An explorative study on business models for sustainability using STOF and stress-testing

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Acknowledgement

When I started my Bachelor electrical engineering, I would never have guessed graduating on the topic of business models for sustainability. During my years of studying to become an electrical engineer I found out that renewable energy and sustainable practices interested me. However, at the same time the realization came that I did not wanted to become and engineer. Technology interested me on a whole different level, and that's how I ended up at the TPM faculty of TU Delft in September 2014.
It was during a course given by Jaco Quist in the third semester, where the focus of my thesis began to take form. It was in that course where I made the connection between business models and sustainability. In the months that followed I started putting my ideas to paper in my first research proposal.
Working on the thesis has been a long and at times difficult process. A process that not only requires commitment but also persistence. The dependency upon external parties to give an interview and participate in a stress-workshop, was frustrating at times. Nonetheless, I would like to thank who gave me the privilege of conducting an interview with them, and who participated in the workshop.

Yet first of all, I would like to thank Prof. Dr. Harry Bouwman for guiding me in the process of writing my thesis and helping me translate my ideas into what has resulted in this thesis. Furthermore, I would like to thank Jaco Quist for his support and opening his office for a discussion.
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In writing this thesis I realized that it are not only the many hours spent working that resulted in this thesis. But equally important are the people who support you when you are not working, therefore I am very grateful for the support and understanding I received from my family. I also would like to thank Sourabh Sharma, who was always opened his house to me whenever I needed a respite. Special thanks goes out to Anuja Naiknavare who understands the struggles that come with writing a thesis and supported me especially in the stressful times before the interviews and workshop and greenlight.

Nico van Ginkel
1-11-2016

Executive summary

The concept of sustainability is often explained in relation to the pillars of the triple bottom line; these are People, Profit and Planet. There has to be found a balance between these three pillars for a business to be sustainable. Sustainability in companies is often approached through corporate social responsibility (CSR), programmes. However, these programmes do not stimulate sustainable practices in themselves. Sustainable products, might help reduce waste or emissions, but if the business model is still geared towards selling as much products as possible one cannot consider this business as being sustainable.

Business models are concerned with economic value creation and capturing, with the focus on meeting customer demands. These aspects can also be found in many business model frameworks. However, these frameworks do not explicitly incorporate sustainability aspects. Firms play an important role in achieving sustainability developments, but mostly adopt a new business approach based on the profitability they foresee (i.e. economic sustainability). Business models therefore need rethinking as to move towards sustainable business models. As such business model that does incorporate social and environmental priorities can be called a business model for sustainability.

There are already companies that have made this move, but is important to know what constitutes such business models. What helps in achieving a viable business model and how can this be incorporated when designing a business model. In other words what are success factors contributing to a viable business model and what are critical design issues for companies to achieve this.

The objective of this research is therefore to develop a business model framework that describes business models for sustainability and can be used to identify critical design issues for a viable business model for sustainability.
The research starts with the literature study as to identify what aspects play a role in business models for sustainability.
Aspects found from the literature are the following: (1) Environmental value (2) social value (3) added value for stakeholders outside the value chain (4) Financial model that provides insight (5) Negative value (6) Having a sustainability strategy (7) Having sustainability leader(s) in the firm (8) Shared cost for investment in sustainable infrastructure (9) Motivate customers to take action and/or responsibility.

Based on these findings a suitable business model framework was identified to express business models for sustainability. To this purpose the STOF business model ontology was selected. Relevant aspects have been included in the STOF ontology which resulted in an adapted STOF model where sustainability aspects are explicitly incorporated. Environmental and social value, have been added as business model element to the service domain(S). Negative value(reduction) has been added to the technology domain(T), added value for stakeholders outside the value chain has been added to the organization domain(O), and shared investments and environmental and social risk have been added under the business model elements Investments and Risks in the financial domain(F), respectively. The other aspects were considered to be generic, and have been separately considered in the research.

To validate these findings a case study has been performed on four companies i.e. Qurrent, VandeBron, MyWheels and Greenwheels. In this cross case comparison explicit attention has been paid to the aspects found in literature and all aspects have been found back across the cases.

Following the case study a stress testing workshop has been performed. Firstly to identify success factors for business models for sustainability as considered by practitioners. And secondly to derive critical design issues based on the insight from the stress testing exercise. This stress testing exercise revolves around the question what business model elements contribute positively to the success factor. In this research the focus has been placed on the aspects added to the STOF ontology.
From the success factors derived during the workshop together with the previous findings from literature, a set of four success factors has been selected, i.e. Value/supply chain arrangement, Accountability/transparency, Intrinsic motivation and Joint initiatives.

The positive impact of business model elements on these success factors has been tested by means of the business model of, one of the cases from the case study. These results have been displayed in a so called heatmap. It was found that the business model elements overall contribute positively to Value/supply chain arrangement, accountability and intrinsic motivation. No negative impact on one of the factors has been identified, but rather a neutral effect meaning that these business model elements do not contribute to these success factors. The success factor joint initiative is not positively influenced by any business model element, but there is room for improvement. This means this success factor has not been found in the business model of VandeBron, but could be implemented. Based on the insights from the stress testing workshop the following four critical design issues have been derived, (1) transparency, (2) selection criteria for target group and technology, (3) approachability and (4) customer equality.
These critical design issues should be taken into account when working towards or a business model for sustainability. However, these critical design issues have been derived based on the stress test of one business model and further research e.g. more stress test workshops, will have to be performed in order to arrive at a generalizable set of critical design factors.

In conclusion the research has yielded an adapted STOF model suitable for describing/analyzing business models for sustainability. Success factors for business models for sustainability have been identified through various approaches and critical design issues have been derived from the workshop results. The results of this research can be helpful for business developers that wish to move develop or change a business model as to move towards a business model for sustainability.

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Chapter 1 Introduction

1.1. Background

There is an increasing awareness in society that sustainability deserves serious attention and Governing parties are pressing the issue. For example in 2014 the European Union adopted the Horizon 2020 programme, which is the biggest EU Research and Innovation programme till date. This programme focuses on several societal challenges that Europe is facing and this includes the sustainability challenges (European commission., 2015b; Teece, 2010). Next to focus on efficiency, reduction of CO_2 emissions and food security, attention will be given to a transition towards a circular economy industry (European commission., 2015a).
In order to achieve this, incumbent companies as well as start-ups need to think about incorporating sustainability in their businesses approaches and this requires more than reduction of energy consumption and CO_2 emissions alone.

In 1994 John Elkington introduced the term 'triple bottom line' or the three P`s: People, Profit and Planet. The rationale behind the three P`s is that sustainability is not solely concerned with better use of the planet (i.e. CO_2 reductions and transitions to greener energy sources), but also with the People involved and Profit that needs to be made. The idea is that harmony has to be found between these three pillars and too much focus on one of the pillars will harm at least one of the others. Connecting this to a profit maximizing businesses the examples are abundant, with the extremes of the exploitation of low wage countries and destruction of nature for the use of fossil fuels.
According to Nidumolu et al (2009) companies should anticipate coming legislation that enforces their business to comply to certain sustainability standards. Anticipating this legislation can give them a competitive advantage, whereby they should focus on making the supply chain more sustainable, design sustainable products and services, developing new business models and creating next-practice platforms. Nidumolu et al (2009) thereby acknowledges the fact that conventional business approaches need serious rethinking.

Incorporation of sustainability in businesses has been achieved mostly through corporate social responsibility (CSR) programmes. CSR is concerned with the company`s responsibility towards society and the environment and is based upon frameworks like the triple bottom line. Companies thus seem to have a sense of responsibility towards society and the environment, but this does not mean companies adopt sustainability practices in their business model. As is acknowledged by Wasner & Majchrzak (2015) these frameworks are empty without proper management and compliance. These frameworks might be used for enhancing the corporate image. For example, sustainability standards as part of CSR frameworks can be used as a façade in order to gain more customers. Hereby not saying that companies do this intentionally, but it highlights that current business models and CSR programmes do not in themselves stimulate practices for sustainability.

To give an example; car producing companies that produce conventional combustion engine cars also started producing electrical or hybrid models to tap into the market place for sustainable products. These new products are marketed with the sense of being sustainable, having less CO_2 emissions or being more fuel-efficient thereby reducing the carbon footprint. However, the business model still revolves around selling as many vehicles as possible

Business models are concerned with (economic) value creation and capturing, where the focus lies at meeting customer demands and having business success at the same time (Teece, 2010). A business model that also incorporates social and environmental priorities can be called a business model for sustainability (Stubbs & Cocklin., 2008). In that sense Business models for sustainability can be seen as a step further than CSR.

1.2. Problem definition

With the rise of the internet came new business models, because conventional business models did not allow companies to capitalize on this new development. In a similar fashion, sustainable products also require a new approach towards business (Boons & Lüdeke-Freund., 2013). Moreover, business model innovation is vital for company success Chesbrough (2010).

Businesses need to react to apparent changes in their environment or their technologies or practices might become obsolete.
An example can be found in the adoption of solar technology. Adoption of this technology is going fast, in fact the amount of worldwide installed photovoltaic installations has doubled from 2009 to 2010 (Grau, Huo, & Neuhoff, 2012). Various buildings now have photovoltaic panels integrated or added to their exterior, causing them to be autonomous or even able to supply power to the grid. As Gsodam, Rauter, and Baumgartner (2015) argue for utilities in Austria; small decentralized renewable energy projects require new competencies and business models, while large scale projects pose no threat. But when photovoltaic becomes more efficient and thus economically viable, things might be different.
It is clear that business model innovation is needed when it comes to sustainability practices. But as Boons & Lüdeke-Freund. (2013) start their paper; there is a gap on the relation between sustainable innovations and business models. Interest in this field is rising, and a connection between business models and sustainable innovation is seen as a win-win situation (Boons, Montalvo, Quist, & Wagner, 2013).
However, companies cannot simply react upon changes in their environment, since they have to consider profitability of their business model as well. That is why business models need rethinking in such a way that companies find ways to create a viable business model for sustainability. Companies need to incorporate environmental and social values alongside economic values and find a way to run a profitable and sustainable business.

Still, most attention is paid to sustainable innovations and little attention is paid to the business models supporting them (Boons & Lüdeke-Freund., 2013). It is not the case that companies are not adopting different business models. In fact, Bocken et al. (2014) for example identified business models for sustainability and have given an overview of the various models in existence.
Yet, it is key to know what constitutes such business models. Another problem lies herein for companies to know what are success factors, for a business model for sustainability as to move towards a viable business model for sustainably. Where success factors are defined as factors that contribute positively to the business model viability.

1.3. Research objective and research questions

To identify what constitutes a business model for sustainability and to identify success factors for a business model for sustainability as to move to a viable business model, two goals are defined alongside the research objective.

The research objective is stated as follows:
This research aims to develop a business model framework that describes business models for sustainability and can be used to identify critical design issues for a viable business model for sustainability.

The first goal in this research is to develop a business model framework that describes business models for sustainability and the second goal is to identify critical design issues. Where critical design issues are to be taken into account when designing a viable business model for sustainability. Or more specifically: "A CDI is defined as a design variable that is perceived to be (by practitioner and/or researcher) of eminent importance to the viability of the business model under study" (Van As et al., 2012)

1.3.1. Research questions

The research objective sets the course for the research questions. One main research question has been set up and four supporting research sub questions have been developed. The sub questions will help in providing the answer to the main research question. This answer gives the direction for companies what to work on in order to move towards a viable business model for sustainability.

Main research question:

What makes a business model viable while incorporating sustainability aspects?

When it comes to business models for sustainability it might be that aspects play a role, that are not considered in conventional business models. Therefore, it is important to know what constitutes a business model for sustainability. Based on a literature study important aspects can likely be identified. This yields the first sub question.

What aspects characterize business models for sustainability, as found in literature?

Based on the first sub question an idea has been formed as to what are important aspects in business models for sustainability. It is however imperative to validate these findings. This means that these aspects should be confirmed in existing business models for sustainability. Therefore the second sub question is:

What characterizing aspects of business models for sustainability can be validated in existing business models for sustainability.

Next to identifying what characterizes a business model for sustainability this research identifies success factors. Since factors that are considered to be important for a business model for sustainability, will to a large extent determine the business models' design. It is important to identify what success factors are, that contribute to sustainability. From the literature study some factors might have been identified already, however it is important to also identify factors that companies and experts from the field consider. At the same time this allows for the validation of factors already identified from literature. This results in the third sub question.

What success factors regarding business models for sustainability do companies and experts from the field consider?

The first three sub questions allows the researcher to get an understanding as to what aspects characterize business models for sustainability and what are success factors. The next step is deriving critical design issues that can be used to move towards a viable business model for sustainability.
The question that needs answering is the following:

What Critical success factors can be derived, from these factors, to move towards a viable business model for sustainability?

