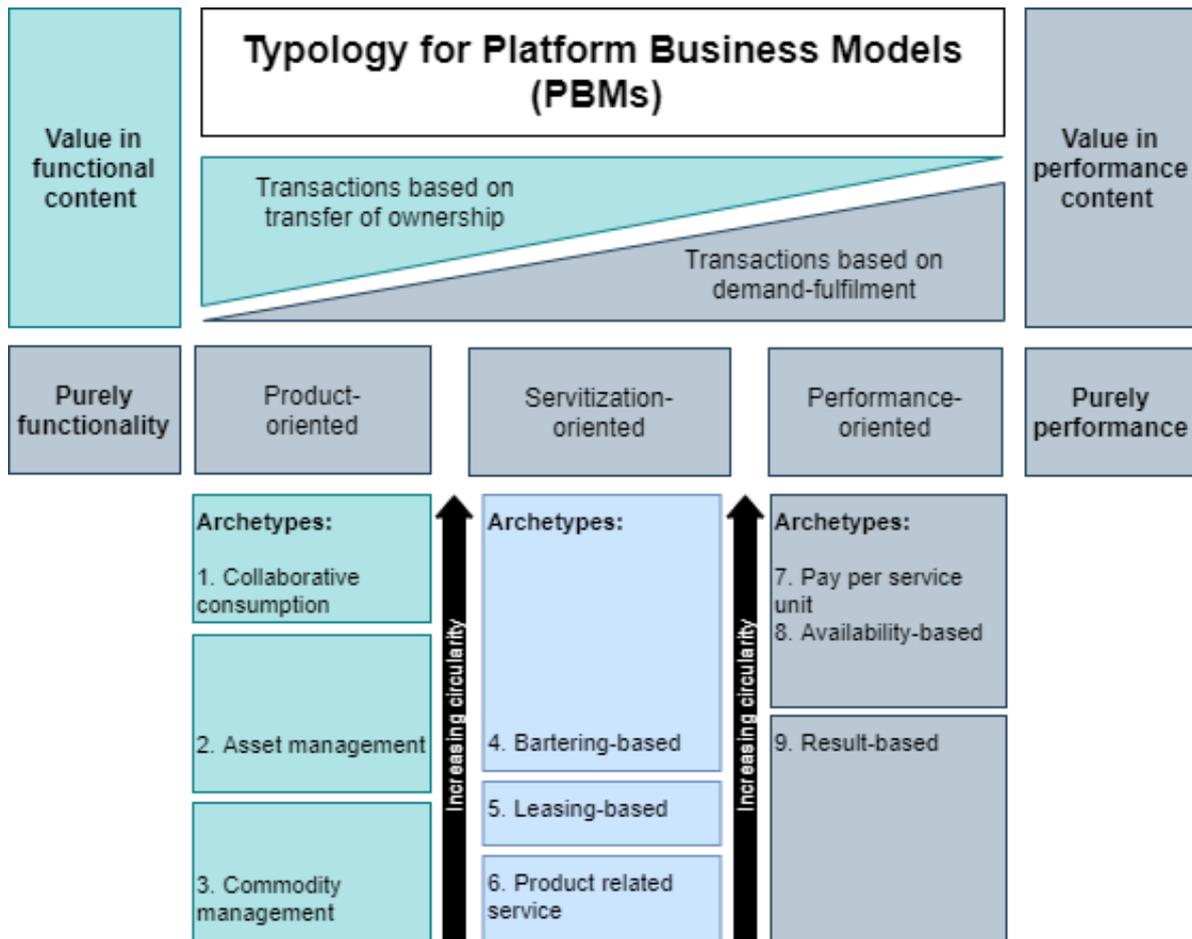


Figure 4 Final typology of platform business models

Source: adapted from Tukker (2004)

The PBM typology in figure 4 can be interpreted as follows: Each archetype has value orientation that is leaning towards functional content, performance content, or a mix in between both. PBMs that lean towards more functionality are classified as product-oriented PBMs. On the other side, PBMs leaning towards performance are classified as performance-oriented PBMs. Between these two classifications one can find servitization-oriented PBMs. Clustering based on transaction type and content can be either based on transfer of ownership or based on demand-fulfilment. All PBM archetypes are explained in the next section below.