1.4. Research approach

In order to answer the main research question, there needs to be made a choice in research approach. Coming up with a research strategy revolves around making at least three key decisions (Doorewaard & Verschuuren, 2010). (1) choice between breadth and depth, (2) Qualitative research versus Quantitative research, and (3) primary data versus secondary data (Doorewaard & Verschuuren, 2010).

The first decision is the choice between depth and breath. The aim of this research is to develop theoretical insight as to what aspects play a role in business models for sustainability and what contributes to business model viability in relation to sustainability.
A generalizable outcome can be achieved by using a breath research approach, however this is not the aim of this study as the study is explorative in nature. Moreover, an in depth approach does allow for more soundness and lesser uncertainty (Doorewaard & Verschuuren, 2010). Therefore an in depth approach is chosen.

The second choice is concerned with a quantitative vs. qualitative research approach. The research builds upon literature from both the field of business models as well as sustainability. There is abundant literature in both fields, however the connection between the two has not been strongly developed. As such the research is explorative in nature, which allows to create insight as to how these fields can be related. This is done by elaborating an existing business model framework, in which sustainability aspects are incorporated. This framework is used again in a case study, as to validate the findings from literature. It also allows conclusions to be drawn with respect to the second research question.

In this case study business models for sustainability are the unit of analysis. This requires in depth insight as to what constitutes the various business models. To this purpose, next to a desk research, semi-structured interviews are conducted.
The interviews allow the researcher to find information that was previously not considered in the desk research.
The research not only focuses on what constitutes a business model for sustainability, but also on what are success factors and critical design issues as to move towards a viable business model for sustainability.
To this purpose a qualitative research approach is chosen as it leaves room for the perceptions of people participating in the research as to what are success factors, and how do various business elements contribute to these success factors.

Thus this research is explorative in nature, using an in depth qualitative case study approach using both data primary and secondary data.

1.4.1. Structure of the thesis

This chapter provided the introduction to the research. The flow of the whole thesis can be found in Figure 1.1 .

Chapter 2 is concerned with the literature review, the literature is used to identify sustainability aspects and identify a suitable business model framework to express business models for sustainability. Attention is paid to literature on business models, business model ontologies and business models for sustainability. Chapter 3 is a research domain chapter that introduces the domains in which the case study takes place, these are the car sharing and energy sector. Chapter 4 is concerned with the research methodology behind this research, also the stress testing tool is explained in this chapter. Chapter 5 and 6 are the chapters that provide the results of the case study and the workshop, respectively. Chapter 5 contains a case study on four companies, together with a cross case analysis. In chapter 6 the findings from the workshop are presented. These findings involve success factors contributing to a viable business model for sustainability and the derivation of critical design issues.

At last chapter 7 discusses the findings and limitations of this research.

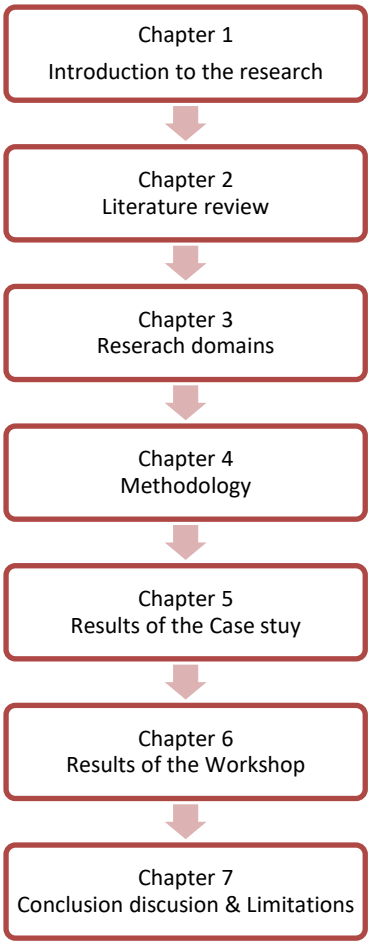


Figure 1.1: Flow of the thesis

Chapter 2 Literature review and theory

This chapter discusses relevant literature that provides a basis for this research. Attention has been paid to the following topics: Business models, Business model tooling and Business models for Sustainability.
First attention is given to business model literature in general. This literature however does not explicitly take into account sustainable aspects of a business model and focuses on the relation between business strategy, business innovation and business models. Also no business model ontologies have been developed so far as to verify and describe business models for sustainability, literature on this subject is discussed in section 2.3.
Business models and sustainability have been connected in another stream of literature, to which attention is paid in section 2.4. This is where the term Business models for sustainability is coined. Most of this literature is focusing on what constitutes a business model for sustainability.

2.1. Approach

The literature study provides necessary background and insight in aspects that are relevant for the study. Further, it will ensure that the research done is relevant and unique.
The literature study is performed in roughly three steps:

1. Literature search
2. Skimming papers and writing down keywords
3. Build a coherent story

The literature study is presented as story, that provides the basis for the research and positions the research vis à vis existing research.

2.1.1. literature search

A search for relevant papers has been done using three approaches. First based on prior knowledge relevant papers have been identified, by using snowball sampling additional literature has been identified. Secondly, key words related to the research questions have been used in search engines. Third, relevant papers from specific journals have been used also here snowball sampling has been used.

Related to the research questions the following key words have been used:

- Business model for sustainability
- Sustainable business model
- Sustainability practices
- Sustainable business model innovation
- Sustainable business model indicators
- Business strategy sustainability environmental

The results as found using web of knowledge and Scopus have been arranged based on relevance (i.e. correspondence with the search terms) and the number of references, which gives an indication of academic importance. The resulting documents have been selected upon their relevance based on, the title, the abstract and introduction. By reading the abstract and/or introduction papers could be placed into context.

2.2. Business models

Already in 1998 (Timmers) discusses business models. In his paper Timmers distinguishes between a business model and a marketing model, where the business model is given as a subset of the marketing model. The marketing model according to Timmers determines the competitive advantage built, the positioning of the firm, the product-market strategy and the marketing mix. He argues that by re-construction of the value chain various types of business models can be found.
He discusses and classifies business models in relation to internet electronic commerce. In the paper the following description of a business model is given:

- An architecture for the product, service and information flows, including a description of the various business actors and their roles
- A description of the potential benefits for the various business actors
- A description of the sources of revenues

Four years later the idea of business models was still relatively new and according to Osterwalder & Pigneur (2002) has various interpretations. Researchers try to define what a business model entails, ranging from a blueprint for business, to a tool that translates strategy into practice (Osterwalder et al, 2005; Sharma & Gutiérrez, 2010)
When it comes to business models there is plenty of literature available and one can divide this literature into various streams. Zott, Amit, and Massa (2011), have done a literature research on business model literature and from this they have identified three different silo`s within the literature; (1) e-business and the use of information technology in organizations; (2) strategic issues, such as value creation, competitive advantage, and firm performance; (3) innovation and technology management.

In the second stream, Zott and Amit have contributed with various papers. It is argued by Zott & Amit (2008) that the business model can be a source of competitive advantage, but also that value creation is not limited to the boundaries of the firm.
Chesbrough & Schwartz (2007) build upon the ideas of Timmers (1998) by saying that companies can achieve more if they engage in co-development. This requires critical review of the business models of the involved companies, such that these can be aligned properly. In this sense they are in agreement with Zott and Amit, that business models span across the boundaries of the firm.

Within the third stream one can identify amongst others Chesbrough, who adopts a business strategy perspective towards business models. In effect this literature gives recommendations for strategic management on how to approach business models.
In literature on business model innovation, Chesbrough (2007) argues that business models in their core, aim to both create value and to capture value. But more extensively a business model:

- Articulates the value proposition (i.e., the value created for users by an offering based on technology);
- Identifies a market segment and specify the revenue generation mechanism (i.e., users to whom technology is useful and for what purpose);
- Defines the structure of the value chain required to create and distribute the offering and complementary assets needed to support position in the chain;
- Details the revenue mechanism(s) by which the firm will be paid for the offering;

- Estimates the cost structure and profit potential (given value proposition and value chain structure);
- Describes the position of the firm within the value network linking suppliers and customers (incl.identifying potential complementors and competitors); and
- Formulates the competitive strategy by which the innovating firm will gain and hold advantage over rivals.

Chesbrough (2007) introduced the Business Model Framework, which orders different types of business models from basic and not very valuable to sophisticated and valuable. The aim of this tool is to identify different types of business models and to improve them by looking at attributes of other more valuable business models. It is argued that when it comes to business model innovation, there is no person directly in charge of a business model within a company. In one of his other papers, Chesbrough (2010) argues that management should be open to experiment with different business models, while at the same time keep them from competing with mainstream activities in the company. Although this appears difficult to be done and requires an organizational change, the main message is that companies must become open to experiment with different business models.
This is in line with the idea of the ambidextrous organization discussed by O`Reilly & Tushman (2004). Ambidexterity means to be able to run business as usual all the while exploring new opportunities and ways to capitalize on them.

In 2010 (Zott & Amit), elaborate on their viewpoint that business models span across the boundaries of the firm. They focus on business model design and rethinking of business models. The focus lies on themes that describe the system of activities that a firm performs.
Teece (2010) looks at business models as value creating and value capturing, and stresses the importance of adopting a business model that meets customer needs for business success, in other words adopting the business model that is able to deliver both customer as business value.

In conclusion Zott & Amit (2008) focus on the relation between business models and market strategy. Chesbrough and Teece focus on what a business model should entail and the role of management in business model innovation. This strand of literature thus focuses strongly on what a business model entails, how this relates to market strategy and what management should focus on when it comes to defining the business model. Timmers, specifically focuses on business models and marketing approaches in e-business.
Both Teece and Chesbrough, define business models as value creating and value capturing.
The value proposition that companies deliver is then largely determined by their business model. So, how products or services are delivered is connected to the business model of the company. Incorporating sustainable practices thus requires companies to rethink their current business model, or at the least be to have the ability to adjust their business model to changing demand. However with respect to the triple bottom line and business models for sustainability this part of the literature can be said to focus on economic value creation and capturing. While in the literature concerning business models for sustainability environmental value receives more or equal importance.

2.3. Business model ontologies and tools

Various business model ontologies and tools can be found in literature. The following part discusses three of such ontologies and a business model tool. Where ontologies can be

defined as, “theories about the structure and behavior of the real world in general” (Shanks, Tansley, & Weber, 2003). Or “a rigorously defined framework that provides a common understanding of a domain that can be communicated between people and heterogeneously and widely spread application systems” Fensel, 2001 as referred to by Osterwalder A and Pigneur Y (2002). First CANVAS is discussed followed by STOF, VISOR and the Value mapping tool, respectively.

CANVAS

With respect to the relation between business models and strategy, Osterwalder A and Pigneur Y (2002), see the business model as a link between business strategy and business processes. They argue that there is a need for a rigorous business model to translate strategy into business processes, for which they introduce an e-business model ontology. In their ontology they identify four related pillars (1) product innovation, (2) customer relationship, (3) Infrastructure management and (4) financials. A more general business model ontology by Osterwalder, is CANVAS. This is a business model design tool, for which Osterwalder and Pigneur (2009) describe the following application: “This concept can become a shared language that allows you to easily describe and manipulate business models to create new strategic alternatives. Without such a shared language it is difficult to systematically challenge assumptions about one’s business model and innovate successfully”. The CANVAS ontology focuses on a single firm. However, the CANVAS is a common tool and can be adequately used as a brainstorming tool and provides an overview of the nine blocks in a template as depicted in see Figure 2.1

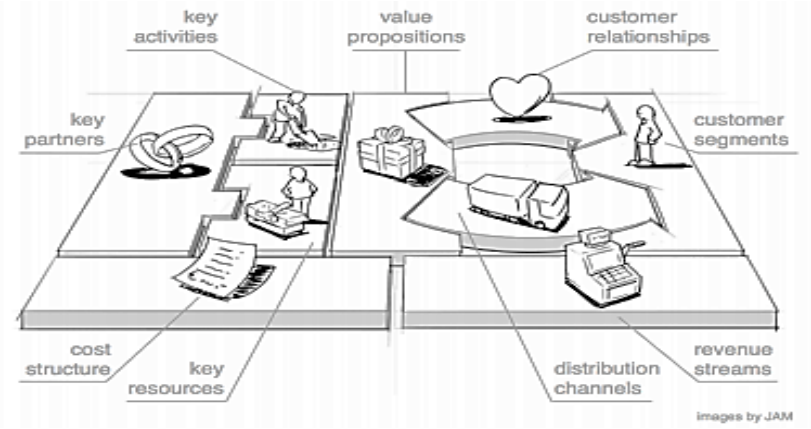


Figure 2.1 Business model CANVAS (Osterwalder & Pigneur, 2010)

STOF

Another ontology, developed by Bouwman et al. (2008) is STOF (Service, Technology, Organization, and Finance). This framework focuses on the interrelation between these four domains in service innovations, specifically in the mobile domain. In contrast to CANVAS, STOF focuses on the service instead of the individual firm (Bouwman et al., 2012).

The STOF framework addresses service innovation in relation to business models. More explicitly the STOF method has been developed as a design tool for robust business models. It is argued that service innovation requires various perspectives to be incorporated. Firstly, both consumers and service providers have to be incorporated since together they create a service. In fact they produce and consume it simultaneously. Secondly, a technological perspective is taken since technology plays an important role in opening up new opportunities for new services and has allowed services to be provided to new and larger markets. To be able to deliver the value proposition and have the

technology, companies rely on actors in their value network. All these aspects contribute to getting a revenue stream. A visual representation of the STOF model aspects and their connections has been given in Figure 2.2

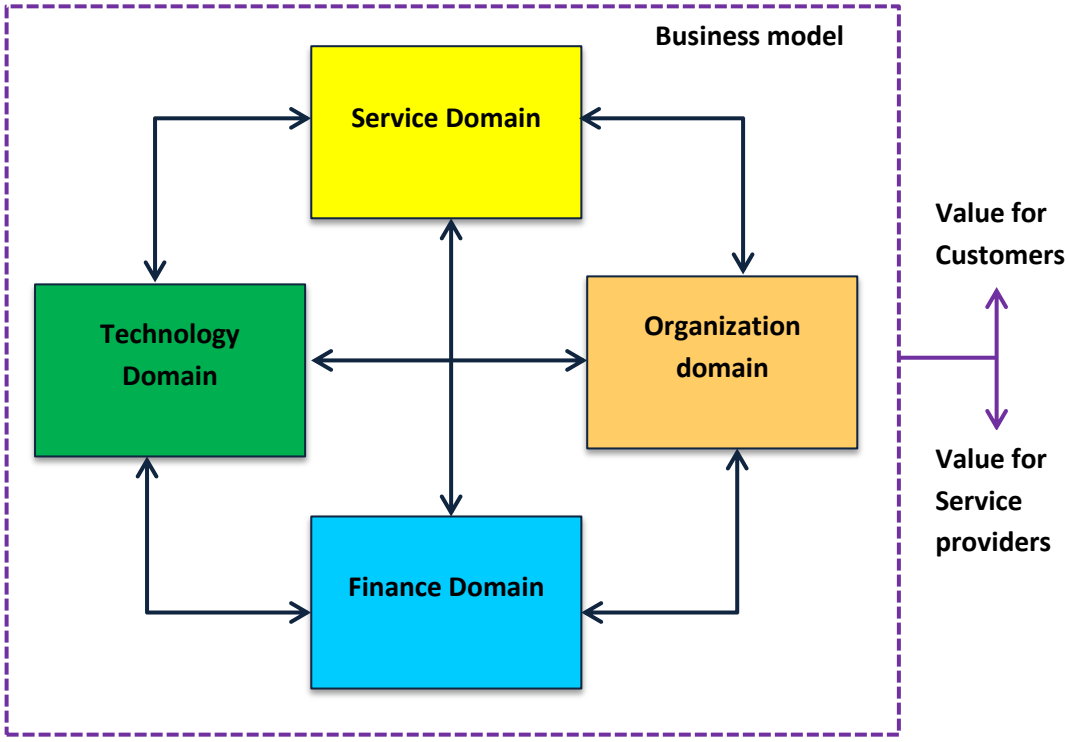


Figure 2.2 STOF model adapted from (Bouwman, Haaker, & De Vos, 2008)

Service domain:

The service domain, mainly focuses on the customer and the value proposition as intended by the firm for the customer. Hence, it is important to realize that the value proposition as intended by a service provider will not per sé be perceived in a same way. In light of this four concepts related to the value proposition can be considered. From the consumer perspective there is expected value vs. perceived value. And from the provider perspective there is intended value vs. delivered value. The service domain takes the firms perspective, looking at the firms value proposition and the market segment with the (potential) customers in this segment.

Technology domain:

The technology domain solely focuses on the technology being utilized to deliver a service. Since the STOF model focuses on ICT services, important aspects involve the network, devices used e.g. service platforms. These technologies are a core part in making the value delivery possible.

Organization domain:

Organizations are often looked at from a resource based view, meaning that an organization can deliver value by means of the resources it has. Also that an organization will have a competitive advantage once resources satisfy the so called VRIN conditions. That is resources are Valuable, Rare, Inimitable, and non-substitutable. Critique on this view is that it is to internally oriented, focusing on the individual organization in than on competitors. Moreover, a vertical value chain is considered. This last point stems from the argument, that in order to obtain resources, firms rely on other firms that make these

resources available. Cooperation with these firms leads to a network rather than a single chain. Hence, access to critical resources is the key element in deciding which actors to incorporate in a value web. The STOF model takes the later approach, thus in this domain the focus lies on actors in the value network, the interactions between those actors, their strategies and goals, and thus not only a single organizations resources, but also those of the other actors in the network

Finance domain:

For all business models the finances are of key importance. Although, the domain is quite straightforward, it is an important part of the business model. The following aspects are discussed in the finance domain.

- Costs
- revenues
- risk
- pricing
- investments
- financial arrangements

VISOR

Building on the relation between strategy and business models Sharma & Gutiérrez (2010) state that there is a need for viable business models. Where a viable business is able to constantly bridge the gap between organization and strategy. This is acknowledged by Osterwalder et al (2005) and De Reuver et al (2007), who say the business model is constantly subjected to external pressures and changing conditions. Where literature on strategy and business models already paid attention to the importance of the external business environment and the relation between business models and strategy. Sharma & Gutiérrez (2010) argue that business models need to be evaluated. Therefore they propose an evolution method based on the business model ontology VISOR. VISOR is a business model ontology by El Sawy and Pereira (2013). From their perspective, a successful business model aligns the components of the VISOR model. Thereby delivering the greatest value proposition that maximizes the willingness to pay of customers, and also minimizes the real cost of delivering these services (El Sawy & Pereira, 2013). This BMO has been developed for businesses that are working in e-business, and takes a service level perspective. It distinguishes between value on one side and cost on the other side, as depicted in Figure 2.3

In this model they divide a business model in five rough categories;

(1) Value proposition; here is described what products and services create value for the customer, and what the customer value is.

(2) Interface; this aspect focuses on the delivery of a service or product, since this strongly influences user experience.

(3)Service platform; focused on the IT-platform that enables, shapes, and support the business processes that are needed to deliver products and services, and improve the value proposition (El Sawy & Pereira, 2013)

(4) Organizing model; how a company or its partners organize their business processes, value chains, relationships etc.

(5) Revenue model; focuses on the financial aspect, the value proposition should deliver value such that revenues exceed costs.

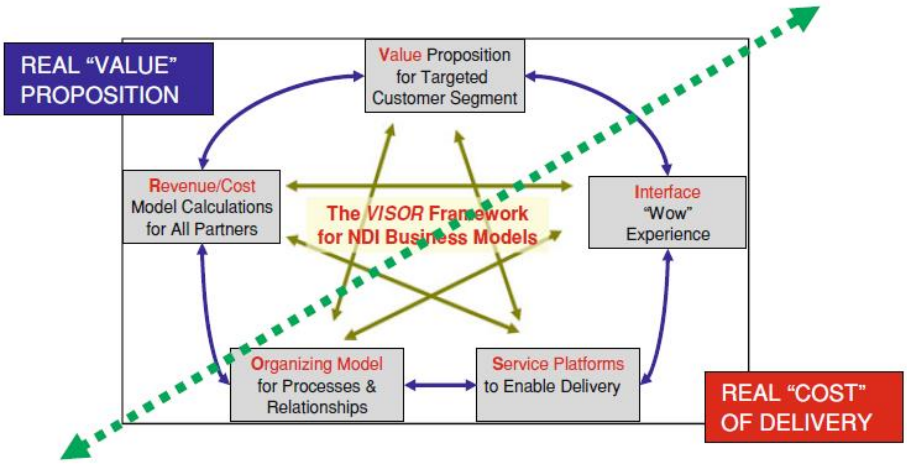


Figure 2.3 overview of VISOR (El Sawy & Pereira, 2013)

Value Mapping Tool

The previous three frameworks were business model ontologies, the following part discusses the value mapping tool, developed by (Bocken, Short, Rana, & Evans) see Figure 2.4. The VMT has been developed as a brainstorm tool, in order to consider the different value perceptions of different stakeholders. The focus lies on value, captured, destroyed, and missed. Where value captured is the current value proposition.

The value destroyed refers to negative environmental and social impacts. Value missed, refers to underutilization of resources, waste streams and failure to capture value (Bocken et al., 2013). Thus focusing mainly on the value proposition and how value is perceived by various stakeholders therefore lacking other important aspects of the business model. And as such it is a tool that takes an network perspective rather than that of a firm or service.

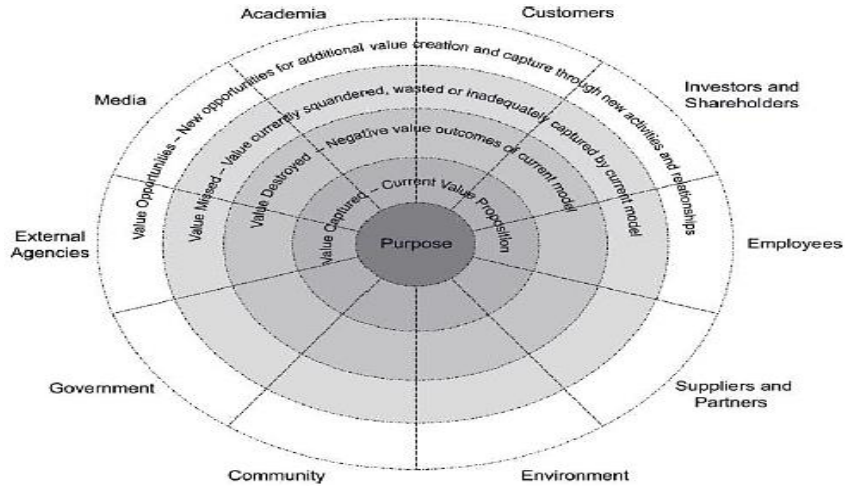


Figure 2.4 Value mapping Tool (Bocken et al., 2013)

Intermezzo

Four business model frameworks have been discussed and an overview of the various aspects that play a role in various components of these frameworks has been given in Table 2.1. The business model CANVAS is seen as an initiative towards being a shared business model language, that is very suited as a brainstorm tool. The STOF ontology, focuses on consumer and network value by looking at the four domains. The VISOR framework also looks at consumer value delivery. alignment of the 5 domains yields the highest consumer value at the lowest costs. At last the Value mapping tool has been

elaborated upon. This tool takes various value perspectives into account, but does not consider other business model elements. Where the VMT does take into account environmental and social perspectives the other three do not. As such it is worthwhile to identify what are sustainability aspects that play a role in business models.
The literature on business models discussed previously does not provide insight as to what these aspects might be. It looks at what entails business models, and how it relates to business strategy and execution. Business models are defined in terms of consumer value, benefits for business actors and revenues. Thus although this literature focuses on key aspects of business models, Environmental and social value are omitted. Therefore, literature that looks at business models for sustainability will be discussed in the part 2.4. From this literature sustainability aspects have been identified that were used to expand an existing business model framework.

Table 2.1 overview of components of the four BMO`s discussed

CANVAS	*STOF*	*Value mapping Tool*	*Visor*
1. Customer Segments 2. Value Propositions 3. Channels 4. Customer Relationships 5. Revenue Streams 6. Key resources 7. Key activities 8. Key partnerships 9. Cost structure	Service domain • Customer • Target group • Value proposition • Service offering • Context of use • Effort for the customer • Customer relationships Technology domain • Technological functionality • Architecture • Channels • Applications (apps) • Devices • Service platforms Organization domain • Actors (as mentioned in VMT) • Actors` resources and capabilities • Value activities • Strategic interests • Organizational arrangements Financial domain • Investments • Costs • Revenues • Financial arrangements Risk	Academia • Value captured • Value destroyed • Value missed • Value opportunities Customers • Idem.. Investors and shareholders • Idem.. Employees • Idem.. Suppliers and partners • Idem.. Environment • Idem.. Community • Idem.. Government • Idem.. External agencies • Idem.. Media • Idem..	Value proposition • Customer relationship • Customers • Customer value • Customer understanding Interface • Customer interface • Value interfaces • Services and linkages Service platform • Key resources • IT infrastructure • Technology • Logistical stream • Core technology investments Operational model • organizational characteristics • key partnerships • channels • value network • connected activities • stakeholder network Revenue model • financial aspects • revenue stream • financial model • financial flows

2.4. Business models for sustainability(BMfS)

The relation between sustainability and business is not new, many researches have paid attention to these aspects and have tried to connect, integrate, define or characterize them. This part sheds light on the connection between sustainability and business models.