1. Collaborative consumption PBMs pursue renting, sharing and/or pooling business models built around collaborative consumption. Providers of this PBM facilitate users to collaboratively access products and/or services while participating in renting, sharing, or pooling. PBMs from this archetype facilitate users coordinating the acquisition and distribution of a resource for a fee or other compensation (Belk, 2014), by offering an open marketplace for the temporary usage of goods or services (Stokes et al., 2014).

2. Asset management PBMs pursue exchanging business models built around exploiting excess or idle resources. Platforms from this archetype match the demand and supply side for assets coming from various industries (Lacy & Rutqvist, 2016). The providers of this business model facilitate economic transactions among its users that enable reuse of existing assets, therefore reducing the amount of existing assets needed to perform the same amount of business tasks.

3. Commodity management PBMs facilitate sharing practices that optimize exploitation of resources and assets that are considered as excess commodities or waste. These types of PBMs aim to reinstate waste as a valuable resource. Commodity management PBMs facilitate a model that adopts a sustainable approach to asset management that guarantees the most efficient internal procurement, re-use, refurbishment and re-sale of goods and materials and decreases the amount of raw materials needed for businesses to complete their business activities, thereby decreasing overall waste (Lewandowski, 2016). Recycled materials are often derived from post-consumer or post-producer waste streams and are considered secondary materials, because they frequently lose function in the original use case and can be re-applied anywhere (Worrell & Reuter, 2014).

4. Bartering-based PBMs facilitate sharing practices based on non-monetary transactions. The internet has contributed to the growth of older forms of non-monetary sharing on a larger scale in the form of bartering, the most primitive version of market exchange (Belk, 2014). From prehistoric times, barter systems have existed and shaped society. Bartering-based PBMs depends on reciprocity and permanent transfer of ownership where there is no monetary exchange involved. Throughout such exchanges, giver-receiver relationships are usually based on reciprocal trust and empathy (Gyimóthy & Dredge, 2017).

5. Leasing-based PBMs pursue business models built around offering leasing contracts to its users. This business model has close resemblance to the business model of renting/sharing/pooling, however, leasing-based PBMs are deliberately placed in a separate category. Product leasing is similar to renting/sharing/pooling in the sense of the provider holding ownership. However, unlike renting/sharing/pooling, consumers that participate in leasing do have unlimited access to the product (Tukker, 2004). Providers offering leasing-based business models oftentimes offer a ‘complete-package’ approach, wherein repairs and maintenance are included during the leasing period, guaranteeing optimal longevity of products.

6. Product related service PBMs are business models built around the product-service systems (PSS) concept. The providers of this business model strive to optimize efficiency of their products by offering them to their users, while remaining ownership over the offered products. Instead of aiming for the sale of maximum numbers of products possible, the model focuses on need fulfillment systems (Tukker,

2015). Consequently, companies using the product related service PBMs are stimulated to invest heavily in the production and reuse of goods and products they offer (Mont & Tukker, 2006).

7. Pay per service unit PBMs are the most basic form of service offering, in which revenue is generated based upon the number of units that is consumed. Revenue is only generated during the actual use of the service and can be measured in units relating to the scale of use, or a mixture of units, dependent on the platform's industry (Van Ostaeyen et al., 2013).

8. Availability-based PBMs ensure that revenue is passed from the consumer to the provider related to the time during which the product or service is available to the consumer, regardless of how often or actively they are being used in that time period. For a service, this results in a set recurring payment to be charged for which the company agrees to deliver the service to the consumer whenever demanded. For products, this is typically in the form of a monthly rent or lease charge (Van Ostaeyen et al., 2013).

9. Result-based PBMs ensure that revenue is generated based upon the service's or product performance. Performance in these business models is considered as demand fulfillment-oriented performance: revenue is created according to subjective functional performance based on how well a consumer need is satisfied. Performance has different levels of abstraction, therefore the way revenue is generated in the business model is usually unique to the platform (Van Ostaeyen et al., 2013).

6.4 Concluding remarks

To answer the main research question, "*What does a typology of platform business models look like?*", a set of three concluding remarks can be mentioned. First of all, platform business models share one thing in common, since they do not make the goods offered on their platform, nor conduct the operation on their website or app. Rather, these businesses bring together the supply and demand sides of a market. The organizations serve as a forum or marketplace that link users to each other. The uniqueness and strength of PBMs lies in their use of idle capacity and assets, since PBMs find and facilitate ways to utilize idle capacity more efficiently and effectively.

Secondly, the typology of PBMs (presented in the previous paragraph) is built along the lines of four dimensions, consisting of: value content, value orientation, clustering based on transaction type and clustering based on content. Starting with the dimension of transaction content, PBMs can be either product-oriented or performance-oriented, which indicate that they facilitate transactions consisting of either products or services. PBMs leaning towards product-oriented contents are classified as facilitators of 'purely functionality', while PBMs leaning towards performance are classified as facilitators of 'purely performance'. However, platforms also appear in between these ends of the spectrum, following a servitization-oriented transaction content, which is a mix between product and performance-oriented contents. The dimension of transaction content therefore forms the three primary categories for the

classification of PBMs. The orientation of PBMs towards purely functionality and/or purely performance indicate the dimension of value orientation of the business model. Value orientation refers to the type of content wherein value is generated. PBMs purely based on functionality allow for value creation in the functional content, while PBMs purely based on performance allow generation of value in the performance content. Continuing with the dimension of transaction type, two contradicting ends of the spectrum can be identified. Since platforms offer either products or performance-oriented contents, their transaction type is focused on that specific content. Therefore, platforms either facilitate transactions based on transferring ownership (in the form of products) or based on demand-fulfilment (in the form of performance-oriented services).

Third and lastly, nine archetypes of PBMs were established, namely: Collaborative consumption PBMs, Asset management PBMs, Commodity management PBMs, Product related service PBMs, Leasing-based PBMs, Bartering-based PBMs, Pay per service unit PBMs, Result-based PBMs, Availability-based PBMs. As a result of the typology development process, the final typology on platform business models is proposed based on theoretical underpinnings and illustrative empirical insights.

To arrive at an answer for the sub question of this research “*To what degree do platform business models contribute to sustainability?*”, this thesis narrowed down the scope of sustainability contributions to solely environmental sustainability. Sustainability with respect to PBMs is about fulfilling demands with reduced use of resources, material, and emissions. Sustainability depends on whether actors can be less material intensive. PBMs can contribute to sustainability when properly set up, which is the case when the business models are able to produce economic value while contributing to environmental sustainability at the same time. Each archetype from the established PBM typology has their own distinct way and degree of contributing to environmental sustainability. From the nine archetypes that are identified, the following R-strategies are employed by the identified archetypes derived from the final PBM typology:

1. **Collaborative consumption PBMs:** Rethink (R1)
2. **Asset management PBMs:** Rethink (R1), reduce (R2), reuse (R3)
3. **Commodity management PBMs:** Reuse (R3), remanufacture (R6), repurpose (R7), recycle (R8)
4. **Bartering-based PBMs:** Rethink (R1), reuse (R3)
5. **Leasing-based PBMs:** Reuse (R3), repair (R4), remanufacture (R6), recycle (R8)
6. **Product related service PBMs:** Repair (R4), refurbish (R5), remanufacture (R6), repurpose (R7), recycle (R8)
7. **Pay per service unit PBMs:** Rethink (R1)
8. **Availability-based PBMs:** Rethink (R1)
9. **Result-based PBMs:** Reduce (R2)

The 9R strategies form a hierarchy in the level of environmental sustainability performance by each business model strategy. The hierarchy of the 9R strategies in the framework corresponds to varying degrees of resource value retention. The highest strategy in the framework (R0: refuse) corresponds to the highest levels of value retention, while the lowest strategy in the framework (R9: recover) corresponds to the lowest levels of value retention. The following hierarchy in contributions to environmental sustainability can be concluded about PBMs contributing to sustainability (table 10).