Although there is no generic definition or agreement on what constitutes sustainability, it is often discussed in terms of environmental, economic and social sustainability. These are the same pillars as Elkington defined as the triple bottom line. Sustainable development then takes place at the intersection of these three aspects of sustainability (Azapagic, 2003; Azapagic & Perdan, 2000; Bansal, 2005; Dyllick & Hockerts, 2002) see Figure 2.5.

Figure 2.5: Intersection of the three sustainability concepts

Economic sustainability implies that a business needs to be economically feasible. Environmental sustainability implies that a business takes into account and does not negatively affect the environment. Social sustainability might be a bit harder to grasp. There is no simple description for what is Social sustainability. Vallance, Perkins, and Dixon (2011) have identified three streams in literature. One stream looks a social sustainability as *Development social sustainability*. This stream is concerned with basic needs, social capital and equality. A second stream has been branded *bridge social sustainability* looking at behavioural changes as to achieve environmental goals. And third *maintenance social sustainability*, which refers to preservation of social cultural characteristics.

Sustainability practices can be seen as practices that are commonly based on the triple bottom line and aim to improve sustainable development within corporations. These practices fall under what is known as corporate social responsibility (CSR). Research done in the field of CSR and its relation to firm performance or financial performance falls under the umbrella of 'the business case for corporate sustainability. Salzmann (2005), gives an overview of the research done in this field and shows that much research aims to assess the link between financial performance versus social or environmental performance. What becomes evident from this approach is that financial performance and environmental or social performance are not placed on the same level. Put differently; the question is whether or how environmental and/or social practices can enhance financial performance.
A critical view upon corporate sustainability was taken by Dyllick and Hockerts (2002), who raise the question whether the business case for sustainability is enough. They indicate that much focus in sustainability practices has been on eco-efficiency and that this misses important criteria in order to become truly sustainable. They, argue to work towards effectiveness and emphasize the need for sufficiency, meaning that consumers have to be made aware of their consumption patterns. In other words create awareness at the demand side rather than at the supply side. It is argued that there is an important role for companies in achieving this.

Already in 2003 Azapagic, argued for the integration of Corporate sustainability strategy in the business vision and strategy. Thus not merely adding it to the business by means of CSR practices, but integrating it in the core of the firm. Schaltegger, Lüdeke-Freund, and Hansen (2012) & Figge, Hahn, Schaltegger, and Wagner (2002), agree with this line of thinking. And the latter therefore proposed an alteration of the balanced score card as introduced by Kaplan and Norton in 1997. They argue that this approach, in contrast to other approaches in environmental and social management, allows for the integration of the three pillars for sustainability in one management tool (Figge et al., 2002). The rationale behind the paper is that integration is needed in order to achieve true sustainability. Although, these initiatives can help to achieve corporate sustainability they will only help to integrate sustainability practices in an existing strategy. This will likely result in small improvements in terms of sustainability and likely in practices related to increasing efficiency. Hall and Wagner (2012) also look at the integration of sustainability management

with other management practices, and it is argued that definitions as given by (Chesbrough, 2010; Zott et al., 2011), are more a single rather than a triple bottom line perspective. And that integration practices will be affected by the type of business model.

This line of thinking is confirmed by various authors, who state that in order to achieve sustainability companies need to work toward sustainability and that this requires rethinking business strategy and thus business models, (Bocken et al., 2014; Boons et al., 2013; Hall & Wagner, 2012; Schaltegger et al., 2012; Stubbs & Cocklin., 2008). Schaltegger et al. (2012), builds on the business case for sustainability and argue that the integration of both economic vale next to sustainable and social value is the goal of the business case for sustainability, but more importantly that the way to get there is by means of business model innovation. The premise, is that there are voluntary efforts to enhance economic performance through social and environmental practices. Schaltegger et al. (2012), have identified several business case drivers, and linked these to the business models and business strategy. They place business case drivers between business strategy and business models. And relate both strategy as well as the business model to these drivers. By doing so they coupled literature on the business case for sustainability with business models.
This resulted in the framework as depicted in Table 2.2. This figure shows three types of sustainability strategies, ranging from defensive to proactive, which in turn have been related to degrees of business model innovation. So, a proactive strategy requires a high degree of business model innovation, which strongly contributes to the business case for sustainability

Table 2.2 Overview of link between sustainably strategy with degree of business model innovation adapted from Schaltegger et al. (2012)

Sustainability strategies	Degree of business model innovation	Effects of addressed drivers of business case for sustainability	Contribution to business cases
Defensive	Business model adjustment	• Mainly cost and efficiency-oriented measures aim for low-hanging fruits and thus only require moderate (if any) business model changes. • Small number of business elements affected. • Sustainability issues are perceived as risks leading to protective behaviour	Business cases for sustainability
	Business model adoption		
Accommodative	Business model improvement	• Cost and efficiency-oriented measures are pursued actively and partly linked to sustainability issues. • Sustainability- oriented risk management can require very basic changes like renewing production processes, changing value network partners, or approaching new market segments. • A General orientation towards external addressees in terms of *reputation, brand and attractiveness to employees* can require basic changes in customer relationships and business processes.	
Proactive	Business model redesign	• Radical changes to core business logic of a company • Sales and profit improved by environmentally and socially outstanding products, leading to not yet available value propositions. • Cost and efficiency measures are applied to support new products and services and to gain a competitive advantage through sustainability performance. Which enhances, risk management, reputation and brand value. • Company may become increasingly attractive to high-skilled employees.	

One of the first authors who connected the term business model with sustainability were, Stubbs & Cocklin. (2008). In an effort to characterize a sustainability business model (SBM) they performed 2 company case studies on Interface and Bendigo bank that had adopted a SBM. They identified that the two companies redefined the purpose of their business in a wider extent than profitability and incorporated a social and environmental aspects. Another finding is that only one of the companies' reports on financial, environmental en social outcomes. However, reporting on these aspects does not imply being sustainable. "For example, companies may report their progress on recycling, levels of emissions, and community engagement initiatives, but may not be change their underlying business practices that cause environmental and social degradation" Stubbs & Cocklin. (2008, p. 115). Other points have been noted by the authors for reaching sustainability goals;

(1) Stakeholder engagement, where nature is seen as a stakeholder;
(2) Need for sustainability leader(s);
(3) Shared costs for investments in new sustainable infrastructure;

An approach where various actors in the system develop sustainable solutions.

(4) Revision of tax system i.e. taxation on environmental burden.

This research is a step in defining what it means to have a Sustainability business model.

The literature discussed so far, is focused strongly on the integration of sustainability with the business strategy and later the business model. Where Schaltegger et al. (2012), already made a division in level of sustainability in business models. Bocken et al. (2014), has given an overview of eight different archetypes of business models for sustainability, see Figure 2.6. This selection is built upon the categorization (technical social organizational) as introduced by Boons & Lüdeke-Freund. (2013). So, Bocken does not look at the level of integration, but gives an overview of business models for sustainability identified, in literature and in practice.

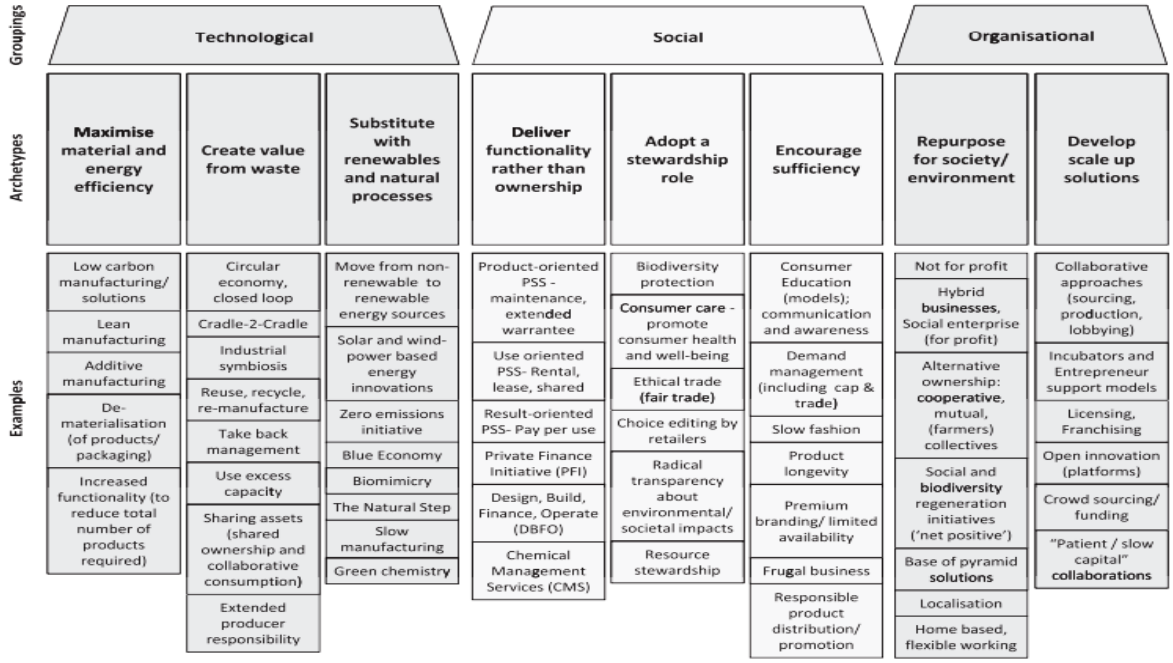


Figure 2.6: overview of archetypes as given by (Bocken et al., 2014)

The need for business models for sustainability is acknowledged in literature, (Bocken et al., 2014; Boons et al., 2013; Boons & Lüdeke-Freund., 2013).

However what can be seen in literature a lot, is an effort to define what a business model is or what it should entail. Schaltegger et al (2015), gave the following definition for a business model for sustainability.

"A business model for sustainability helps describing, analysing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries"(Schaltegger et al, 2015).

The definition of Schaltegger et al (2015), explicitly encompasses the social and environmental values.

It clearly builds on previously discussed authors (Chesbrough, 2007; Teece, 2010; Timmers, 1998), since this definition incorporates thoughts on value creation and capturing, but also on the idea that business models span across firm boundaries. In fact Schaltegger et al (2015) argue that no sustainability business model can go without stakeholder involvement, and even needs to create value for stakeholders beyond customers and shareholders. Which makes a case for approaching sustainability from a system level perspective.

Bocken et al. (2013) think in line with Schaltegger et al, in the sense that they emphasize the narrow scope of business model definitions as given by Chesbrough and Teece. They argue the need for the incorporation of both environmental and social values in a business model definition. In their research they have developed a value mapping tool that aims to help in the design of business models for sustainability. This tool focuses on the network a company is in and the stakeholders it is involved with, thereby focussing on value created and negative value. While a tool like CANVAS is more focussed on the company and its customer. Bocken et al. (2013) argue that CANVAS therefore seems poorly suited to look at sustainability across a full stakeholder network. In can be concluded that the stakeholder network is seen as an important aspect by various authors, in business models for sustainability.

When relating business models and sustainability, Boons & Lüdeke-Freund. (2013) identify four main elements that connect business models and sustainability. These four elements are also found in Schaltegger et al. (2012) and Gauthier and Gilomen (2015).

1. Value proposition provides measurable ecological and/or social value in connection to economic value.
2. The supply chain: actors do not shift their ecological burdens to their suppliers.
3. Customer interface; motivating customers to take responsibility
4. A financial model that reflects cost and benefits across actors involved and accounts for ecological and social impacts.

Also studies by Roome and Louche (2015) indicate the importance of stakeholder involvement. Next to that it also indicates the importance of considering value destruction next to value creation. An important aspect of a business for sustainability is being aware of what value is destroyed and taking action in order to prevent or reduce this. Roome and Louche (2015), performed a case study on two companies that abandoned their business model to adopt a business model for sustainability. An important notion, is that the need for a change in business was the starting point, not the necessity for adopting a business model for sustainability (Roome & Louche, 2015). Gauthier and Gilomen (2015) also focus on the transition towards a business model for sustainability. They looked at organizations that are collectively engaged in a sustainability project and identified components of business models in literature. It was found that various organizations engage in different levels of business model transition, but that future research should focus on factors that helps cooperation between firms.