Table 10 Conclusion: hierarchy of platform business model contributions to sustainability

9R strategy hierarchy	PBM archetype	Average R-score
#1	Collaborative consumption PBMs, pay per service unit PBMs, availability-based PBMs	1
#2	Asset management PBMs, bartering-based PBMs, result-based PBMs	2
#3	Leasing-based PBMs	5.25
#4	Commodity management PBMs, product related service PBMs	6

In conclusion, the archetypes of collaborative consumption PBMs, pay per service unit PBMs and availability PBMs have the greatest contribution to sustainability of the nine identified archetypes in the PBM typology, since they score the highest on the 9R framework hierarchy (Kirchherr et al., 2017). These highest ranked PBMs all employ the ‘rethink’ R-strategy, which is proven to offer the highest levels of circularity according to the 9R framework. The ‘rethink’ strategy is about making product use more intensive (typically by facilitating sharing practices), resulting in smarter product use and manufacturing.

The degree to which each archetype contributes to sustainability is also visualized on the bottom of the final PBM typology (presented in the previous paragraph). PBMs with higher contributions to environmental sustainability have been placed at a higher position in the archetypes section of the model.

6.5 Reflective Criticism and Limitations

This thesis has used three key theoretical perspectives in the process towards development of a typology for PBMs. These key theoretical perspectives consist of that of product-service systems, value orientation and the operationalization of sustainability. Some limitations concerning the execution of this research are worth noting, based on theoretical as well as methodological approaches.

First of all, with respect to the chosen theory foundation of product service systems by Tukker (2004), the main weakness with this theory is that the predominant classification of PSS into product-, use- and

result-oriented types fails to grasp the complexities of PSS business models encountered in practice. It tends to confuse use-oriented logic with the transfer of ownership, and it fails to differentiate between the dimensions of availability and use. Furthermore, it does not distinguish between functional results on different abstract levels. While Tukker's typology is frequently cited among scholars and generally considered to reflect the PSS viewpoints most accurately, it does not identify specific individual business models. In addition, and in order to shed light onto contributions to sustainability, business model typologies should take the consumer (demander) into consideration as well as benefits for the producer (supplier) in addition to the impacts to the environment. Therefore, a proper business model typology is not distinguished by a singular focus on economic values. Additionally, choosing Tukker's typology as a foundation has been a deliberate methodological decision for the final typology development. Choosing a different theoretical foundation for typology development, such as the 'supplier, tailor facilitator' framework proposed by Kim and Min (2019), would have yielded different results. This model analyzes characteristics of business models according to value streams based on six categories: normal value stream, reverse (flow) value stream, value creation, value co-creation, direct network effects, and indirect network effects. Although theory by Kim and Min (2019) was initially used for the literature study of this research, little of its elements were used in the development process of the final typology. Using a theoretical foundation of that of Kim and Min (2019) would have resulted in a typology leaning more towards the nature of value creation, while the typology from this research is more leaning towards value orientation, transaction type and transaction contents of PBMs.

Next, some limitations are worth nothing with respect to the chosen methodology and research design. First of all, regarding the illustrative case analysis. Since the illustrative cases of this research are not based on direct interviews and thorough case studies, there is a possibility that not all aspects of the observed PBMs are captured. For that reason, this thesis does not offer empirical justifications, but instead illustrative examples of the way the typology operates in practice. In addition, instead of using secondary data, primary data could have been gathered. A research design using semi-structured interviews with organizations would have resulted in more structured data to analyze PBM cases. Due to these limitations, it is impossible to test the validity of the typology since it lacks objective proof. Furthermore, with respect to the illustrative case analysis, the selection of illustrative cases is determined by setting up a longlist of cases is created based on a set of criteria. However, the selection procedure, while following a set of criteria, has been somewhat arbitrary. Cases were selected using index websites and some cases that were encountered along the way of the literature study were also included. A selection of nine illustrative cases coming from the various industries were selected. This arbitrary selection procedure could pose limitations as opposed to a more systematic selection approach typically seen in more traditional case studies. Another limitation to the study was the number of cases to be examined for the analysis in the time allocated. Since there were 9 cases consisting of large amounts of information, it was not possible to fully analyze each case in-depth.