Another publication on business models for sustainability, is by Abdelkafi and Täuscher (2016). They develop conceptual model for a business model for sustainability, where focus lies on the value creation capacity, value to the customers, value to the natural environment, and captured value and how they can reinforce each other. The perspective taken is from system dynamics, to understand how different aspects of business models for sustainability work together and reinforce each other.

2.4.1. Identified literature gap:

Until so far this chapter has given an overview of the literature on business models and introduced three BMO`s and one tool. Furthermore, attention has been paid to literature on sustainablity in relation to business. The literarure discussed in the beginning of the chapter, does not explicitly incorporate environmental and social sustainability aspects. Other literature that does look at these aspects, does not connect sustainability to business models as such, but is mainly focussed on charaterizing or defining what constittues a business model for sustainalbility. Also no business model ontology pays attention to environmental aspects.

This research connects these fields of literature by developing a business model framework that does incorporate sustainability. Furthermore, this research gives insight in what is needed to achieve a viable business model for sustainability Thereby, this research thus goes further than identifying what constitutes a business model for sustainability alone.

2.5. An addapted business model ontology

This part elaborates on the sustainablity aspects that have been identified from literature, thereby providing an answer to sub-question one. Part 2.5.1 gives an overview of the sustainalbity aspects identified, thereby providing an answer to the first sub question.

In order to answer the second sub question the business model framework used for the case study should cover most of the aspects identified in literature. If needed they will have to be included. As such a choice, in favour of one of the frameworks discussed is made in part 2.5.2.

2.5.1. Sustainablity aspects found in literature

From the literature, characteristics of business models for sustainability have been identified, of which an overview is given in Table 2.3

Table 2.3 Aspects that play a role in business models for sustainability according to literature.

1.	Environmental value in value proposition
2.	Social value in value proposition
3.	Value proposition for more stakeholders in/outside value chain.
4.	Financial model that reflects cost and benefits of actors involved, i.e provides insight.
5.	Negative value or value destroyed
6.	A sustainability strategy
7.	Sustainability leader(s) in the firm
8.	Shared cost for investment in sustainable infrastructure
9.	Motivate customers to take action and/or responsibility with respect to sustainability

The first aspect given in table 2.3 has been mentioned by various authors as necesarry for a business model for sustainablity. As indicated environmental value is delivered when a business takes into account and reduces its impact upon the environment. Social value, has been explained by means of three aspects (1) creating equality, (2) stimulating behaviour in favor of sustaianblity and (3) keeping in mind (cultural) habits and customs, see part 2.4.

The second aspect has been derived from the the aspect mentioned by Schaltegger et al. (2012) and Gauthier and Gilomen (2015). I.e. actors do not shift their ecological burdens to their suppliers. Next to that, in the definition given by Schaltegger et al (2015, p. 6), it is mentioned that a value proposition should deliver value to all stakeholders and look beyond

organizational boundaries. Also Bocken et al. (2013) argue in favor of incorporating a wider range of values for different stakeholders.
The third aspect has been explicetly mentioned by Schaltegger et al. (2012) and Gauthier and Gilomen (2015). Moreover, Stubbs & Cocklin. (2008) indicate that their might need for a revision of the tax system, which impacts the financial system.
The fourth factor, negative value, has been mentioned by Roome and Louche (2015) and Bocken et al. (2014).
The fifth factor has been added, based on insights from various authors who stated that there is a need for busines model innovation in order to move towards a business model for sustainablity. Schaltegger et al. (2012) in has connected this with a level of business model innovaton and related this to three degrees of sustaianblity strategies, see Table 2.2 This shows that in order to move towards a business model for sustainability a sustainability strategy has to be in place. The sixt aspect has explicetly mentioned by Stubbs & Cocklin. (2008). There is need for leaders that 'sell'sustainablity within the firm and make it part of the company culture (Stubbs & Cocklin., 2008). Also the seventh aspect has been identified by Stubbs & Cocklin. (2008). The last aspect has been argued to be important by Dyllick and Hockerts (2002), in their discussion on sufficiency. Furthermore, it has also been mentioned by Schaltegger et al. (2012) and Gauthier and Gilomen (2015).

2.5.2. Selection of a suitable the business model framework

Based on the eight sustainabiliyt aspects a set of selection criteria have been set up for a suitable business model ontology, see Table 2.4.

Table 2.4: Overview of selection criteria for business model framework

Criteria	Related to aspect #
1. The BMO should consider a wider value proposition. This means that environmental, social value is incorporated in the value delivery.	1
2. The BMO should focus on more stakeholders in the value chain, besides the firm and the customer.	2
3. The financial model should be addressed, regarding costs and investments.	3,7
4. Negative value should be incorporated in the BMO	4
In business models for sustainability it is not only important to deliver consumer value, but also to motivate consumers to engage in sustainable behavior as part of this value delivery. Therefore, it is important to consider the customer value, but also the effort required from the customer.	
5. Attention should be paid to the customer value and actions required by the customer	8
6. Attention should be paid to the presence of sustainability leaders in the firm and the strategy. The latter relates to many business model elements, therefore the ontology should address the business model not only on a generic level and focus on detail.	5,6
However, next to these six criteria there is another criteria that the BMO must fulfil. Since not all businesses investigated operate in the e-business domain.	
7. The BMO hast to be suitable for use outside e-business domain.	

The three ontologies and tool have been compared with respect to these criteria. Based on compliance with the criteria points have been awarded, ranging from 0 to 2. Before making

a selection the compliance to these criteria will be elaborated upon further. An overview of the outcome has been given in Table 2.5.
As argued at the end of section 2.3, none of the ontologies explicitly takes into account environmental and social value. Only the value mapping tool (VMT) takes into account these aspects. This results in a score of 0 for CANVAS, STOF and VISOR and a score of 2 for VMT.
The CANVAS approach has been criticized, because it focuses on the individual firm. This makes it less suitable for taking into account the environment the firm is operating in. Which has been indicated by various authors as important for the value creation of the firm, because business models span the boundaries of the firm. Looking at the aspects considered in CANVAS, see table 3.2.1, then it are merely the key partners that receive attention. Therefore on this point CANVAS is given a score of 0.
In both VISOR and STOF attention is paid to the customer, to the value network and the actors in this network. However, no attention is paid to the impact on actors outside the value chain. Therefore a score of 1 has been awarded. Again the VMT receives a score of 2 since this tool from the outset aims to incorporate all stakeholders.
The third criteria is concerned with the financial model, the VMT as a tool is only concerned with value and negative value in relation to the various stakeholders. It does not address the financial model or other business model elements. Therefore the VMT receives a score of 2 for the incorporation of negative value, and scores of 0 for criteria 3,5 &6.
All three ontologies consider the financial aspect of business. Both CANVAS and VISOR focus on the cost and revenues associated with delivering the value proposition, while STOF also addresses investments. Shared cost for investments in sustainable infrastructure was seen as an aspect to be taken into account in a business model for sustainability. Therefore, STOF gets a score of 2 and bot VISOR and CANVAS a score of 1.
Negative value is explicitly taken into account in the VMT, but this aspect cannot be found back in any of the three ontologies. Hence, a score of 0 for all three ontologies.
Customer value is considered in all ontologies, but in STOF more aspects related to customer value delivery are explicitly considered. Therefore, STOF receives a score of 2 and the others a score of 1. Customer value is also considered in the VMT, but no attention is paid to the realization of this value delivery, hence score 0.
For each of the domains in the STOF and VISOR ontologies the different business model elements that play a role have been addressed. The level of detail can be considered both a strong or a weak point. The level of detail, leaves less room for interpretation which makes cross case comparison more robust, but at the same time also time intensive and might result in a focus on redundant factors. In contrast, both CANVAS and the Value mapping tool are not domain specific and as a result less detailed. CANVAS specifies nine components of a business model, but the tool does not give much further direction as to the aspects that play a role in those segments, which leaves room for interpretation leading to a lack of consensus and uneven focus. Therefore, both STOF and VISOR score 2 and the VMT and CANVAS score 0, for criteria 6. Both VISOR and STOF have been developed from an ICT background. Which means that especially in the technology domain certain elements are there that might be redundant outside the field of ICT. This does however not make the BMO unusable, as these can be omitted. A strong point of CANVAS is that it is an established framework, and therefore enjoys familiarity and recognition. This can lead to more clear and straightforward communication, and lesser miss understandings or points missed in interviews. The VMT focuses mainly on the stakeholders and the value created,

destroyed and missed. It can therefore be used in any field. Based on this reasoning, VISOR and STOF are given score 1 and CANVAS and the VMT score 2.

Table 2.5 table given comparison between various BMO`s and tool based on criteria given

Business model	**CANVAS**	**STOF**	**VMT**	**VISOR**
Domain	Generic	ICT service	Generic	ICT service
Unit of analysis	Organization	The Service	Network	The Service
1. The BMO considers a wider value proposition. (Incorporating social and environmental value)	0	0	2	0
2. It should focus on more stakeholders in and outside the value chain, besides the firm and the customer.	0	1	2	1
3. The financial model should be addressed, regarding costs and investments.	1	2	0	1
4. Negative value should be incorporated in the BMO	0	0	2	0
5. Attention should be paid to the customer value and actions required by the customer	1	2	0	2
6. The ontology should address the business model not only on a generic level and focus on detail	0	2	0	2
7. Suitable for use outside e-business domain	2	1	2	1
TOTAL	4	8*	8	7

Based on the criteria, both STOF and VMT score equally well. However, STOF has been chosen for this research. The VMT strongly focuses on a wide value proposition and the various stakeholders, but does not at all focus on financial aspects and other aspects that play a role in a business model. STOF lacks focus on the wider value proposition and does not incorporate negative value. However, these aspects can be incorporated in the STOF model without much difficulty. Another point in favor of STOF is that especially the car sharing companies make use of ICT services.

2.6. STOF and sustainability

STOF has four domains, Service, Technology, Organization and Finance. One can ask the question whether this framework covers the aspects that constitute or characterize a business model for sustainability. Or whether there are certain aspects that have not been considered so far in business model literature. Although, STOF has been chosen as the ontology to be used, it did not comply with all selection criteria. This part discusses the different aspects of the framework in more detail to show where missing aspect can be incorporated within the STOF framework, as to make it comply the criteria. The result is displayed in Table 2.6.

Service domain:

One can distinguish various aspects of value; Chen & Dubinsky, as referred to in (Bouwman et al., 2008, p. 38), for example state that:

"*Value is seen as part of an equation in which customers compare the perceived benefits and total costs (or sacrifice) of (obtaining) ownership of a product or service.*"

This definition takes the perspective of the customer, but it is important to realize that the notion of value is a subjective concept. Therefore it is important to incorporate the important stakeholders. One can argue for the incorporation of the environment as a separate stakeholder as done in the VMT. However, considering the environment as a stakeholder might prove to be difficult since, the environment in itself cannot express expected nor perceived values. These values are an interpretation by society or the consumers. Therefore, it seems more useful to see environmental values in relation to consumer values directly.

A firm delivers value as perceived by the customer, but delivered value and perceived value are mostly two different things. In principle firms aim to align consumers perceived value with their intended and in the end delivered value. Their business models are mostly tailored toward achieving this goal while at the same time striving for profit maximization through efficiency.
But in order to move towards sustainability firms have the obligation to consider value created, not only for the customer but also for the environment. As Dyllick and Hockerts (2002) indicated, firms have a role to make the customer aware of the need for sufficiency. The difficulty is however that a customer generally does not couple value with production costs and other costs incurred by a firm in bringing about a product or service (Bouwman et al., 2008). Going back to the definition, environmental or social costs and benefits might not be an essential part of the comparison consumers make.
So, most customers do not incorporate environmental values in their perceived value. While firms would incorporate environmental and social value, in their value proposition as part of their delivered value, there will be a difference in delivered and perceived value. Nonetheless, it is then the role for companies to find a way in which consumer value is delivered without jeopardizing social and environmental value. Meaning, value is delivered or at least not destroyed. This means that there is a need for the integration of social and environmental value in the delivered value of the firm, while still making a profit.
Established business models appear not suited to achieve this goal, which justifies the call for business models for sustainability. Business models for sustainability thus in their core aim to deliver value to the customer, and at least be at par with cost benefit regarding environmental or social value.

Hence it is important that the STOF framework allows for the incorporation of these aspects. The framework does not in itself forego these concepts of value, but it does not necessarily pay attention to it since it is not an explicit customer value.
When analyzing a business model for sustainability, the assumption should be that customers do indeed value social and environmental concerns, and hence it should be explicitly taken into consideration in applying the STOF methodology.
In practical terms this means that in the service domain one does not only look at the service delivered, but also explicitly at its implications regarding social and environmental value.
Thus taking social and environmental value propositions into account as part of the value proposition of firm.

Technology domain:

In the Technology domain attention is paid to the technology that enables the delivery of a service. To some extend ICT plays a role here, but especially for environmental impact the technologies in the industries investigated i.e. energy sources in the energy industry and cars in the car sharing industry have a big impact on the sustainable value delivered and perceived. Therefore, it is important to explicitly describe these components in the technology domain. Equally important is the consideration of the negative value attributed to such technologies. For example, a parking spot takes up free space and the opportunity for something else. Or a windmill, has horizon and sound pollution for nearby citizens. In order to move towards sustainability companies have to look at reduction of negative value attributed to the technology they use. Moreover, the reduction of these negative aspects can contribute to the value proposition. But the value proposition looks at positive value delivered and one cannot omit negative affects attributed to technology deployed. Therefore, this aspect has been added to the technology domain.

Organizational domain:

A firm will collaborate or reach out to firms that can help them in delivering their value proposition. One can therefore logically expect that in a business model for sustainability firms with capabilities and resources will be collaborating with the firm that can help in reaching environmental value. The STOF model considers actors that directly contribute to the realization of the value proposition these actors as part of the value network. However, an important aspect is also added value for stakeholders inside/outside the value chain.

The focus in the STOF ontology lies mainly on *resources, capabilities, strategic interest.*

Added value as such is not taken into account in the organizational domain, but this can easily be overcome by adding a business model element in the organizational domain.

Added value for stakeholders inside the value chain is already captured in strategic interest and value activities. Therefore, the business model element; added value for stakeholders outside the value chain has been added. This added value is different from the value proposition, as for added value actors are not per se customer or part of the value network.

Financial domain:

Aspects that were found to play a role in the finance domain were; *shared investments and reflect cost and benefits i.e. provide insight.* In the financial domain of STOF, one considers the costs, risks, financial arrangements etc.

Whether or not the financial model provide insight and whether or not investments are shared can be derived from these elements. As such these aspects are mostly covered in the existing STOF model. Nonetheless, it has been added to the financial domain, as to give explicit attention to it. Also added to the financial domain is the notion of shared investments.

In the financial domain one can also incorporate environmental costs, risks, etc..,. Next to financial risks it is worthwhile to also consider environmental and social risks that might jeopardize the business. Although, this aspect has not explicitly been derived from literature it can be worth to investigate if these risks can be identified. Moreover, to get insights on the environmental and social cost or benefits of a business models and its technologies, one would need to engage in a thorough cost benefit and impact analysis. Nonetheless, it might be an aspect that is worth incorporating. Also since, various firms have estimated their footprint. The difficulty here lies , just as with CSR with the lack of a standard approach and verification. To incorporate a financial expression of environmental and social cost and benefits is outside the scope of this research.

Generic aspects:

Three aspects have not been explicitly added to the STOF business model, i.e. *Sustainability leader, Sustainability strategy and motivate customers to take sustainable action/or responsibility.*

Having a sustainability leader who drives sustainable business, is not part of the business model. It can be seen as a factor contributing to the realization of a business model for sustainability.

Strategy positions the company, defines an sets goals. Through business processes this has to be implemented translated into business functions. A business model is the link between business strategy and business process (Osterwalder A & Pigneur Y, 2002). Therefore the aspect sustainability strategy cannot be incorporated in the business model as such. However, based on insights from the desk research it should be possible to say something about this aspect. Similarly, this can also be seen as a factor contributing to the realization of a business model for sustainability.

The last aspect, motivating customers to take action or responsibility. Is something that is affected by various business model elements e.g. effort, price, technological functionality. This can also be seen as a factor that contributes to the realization of a business model for sustainability. This results in an adapted STOF ontology as shown in the table below.

Table 2.6 STOF ontology adapted with sustainability aspects

Original business model elements of the STOF business model ontology			
Service domain • Customer • Target group • Value proposition • Service offering • Context of use • Effort for the customer • Customer relationships	**Technology domain** • Technological functionality • Architecture • Channels • Applications (apps) • Devices • Service platforms	**Organization domain** • Actors • Actors` resources and capabilities • Value activities • Strategic interests • Organizational arrangements	**Financial domain** • Investments • Costs • Revenues • Financial arrangements • Risk
Business model elements added to the STOF business model ontology			
• Environmental value • Social value	• Negative value of technology	• Value added for stakeholders outside the value chain	• Focus on Shared investments • Insight • Environmental and social risks that affect business
Generic sustainability aspects			
• Having a sustainability leader • Having a sustainability strategy • Motivate customers to take action/responsibility towards sustainability			

2.7. Conclusion

This chapter has discussed literature regarding business models, business model frameworks, and business models for sustainability. The purpose of the literature study is twofold firstly, it makes sure the research done is relevant and unique and secondly it provides much needed insights in order to answer the first sub-question.
In established literature on business models no explicit attention is paid to sustainability, the same holds for literature on business model ontologies. Literature that does focus on sustainability mostly does not relate sustainability to business models as such. Authors that do relate sustainability with business models are mostly concerned with defining what constitutes such a business model. This research builds upon these authors by connecting these aspects that define a business model and connecting it to business model ontologies.
The literature study allowed for the identification of sustainability aspects thereby answering sub-question one. This part was followed by a theory developing part, in which based on the aspects identified the STOF ontology was chosen as a suitable business model representation for the case study. The aspects found have been added to the STOF ontology resulting in an ontology that also incorporates sustainability elements. Therefore it is suitable to use for business models for sustainability.

Ten elements have been added to the framework **(1) environmental value (2) Social value (3) Negative value (4) Value for actors outside of value chain.**
Further, (5)**social and environmental risks** together with (6)**insight in the financial model** and (7)**shared cost for investments in sustainable infrastructure** have been added to the financial domain as to place explicit focus on these elements in the cross case analysis. Three general aspects that play a role have also been identified and can be considered potential success factors (8) **Sustainability leader** (9) **Sustainability strategy** and (10) **motivate customers to take action/ responsibility towards sustainability**
The first sub question has thereby been answered.

Chapter 3 Domains of the cross case analysis

The literature study in chapter 2, has yielded an adapted STOF ontology to which sustainability aspects have been added. This adapted STOF ontology is used in the cross case analysis on companies that have adopted a business model for sustainability. This allows for the validation of the adapted STOF ontology, with respect to existing business models for sustainability. This choice for an adapted STOF ontology is the first of two choices that needed to be made for the case study, the second choice is the selection of cases. This chapter introduces the domains in which these companies operate. These domains are the car sharing sector and the energy industry which will be discussed respectively.

3.1. Sharing economy and the rise of prosumers

The car sharing industry falls under what is called the sharing economy. The sharing economy is a growing concept in which companies and private consumers focus on the sharing of resources or products. This ranges from industrial symbiosis, where waste streams of industry become another parties resource, to sharing attributes. Examples of businesses that fall under the umbrella of the sharing economy are amongst others, Peerby; a platform which allows people to share goods. Bla Bla Car; a service where people share free spots in their cars who have similar destinations. AirB&B; a platform which allows home owners to temporarily rent free rooms in their apartments or houses. Or Greenwheels; a company that provides shared cars. For most, if not all, of these companies the business model can be categorized as being a product service system archetype. Thus these companies that facilitate sharing in some form can be characterized as having a business model for sustainability.

Within the sharing economy it is not necessarily the case that services are offered through a B2C approach. One can also recognize C2C approaches where the a company only provides a service by bringing consumers together. AirBnB and Peerby for example, can be considered to take a C2C approach.

The distinction B2C vs. C2C has to do with the parties that supply goods, products or services to one another. In business to consumer, it is generally a company or organization that sells/provides a service to consumers. Here consumers are individual people i.e. not organizations or companies. In consumer to consumer, it are consumers themselves that provide services or products to other consumers, without necessarily having a formal business. However, companies can play a role in this type of transaction, which might make it difficult to distinguish between B2C or C2C. In the C2C approach, it is possible to share attributes as part of the sharing economy, but it is also possible to be a prosumer. This means that a person takes the role of both producer and consumer. This is a concept that can be identified in the energy sector, where people produce their own energy (i.e. they own an energy source) and both use this energy and sell it to other consumers. Examples of this are solar collectives, where people sell their excess power production back to the grid to be used by other people. Two companies that facilitate this approach in the energy sector are Qurrent and VandeBron.

3.2. Car sharing industry

Car sharing is the concept in which a car is used by multiple people at different timeslots, it helps people gain access to the mobility a car brings without having to bear the costs and having the responsibilities that come with owning a car (Susan Shaheen & Adam Cohen, 2007). Also in car sharing people have the option to rent a car at any moment of time for

any desired timespan (Frenken, 2013). Moreover, people can reserve vehicles that are placed across the city, often near transportation hubs (Baptista, Melo, & Rolim, 2014).
In contrast to car sharing, when owning a car one needs to acquire a car which often involves several thousands of euros. Second, there are variable cost that are largely dependent upon the users` behavior e.g. petrol, maintenance, parking and third there are fixed costs for maintenance, insurance, taxes and depreciation.

The obvious difference between car sharing and car ownership, is that users of car sharing do not privately own the car they are using. There are however various forms of car usage that could be considered car sharing, an overview is given in table 3.2.1. As the focus in this research is placed on only two types of car sharing namely the classical and peer2peer approach these will be elaborated upon.
The largest form of car sharing in the Netherlands, looking at the number of users, is classical car sharing. In this form an organization provides cars at various places, which can be rented. The organization has its own fleet of cars, that are maintained and often come with designated parking spots at convenient places where users can pick the car up and return it. Users pay a fixed amount for their subscription and pay an additional amount for the time they use the car and the kilometers driven. The fleet of cars often consists of only a few type of cars, that are convenient for different needs. This classical car sharing is a business to consumer approach.
Peer to peer car sharing is a form of car sharing where cars are not owned by an organization, but instead car owners make their car available for other people to use. Although this form in absolute numbers is smaller than classical car sharing, it has been growing very fast in the past few years in the Netherlands. Various platforms facilitate this form of car sharing, thereby taking care of transactions and insurance issues, but more importantly they provide the platform through which people can get connected with each other. In contrast to classical car sharing, cars are thus rented from private owners, this means that these cars often do not come with fixed parking spots and that there is a wide variety of cars available for rent.

Table 3.1 overview of various forms of car sharing in the Netherlands (Ministerie van Infrastructuur en Milieu, 2015)

Form	Classic	Peer-to-peer	Private	One-way
Approach	Providers have own fleet	Open supply and demand	Private	Providers have own fleet
Parking	Fixed location	On agreement with owner	(near) home	Within a zone
Costs in using the car	Cost per time slot Cost per kilometre driven	Costs for gas	Split costs for car purchase and maintenance.	Pay per minute Or use discount packages
Service/ registration cost	Subscription Cost	Service cost every time a car is rented	n.v.t	One time fee.
Examples in the Netherlands ***) Partly**	Greenwheels, Connectcar, MyWheels*	SnappCar, MyWheels*	MyWheels provides supports	Car2Go

3.2.1. Dutch Market

Many car sharing initiatives have come up in the past decade and as a result the amount of shared cars in the Netherlands has grown by 86% from the year 2012 to the year 2013 to a number of 5275 cars (De Haan, 2015) This number continues to grow, including shared cars in businesses. In the spring of 2015 the Netherlands was home to 16.167 shared cars (De Haan, 2015). Before 2011, cars sharing basically existed in the form of organizations offering cars. i.e. the classical form, with next to this a very small number of cars offered through the one-way approach. However, after 2011, both the one way as well as the peer to peer approach started to grow. In fact peer to peer has outgrown all other forms of car sharing regarding the number of cars offered in the market. What is interesting to see is that the classical car sharing form has not grown at all, in fact it has slightly declined (De Haan, 2015). Next to this the business market shows no growth curve, it therefore seems likely that classical providers, also offer their fleet to business customers. In the Netherlands Greenwheels is the largest classical car share provider with a fleet of 1700, who indeed offers its fleet to business.

Most growth in car sharing can be seen in urban areas and of the various forms discussed peer 2 peer sharing is growing the fastest. As can be seen in Figure 3.1, cars also become available in non-urban areas this is mostly due to the increase in peer 2 peer sharing. However, to put these growth numbers into perspective, in 2013 there were still 13 times as many rental cares as shared cars and 135 times as many lease cars (Mets, 2013). In fact the car sharing population constitutes less than 1% of the overall population. Thus despite this rapid growth, car sharing caters to a small group of people that live especially in cities. Hence, car sharing is (still) catering a niche market.