Next, reflective criticism on the proposed typology is described. This section reflects on possible limitations resulting from the development process of the typology. A first limitation of this typology is on the notion of mutual exclusivity. In some cases, during PBM classification, overlap of multiple archetypes could occur. Since the case in question could be operating in a grey area between two classifications, the classifications of the typology might not always be mutually exclusive. For instance, the archetypes of asset management and commodity management tend to have overlap in their classifications. Even though this is the case, the split between these archetypes is by design. Whereas the commodities offered on commodity management platforms could also be interpreted as (idle) assets for asset management platforms, the analysis phase of this research proven a clear distinction for platforms specializing in the optimization of the use of commodities and waste. Moreover, asset management platforms focus on those assets that can be used more optimally but are used to some degree either way. Commodity and waste focused platforms focus on those assets that are considered as having no use whatsoever. Therefore, commodity management is deliberately placed in its own unique archetype within the typology.

The typology presents a total of nine archetypes which are based on the following general definition: PBMs do not make the goods offered on the platform, nor conduct the operation on their website or app. Rather, these businesses put together the supply and demand side of a market. The organization serve as a forum or marketplace that link users to each other. PBMs thrive in their use of idle capacity and assets, since PBMs find and facilitate ways to utilize idle capacity more efficiently and effectively. Furthermore, do they enable transactions and facilitate multiple value creation. For the classification proposed in this research, only PBMs are included that address these three key characteristics. However, the notion can be made that there could exist additional PBM archetypes on top of the ones proposed in this typology. Since the three key characteristics on PBMs have been a boundary condition for identifying PBMs that contribute to environmental sustainability, the deliberate choice was made to only include the nine archetypes presented in the final typology.

Additionally, the decision was made to base the typology on the presented dimensions in the typology. It is likely that additional dimensions are applicable for the presented set of PBMs, which means the classification could be approached from a different perspective when taking other dimensions into account. Therefore, the final typology could have turned out different if other theoretical perspectives and concepts were applied in the development process.

Lastly, some limitations regarding answering the sub question of this research are worth mentioning. First of all, the decision was made for the scope of this research that the concept 'sustainability' is narrowed down to environmental sustainability. This limits the research since sustainability is a broader concept and the decision leaves out implications for social and economic sustainability. Moreover, in relation to the established definition of PBMs, their ability for valorization of idle capacity and assets is a characterization strongly connected to the definition. However, as the illustrative case analysis demonstrates, there are also varieties of PBMs that do not take advantage of facilitating the valorization

of idle capacities, leaving it somewhat questionable that all PBMs within the proposed typology are contributing towards optimizing idle capacity and therefore sustainability.

Secondly, with respect to the used methodology in the analysis phase and the goal to shed light onto the contributions of PBMs to sustainability: For the analysis phase the choice was made to use the 9R framework by Kirchherr et al. (2017) as a data analysis method. While the 9R framework is deemed as highly suitable for measuring contributions towards a more circular economy by PBMs, other theories might be applicable and suitable for the analysis as well. Moreover, the use of the 9R framework, while being suitable for capturing circularity contributions, might fail to grasp the full spectrum of sustainability contributions provided by PBMs. In addition, the 9R framework turned out to be unsuitable for analyzing illustrative case 5: Fiverr. A PBM that solely focuses on facilitating digital services in the form of freelance labor did not fit the product and material focused orientation proposed by the 9R framework, which therefore poses limitations to the illustrative case analysis phase of this study. Discussions around circularity focus mostly on environmental quality and these same discussions are done from an environmental impact perspective (Geissdoerfer et al., 2017; Lieder & Rashid, 2016). Since this research has narrowed sustainability statements down to environmental sustainability, the operationalized sustainability statements coming forward are aimed at environmental impacts. Circularity focuses on PBM resource cycles, while sustainability is more broadly related to the triple bottom line of environmental, social and economic sustainability. Therefore, analyzing the illustrative cases according to a different framework could yield different results. Another methodological consideration would have been to use the Data Envelopment Analysis (DEA) for measuring sustainability performance by Charnes, Cooper, and Rhodes (1978) to analyze the illustrative cases. Their research provides a framework for assessing sustainability under various scenarios. Such scenarios reflect their individual importance in relation to the three dimensions from the TBL of Elkington (1998) for sustainability. This framework could have provided more insight into PBMs' contributions towards the broader spectrum of sustainability.