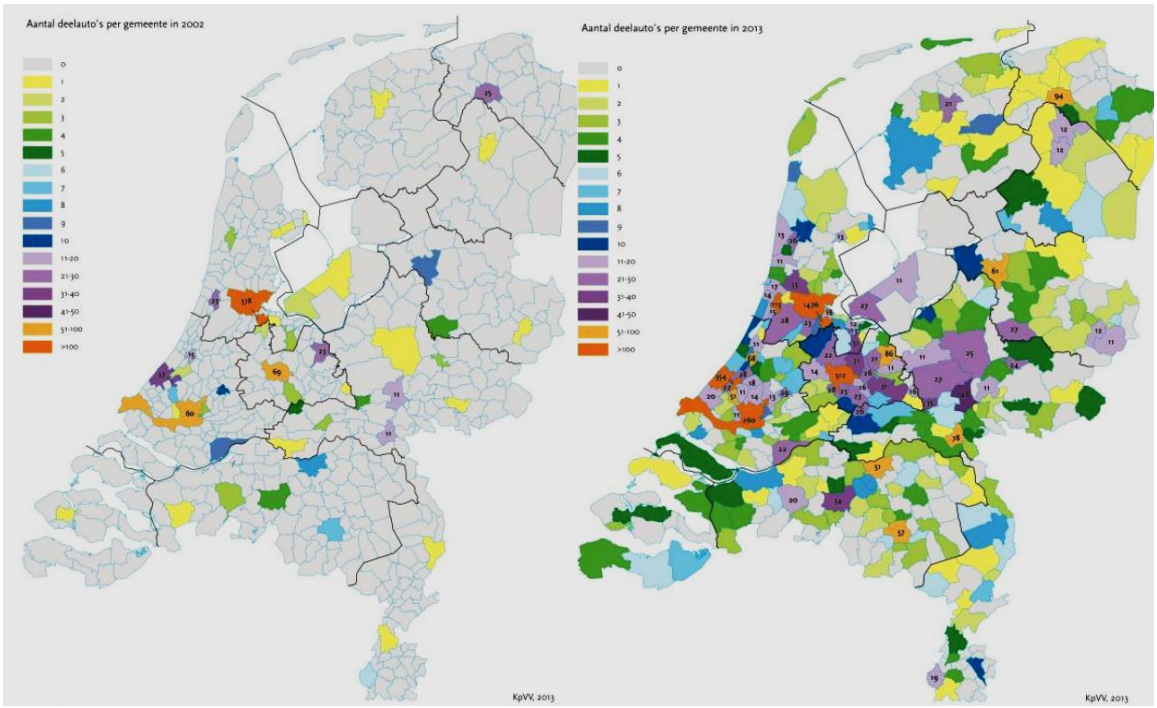


Figure 3.1 development of number of shared cars per municipality in the Netherlands (left 2002, right 2013) (Mets, 2013)

3.2.2. Potential environmental benefits of car sharing

Car sharing enjoys a green image, consider for example the name Greenwheels, but also studies done on car sharing explicitly focus on the environmental benefits that might come with car sharing e.g. Meijkamp (1998). There are various arguments that feed this green

image of the car sharing concept. It is said that car sharing leads to a reduction in emissions, by means of decreased mileage by car. However, the effect of car sharing on emission largely depends on what mode of transport the shared car is replacing. For example car sharing might make the car a suitable mode of transport for carless people. However, Meijkamp (1998), who did research on car sharing in the Netherlands shows a reduction in mileage driven by the carless. He also showed a reduction for the people who replaced their privately owned car for car sharing. It were only the people who used car sharing for their second car that increased their mileage. This resulted in an average decrease in mileage of 30%. Since, the number of car sharers on the overall population is small the effect of this reduction in emissions is unlikely to be noticed. However, in dense populated areas, where traffic congestions are an every-day event, things might be different.

Cars moving in a traffic congestion, have higher emissions compared to driving the same distance at constant speed. Especially, in cities traffic has a major effect on local air quality. Car sharing thus has the potential to reduce this pollution. Firstly, due to car sharing, there will be less cars on the road. Shaheen and Cohen (2007), for example have shown that in Europe one shared car replaces 4 to 10 privately owned cars. Other literature also shows an amount of cars replaced within the range of 4 to maximum 10 in Europe (Van Driel & Hafkamp, 2015). This also means that less cars need to be produced. Secondly, car sharing affects local air quality indirectly, because of the decrease in cars there is less need for parking space. This space can in turn be filled with vegetation. It is however important to note, that traffic jams are mostly caused by people commuting by car and thus people use a car in a similar time slot. Nonetheless by reducing traffic on the road, car sharing has potential to reduce traffic congestion and help decrease emissions and improve local air quality. A research done by the PBL Netherlands Environmental assessment agency in 2014, showed that based on a reduction in driven kilometers, switch in transport modes and change in ownership, could lead to a reduction of $C0_2$ emission between 175 to 265 kg/year (Nijland, van Meerkerk, & Hoen, 2015).

3.3. Energy industry

With the increased demand for renewable energy sources and the European 2020 goals, the energy market is going through a change. New players that focus on decentralized energy provision are entering the energy market. The industry is seeing an up rise of more sustainable energy sources, environmental concerns, changing policies, and changing customer need (D'Souza et al, 2015). For example, there has been a big increase in collective solar parks. In October 2015, 83 of such parts have been realized, having a market share of 44% in solar energy production (EnergieBusiness, 2015).

As a result the concept of central energy generation is being challenged by a more de-central approach. In the Netherlands there are currently over 20 energy providing companies, some of whom have engaged in collective approaches towards energy provision. Qurrent for example takes an approach following the principle; generate what you use. Briefly explained a customer buys part of an energy source, to compensate for their energy usage. In contrast to generic central energy generation, this approach ask for a different way of doing business. Hence it is worthwhile to investigate these business models in terms of their sustainability. This is acknowledged by Gsodam et al. (2015) who looked at the Austrian energy market. They adopted a characterization stating there are two types of utility business models for renewable energies at the ends of the energy value chain. The utility-side and the customer side business model. In the former energy generation is at the

utility side while in the later it takes place at the customer side. In the Netherlands there are several energy providers that have production capacity, they are thus found at two positions in the value chain. For transmission and distribution the Netherlands has one provider Tennet. Other energy providers fall purely under retail, they provide energy but buy their capacity from energy producers.
Before long, the value chain would end with the consumer taking the energy from the retail energy companies. However with the increase of decentralized energy production, and the rise of prosumers this is changing. The example of Qurrent would in this value chain fall under the characterization of a customer side business model, see Figure3.2.

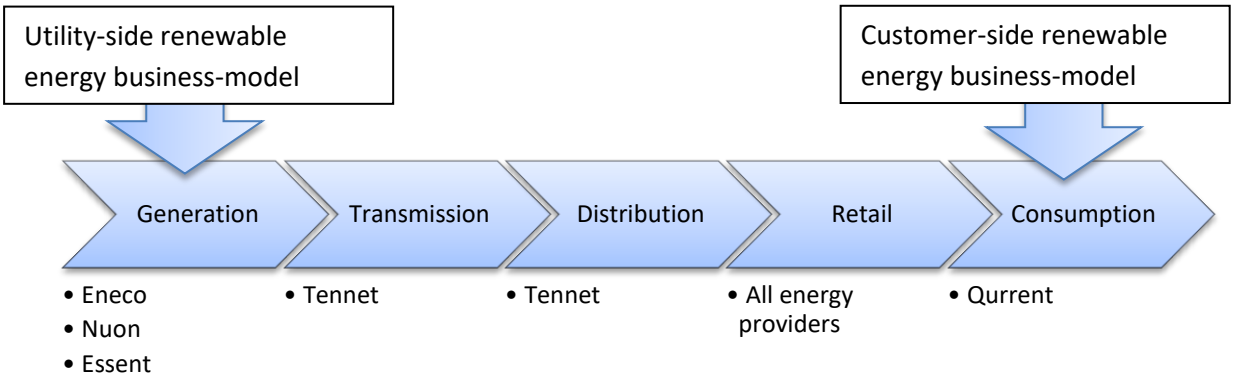


Figure3.2: Value chain of energy sector

3.2.3. Dutch renewable energy market

The Dutch energy supply is dominated by electricity generated from non-renewable energy sources, of which the lump sum stems from gas and only 10% of the total energy capacity comes from renewable energy sources, of which 82% is wind energy. Only a small amount of the total energy in the Netherlands thus comes from renewable sources, while gas is by far the largest source of energy. he Dutch households required around 20% of the electricity supply of the Netherlands in 2012. At a total usage of 112 TWh in 2012 this comes down to 22 TWh or around 800 times the total production capacity.
With only 10% of the energy being renewable in the Netherlands, most households simply cannot be supplied with renewable energy from the Netherlands. The Dutch government has put a target to reach 14% of renewable energy consumption by 2020. In 2012 this was around 5%, thus there seems to be market potential for introducing renewable ways of power production.
Looking more specific at the customers for energy companies rather than the technology in the market. Then the market is subdivided into two categories; large users and small users. Qurrent for example focuses solely on small users, therefore the focus is placed on this segment of the market. In 2014 there were around 7,6 million households in the Netherlands, of which little over 2 million switched from energy provider (Schmid 2015; van Duin, 2013).
The Dutch energy market is home to close to 30 providers, which shows that the market can change rapidly, and is constantly changing in terms of customer base. Customers are not at all loyal to their provider.

3.4. Conclusion

This chapter started with an introduction to the sharing economy and different business approaches. This was followed by an introduction to the car sharing sector. Two of the four cases in the case analysis are operating in this domain. Various forms of car sharing have

been introduced, but the focus in this research has been placed on classical and peer2peer car sharing. Where classical car sharing is one of the older more established approaches, peer2peer car sharing has seen rapid growth in recent years. Car sharing as part of the sharing economy has potential environmental benefits, which have been confirmed by various studies. However, whether full potential is reached is highly dependent upon user behavior.

The other domain discussed is the the energy sector. It was shown that new developments are taking place and that new forms of utility companies are appearing with customer side business models. Instead of the companies owning production capacity these models stimulate consumers to start play a role in the generation of energy.

This chapter gave the background for the case study and provides a basis for step three of the research approach. The following chapter will further elaborate upon the choice for this sector and the respective companies together with the methodology for the case study and the workshop.

Chapter 4 Methodology

As explained in chapter one this research is an in depth research following a qualitative approach using both secondary data and data from the field. This chapter elaborates on the methodological approaches taken in this research. The first two steps involved the identification of sustainability aspects and the selection of a suitable business model framework to be used in the case analysis. This chapter will elaborate upon the following steps that need to be taken in order to answer the research questions. Furthermore, attention is paid to the data collection methods in this research.

4.1 Research design

The aim of the research is to develop a business model framework that describes business models for sustainability and that can be used to identify critical design issues. To this purpose supporting questions have been set up, which results in the following unknowns that need to be identified: (1)sustainability aspects, (2)a suitable business model framework, (3) business models for sustainability and (4) success factors. This research follows a set of 6 steps which have been elaborated upon in this chapter, an overview is given in Table 4.1.

Table 4.1: overview of steps taken in the research

	Aim	Input	Result
Step 1 Literature study	Identify sustainability aspects from literature	Literature business models for sustainability	Set of 9 aspects see Table 2.3
Step 2 Framework development	Develop business model framework	Literature on business model frameworks and results of step 1	Adapted STOF model see Table 2.6
Step 3 Case selection	Identify business models for sustainability	Literature on business model archetypes by (Bocken et al., 2014)	Business models of: Greenwheels, MyWheels, Qurrent & VandeBron
Step 4 Case studies	Cross case comparison of the cases, as to validate the findings of step 1.	Desk research and interviews	Filled out adapted STOF model for each case.
Step 5 Brainstorm session	Identify success factors for business models for sustainability.	Insights from literature, interviews and brainstorm session	Set of 4 factors.
Step 6 Stress testing	Derive critical design issues	Business model in STOF and a Set of success factors	Set of critical design issues

4.2 Steps taken in research

This part will further elaborate upon the steps taken in this research, as introduced in table 4.1. After discussing the six steps part 4.3 addresses the data collection methods used in this research.

Step 1: Literature study

The purpose of the literature study, next to placing this research vis á vis other research, is to identify sustainability aspects. Business models for sustainability are the unit of analysis and understanding what plays a role in these business models is imperative. The outcome of this literature study is a set of sustainability aspects that play a role in business models for sustainability, according to literature. Taking this step means answering the first sub-question.

Step 2: Framework development

As sustainability is not explicitly embedded in existing business model frameworks, an effort has been made to adapt an existing business model framework. This allows the business models to be presented in a unified way and allows for adequate attention to sustainably aspects. By validating the aspects found in step 1 by means of the case study in step 4, this framework has also been validated.