Because of these limitations, the sustainability statements defined in this thesis cannot be applied throughout the entire PBM ecosystem, since each business model is distinct and has particular features that affect whether and to what degree the model fulfills to the ecosystem's sustainability potential. The PBM typology described helps to distinguish between the models and to differentiate various trends. Due to these limitations, lack of understanding of the true contribution towards sustainability of each identified platform business model is a limitation linked to this study. Therefore, hypotheses on the effectiveness of sustainability performance for PBMs are not adequately backed by objective and representative indicators.

6.6 Contributions of this Research

The established typology contributes to research on the topics of sustainability, business models for sustainability and platform business models by further defining dimensions and concepts of platform-

related literature. Thus, it strengthens the connection between the research bodies listed above. The conceptualization of PBMs contributes to understanding possible pathways and circumstances required for the further diffusion of the idea of PBMs, ultimately aiding the spread of sustainable business model developments in theory and practice. Companies and start-ups seeking to adopt a PBM can utilize the results from this research as inspiration in their incubation phase when on a pathway for building a business model contributing towards sustainability. Furthermore, policymakers benefit from the proposed classification of PBMs, since the results of this research allows for an improved channeling of policy intervention efforts, as it assists in addressing actors of the PBM ecosystem, as well as their respective needs. Lastly, this research provided insight into the diverging ways different PBMs contribute to sustainability. The nine proposed archetypes were ranked according to the 9R framework, providing deeper understanding in the employed R-strategies per PBM archetype, and the levels of circularity these R-strategies can achieve.

6.7 Suggestions for future Research

The proposed research towards a typology of platform business models has encountered some suggestions for future research. A comparative overview of the various PBM archetypes covered in this study may be suggested for further studies on this topic. To gain a more structured insight into these differences, a deeper qualitative analysis is required. Therefore, the dominant objective review of cases used in this study needs to be enriched in the form of a thorough multiple case study including semi-structured interviews. A case study consisting of a larger set of cases would enrich the findings from this paper, since each archetype proposed in this study is only based on one case. Additionally, an expansion of data collection based on different dimensions than those that are proposed in this study would lead to a more refined overview of diverging characteristics of PBMs. Moreover, more empirical data would aid to test the validity of the proposed typology by offering actual empirical evidence, as opposed to solely illustrative examples. Future research could contribute to advise policy makers and investors in the field of sustainability for making more informed decisions towards moving sustainability forward. Lastly, further research on the more ‘darker side’ of platforms is a clear suggestion for future research. This study has predominantly focused on environmentally sustainable PBMs. Nevertheless, as Schor (2016, p. 12) puts it: “technologies are only as good as the political and social context in which they are employed”. The premises of the PBM ecosystem provide powerful tools for building a society for sustainable consumption. Nonetheless, whether all platforms business models in the ecosystem will trigger a movement to take advantage of that power is still unclear. Since there could be platforms within the ecosystem taking advantage of the sustainable movements surrounding platform organizations with sustainable intentions, additional research on the negative aspects of certain PBMs could be of interest.

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List of figures

Figure 1 Main and subcategories of product-service systems..... 18
Figure 2 Platform orientation accordance with the value stream. 21
Figure 3 Typology framework of platforms 25
Figure 4 Final typology of platform business models 52

List of tables

Table 1 Platform business models: Market orientation vs market structure 22
Table 2 Platform business models: marketplace participants..... 23
Table 3 Dimensions of the preliminary platform business model typology framework 24
Table 4 Overview of PSS types..... 35
Table 5 The 9R framework for operationalizing sustainability for PBMs 36
Table 6 Product-oriented platform business models 46
Table 7 Servitization-oriented platform business models 46
Table 8 performance-oriented platform business models..... 47
Table 9 Hierarchy of platform business model's contribution to sustainability 47
Table 10 Conclusion: hierarchy of platform business model contributions to sustainability..... 56

Appendix A: Requirement form for longlist of cases

#	Requirement/ question about case	Answer: YES	Answer: NO
1	Does the company (case) serve as a forum or marketplace that links users to each other?		
2	Does the company (case) create value to its stakeholders by facilitating the process of exchange between at least two participants, namely the demanding and supplying party of a certain product or service?		
3	Does the company (case) not make their own goods, nor conduct the operation on their platform?		
4	Does the company (case) facilitate ways to utilize underused or idle capacity more efficiently and effectively?		
5	Does the business model of the company (case) follow a network-centric perspective which implies engagement in a continuously evolving ecosystem of individuals and companies?		
6	Does the business model of the company (case) strive for multiple value creation?		
7	Does the available case information consist of sufficient amounts of secondary research material?		

Appendix B: List of cases

List of index websites:

Index	Website
Justpark	https://www.justpark.com/creative/sharing-economy-index/
Angel	https://angel.co/all-markets
Wrap	http://www.wrap.org.uk/resource-efficient-business-models/innovative-business-models

List of illustrative cases for platform business models:

Platform name	Industry and contents	Website
Bobtrade	Construction, material	https://company.bobtrade.com/
Bookmooch	Books	http://bookmooch.com/
De Kringwinkel	Second hand goods, thrift store	https://www.dekringwinkel.be/
Excess Material Exchange	Construction, material, secondary raw material	https://excessmaterialsexchange.com/
Fiverr	Labor marketplace	https://www.fiverr.com/
FLOOW2	B2B sharing	https://www.floow2.com/
Hello Tractor	Farming equipment	https://hellotractor.com/
Industriepark Kleefse Waard	Company property	https://www.ipkw.nl/
Insert	Construction, material	https://www.insert.nl/
Klarx	Construction Equipment	https://www.klarx.de/en
Madaster	Construction, material data	https://www.madaster.com/en
Material-exchange	Construction, material	https://material-exchange.com/
MUD Jeans	Jeans	https://mudjeans.eu/
New Horizon	Urban mining	https://newhorizon.nl/
Oregon Recyclers	Construction, material	https://oregonrecyclers.org/resources/additional-materials-exchanges
Partners in project green	Construction, material	https://partnersinprojectgreen.com/your-needs/waste-management/material-exchange/
PTC	Construction, material	https://www.ptc.com/en/industries/retail/material-exchange

Recytrader	Construction, waste and secondary raw material	https://recytrader.com/
Smartbeam	Budget management	https://www.smartbeam.co/en/
Snappcar	Mobility	https://www.snappcar.nl/
Textile Exchange	Construction, fibres	https://textileexchange.org/materials/
USBCSD	Construction, material	https://usbcd.org/materials
Werfink	Construction, material, secondary raw material	https://www.werflink.com/en-werflink.html
Zipcar	Mobility	https://www.zipcar.com/

Appendix C: Illustrative case company profiles

Case 1: FLOW2

FLOW2 “World's Reset Button” (hosted on <https://www.flow2.com/>) is an initiative of Dutch entrepreneurs, based in Luxembourg and launched in May 2012. FLOW2 is a sharing platform on which companies, organizations and institutions worldwide from every sector can temporarily rent equipment, services and employees. or seconding to fellow companies, also possible within a trusted community of companies via a private sharing platform (FLOW2 Community).

FLOW2 is a network organization of independent entrepreneurs and about twenty-five international cooperation partners, who carry out sales, marketing and communication activities. FLOW2's revenue model is based on a subscription fee, which companies pay to place an x number of advertisements on the platform online.

Case 2: Zipcar

Zipcar is a platform with a mission to enable simple and responsible urban living—a future filled with more car-sharing members than car owners in major cities across the globe. Zipcar aims to achieve their mission by delivering on-demand vehicles that support environmental sustainability; helping members save time, hassle and money in their everyday transportation; freeing up city space through strategies that consider campus, urban, residential, commercial and city planning needs and becoming a premier employer for talented, passionate people who thrive on changing the world for good.

Case 3: Excess Material Exchange

Excess Materials Exchange (EME) (hosted on <https://excessmaterialsexchange.com/>) facilitates the transition to a circular economy by aiming to reinstate waste as a valuable resource. The EME is a facilitated, digital marketplace where companies can exchange any type of excess materials (materials, components, products) business to business (B2B). This ranges from, for example, textiles, to plastics and organic materials. EME actively matches supply and demand, and materials with their highest-value reuse potential. This helps businesses turn waste into wealth while contributing to the realization of a circular economy (Excess Materials Exchange, 2019). Their value proposition is as followed:

- Increased high-value reuse and recycling of materials and products
- Turning a cost into a revenue stream (waste into wealth)
- Help achieve sustainability goals
- Extensive knowledge and network of the circular economy and business models
- Facilitation of circular alternatives by active matchmaking, including legal, financial and accounting support
- Helping companies position themselves as a front-runner in the circular economy by providing materials with an identity

Case 4: Snappcar

SnappCar, founded in 2011, offers a full-service car sharing system, from matching vehicles and drivers to payment and insurance. The company's mission is to reduce the total number of cars in Europe by sharing already owned vehicles. SnappCar offers a transport option that is affordable for the general public. Currently SnappCar operates in The Netherlands, Sweden and Denmark.

Case 5: Fiverr

Fiverr (hosted on <https://www.fiverr.com/>) is a global, online freelancing platform that hosts virtual jobs such as website design, programming and video production. The platform, founded in 2009, let workers advertise jobs they are willing to do starting at a cost of 5 dollar per job completed. Fiverr distinguishes itself from other platforms by only promoting virtual tasks which can be carried out entirely online. The platform reported more than three million tasks in 2015. Fiverr's mission is to grow and cultivate the world's largest digital marketplace, a place where people can find and purchase any service they need, and build any business they dream.

Fiverr facilitates work offerings in the following categories: Graphics & Design, Digital Marketing, Writing & Translation, Video & Animation, Music & Audio, Programming & Tech, Business, Lifestyle, (Other) Industries

Case 6: Bookmooch

BookMooch is an international, on-line book exchange community, with over 74,000 users in over 90 countries and the platform is open to anyone and is free.

BookMooch allows its users to exchange books using a points system. Members earn points by adding books to their inventories, sending books to other members and providing feedback when the books are received. Then, the points won will be used to "order" other members books. Point exchange takes place at the start of any transaction, allowing rapid circulation of the "currency." Members may opt only on request to send books within their own country, worldwide or worldwide.

Case 7: De Kringwinkel

De Kringwinkel is a partnership of companies that creates sustainable added value with second-hand goods. Thrift shops work together on a strong thrift store sector with recognizable, high-quality services for a wide audience with affordable products. De Kringwinkel presents itself as a strong and professional sector with uniform communication and corporate identity.

The Thrift Stores are excellent thrift centres that distinguish themselves by meeting the standards they set for themselves. The pursuit of quality encompasses all facets of the organization. De Kringwinkel stands for corporate social responsibility and supporting the Kringwinkel in their daily operations and in making decisions.

Case 8: MUD Jeans

MUD Jeans is a sustainable and fair trade certified denim brand based in The Netherlands. MUD Jeans fulfills principles of the circular economy. The MUD Jeans are made of 40% recycled content and the material is derived from discarded jeans. The company's main business concept is to rent out its clothing to consumers. Consumers can switch them to another pair after the one-year lease period and continue leasing, return them for recycling or upcycling purposes or retain them. The lease contract includes free unlimited repair services. This concept is known as Lease A Jeans and launched in 2013. MUD Jeans sells the products online and is available in a limited number of globally sustainable concept stores.

Case 9: Hello Tractor

Hello Tractor is a platform which aims to make the contracting of tractors competitive and more efficient for farmers. The systems use automation and analytics to improve decision taking, accountability, and effectiveness. The Hello Tractor platform allows farmers to request inputs of affordable equipment, while providing tractor owners with increased security through remote tracking of assets and virtual monitoring. This interest spreads over the mechanization environment to all stakeholders.

Hello Tractor focuses on connecting tractor owners and smallholder farmers through a sharing application of farm equipment. Over the years, the organization has emerged as the leading supplier of tractor services technology solutions, catching 75% of private commercial tractor inflows to Nigeria, growing to a total of 16 markets across the continent and touching well over 500,000 smallholder farmers.