Step 3: Case selection

Having identified sustainability aspects and having developed an adapted STOF ontology, these findings need to be validated by investigating existing business models for sustainability. To this purpose a case selection needs to be done.
An important aspect of the case study approach is the selection of the individual cases. According to Yin (2009) case studies should be selected such that they either predict similar results or predict contrasting results for anticipated reasons. The cases chosen can be distinguished on two points; firstly, there is made a distinction between the industry i.e. Car sharing versus Energy industry and secondly, a distinction is made between a business to consumer (B2C) and Consumer to consumer (C2C) or peer to peer, business approach. Four companies have been chosen to keep a feasible study with regard to time, moreover four cases allows for a higher level of external validity than does a single case.

The respective sectors have been chosen as they have potential for contributing to sustainability. Furthermore, technologies such as renewable energy sources and the electric car are being continuously developed further.
The distinction in business approach has been chosen since the peer to peer approach can be seen as a part of the sharing economy which implies a sustainable practice. To have a contrasting approach B2C has been chosen.

There are two main reasons why the companies have been selected for the case study. Firstly, all companies have a business model that can be identified as a business model for sustainability according to the archetypes as given by Bocken et al. (2014). Secondly, being established companies enough data is expected to be found. The following part will elaborate on these selected companies in their respective company.

Selected companies for the cars sharing sector

Within the car sharing sector two companies have been chosen for the case study. The first company is Greenwheels, which follows a classical car sharing approach. The second company is MyWheels, which follows both a classical and peer2peer approach, although the peer2peer part is bigger.

Car sharing sector B2C: Greenwheels

This company was founded in the Netherlands, and has been in business for over 20 years. Greenwheels, offers a car sharing service for people with a subscription. People can pick up a car, and drop it of at a designated location. It is this service that enables people to drive by car (individually) without the necessity of owning a car themselves.

Car sharing sector C2C: MyWheels

MyWheels in its current form was founded in 2010. This company also offers car sharing, in a similar fashion as does Green wheels, but the difference is that MyWheels also allows people to share their own car. So next to cars provided by the company, users can also rent-out their own car.

Selected companies for the energy sector:

The various utilities usually offer electricity and or gas. Utilities differ in the approach they take in offering gas and or electricity. Mostly this is offered in two contracts, it can therefore be considered a different product. Therefore, the focus in this research is placed on the electricity component utilities offer.

Within the energy sector two relatively new players have been selected; Qurrent and VandeBron. The first operates as a cooperation, which is one of the business model archetypes and an alternative type of ownership. In a cooperation ownership is shared among various parties. The cooperation acts as a utility company, for any customer and also for its members who own part of the production capacity. This approach is thus not purely a business to business approach nor a consumer to consumer approach. VandeBron operates in a similar form as MyWheels connects owners and potential users. This company thus facilitates a Consumer to Consumer approach.

Energy sector B2C: Qurrent

The company is located in the Netherlands with the core business of energy provider. It was founded in 2006 with the goal to become the first energy company that aims to let people use as little energy as possible. By letting consumers acquire part of an energy source, they can let people use what they produce. However before Qurrent became a utility company it was a company that focussed on helping people save energy.

Energy sector C2C: VandeBron

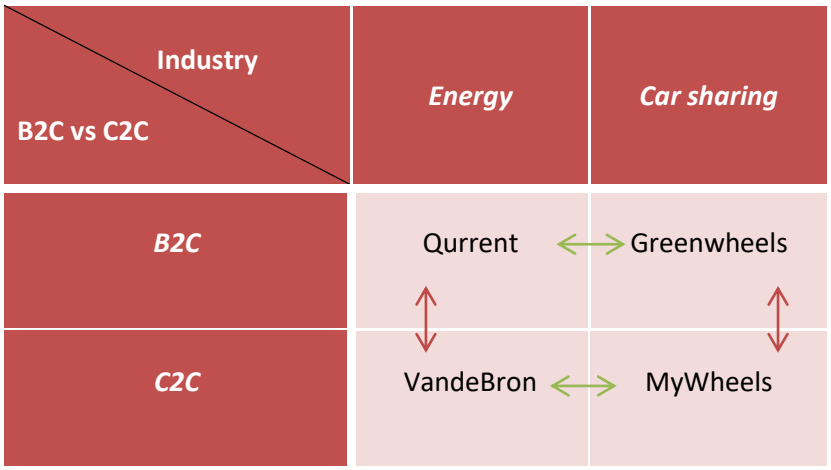
This company was founded in 2014 and wishes to play an important role in making the transition to an autonomous energy transition (van De Bron, 2016a). Van de Bron, is operating as energy provider and is based upon the idea of buying your energy directly from a producer. In a sense they directly connect consumer and producer. This gives the consumers the freedom to decide from whom they want electricity and what form of renewable electricity they want for their electricity consumption. Today, the company employs more than 50 people, and the model is already being adopted by the more established firms.

Case study set-up

Having selected the four companies for the case study the approach for the case study is discussed next.

The distinction in industry and business approach allows for a cross case comparison between various business models for sustainability, thereby increasing the confidence in the aspects found that constitute a business model for sustainability. This approach allows for various comparisons as shown by the arrows in figure 4.2. Comparing Qurrent with VandeBron and Greenwheels with MyWheels, provides insight in how business models for B2C differ from a C2C approach. Comparing the outcomes of these couples gives insight in what discrepancies or commonalities are there in the business models across the two industries. These case selections result in the following matrix.

Table 4.2 Cross case matrix showing industry and target segment for respective companies



Connecting this setup to Yin (2009); comparing within industries is expected to give contrasting results as the business models are different. Comparing across industries is likely to give more similar results when it comes to what sustainability aspects play a role. By making a comparison across industries, aspects that are industry specific can potentially be identified.

Step 4: case studies

The data collection methods used for the case analysis were; Desk research and semi-structured interviews. For each case the adapted STOF model has been filled in, thereby focussing on the added business model elements. This way insight has been created as to what aspects found from literature indeed play a role in business models for sustainability. All companies in the cross case have been approached for an interview and three out of four companies replied positively. To still gain more insight on the fourth company and the sector, an external party has been interviewed. The desk research provided the basis for the interviews, and the interviews allowed gaining a deeper insight in the business models. Further, it allowed for clarification since not all information on each business element could be obtained by means of the desk research. The focus of the interview was on the business model of the respective companies, thereby adhering to the aspects as found from literature.

Performing this step means validating the findings from step 1 and 2, and answering sub-question 2.

Step 5: Brainstorm session

In order to test the viability of a business model, the stress testing tool has been developed. As briefly touched upon in the first chapter, this involves testing the positive contribution of the various business model elements to the identified success factors. However, before being able to test the viability of a business model, these success factors need to be identified. This has been achieved by hosting a workshop, in which a brainstorm session on these factors has been held. However, the literature review has also yielded potential success factors which were validated in the case analysis. These have also been introduced during the brainstorm session. Performing this step means answering sub-question 3. Following the brainstorm a stress test exercise can be held, this will be elaborated upon in part 4.3.2.

Step 6: Stress test exercise

The last sub-question revolves around the identifications of critical design issues, this will be the purpose of the stress test exercise. More precisely critical design issues have been derived from the results of the stress testing exercise. This exercise has been performed on the business model of one of the energy companies present during the workshop. During the stress test, the participants have argued for a certain contribution of each business element to the success factors, this has yielded a heatmap. The argumentation behind this heatmap provides the input for the derivation of the success factors. This argumentation has been recorded in an excel sheet at the same time the participants were executing the stress test. This documented argumentation can be seen as a form of open coding. Common themes were identified and critical design issues were abstracted.

Overview:

The six steps taken in this research are connected the first two steps allow the identification of sustainability aspects and a suitable business model framework.
An overview of how these steps are connected is provided in the figure on the next page.
Step 1 and 2, form the literature study and provide the basis of this research. Step 3 and 4 are concerned with the case study and allow for the validation of the findings of step 1 and 2 i.e. can the sustainability aspects be identified in the cases. The finding from the case study, provide potential success factors that have been used as input for step 5. Furthermore, one of the business models expressed in the adapted STOF ontology is used in step 6 for the stress testing exercise.

Having discussed the steps taken in this research, the following part discusses the data collection methods used in this research and the reporting of the case study data. In this part the stress testing tool is also elaborated upon.

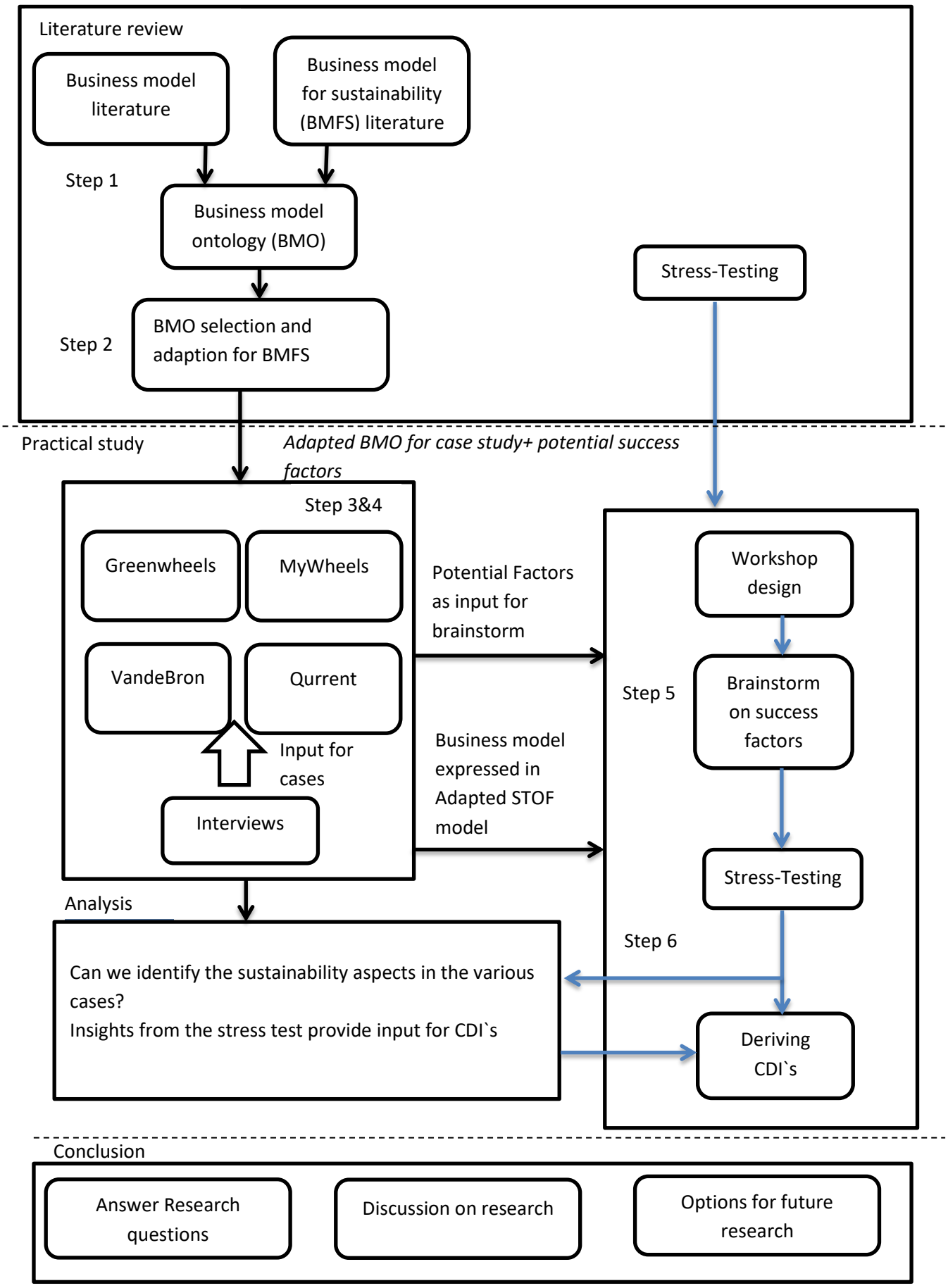


Figure 4.1 Overview of the various steps taken in the research

4.3 Data collection and reporting

The data collection for the case study is based on both a desk research and semi-structured interviews. The data collection for the workshop is done by means of a brainstorm session and a stress testing exercise.

4.3.1 Case study

For the case study two forms of data collection have been used, firstly a desk research and secondly by means of semi-structured interviews. The desk research has been the starting point for the case studies, which also provided the required knowledge to develop meaningful interview questions. Next to data collection the reporting of the case data is an important aspect of the case study.

Desk research:

The desk research for the cross case analysis focuses on several types of documentation:

- Academic literature
- Company websites
- Annual reports
- Business plans (if available)
- Others studies (if available)

Interview:

For the interviews the desk research is important input, on the one hand to be prepared and on the other hand to be able to ask the right questions. Next to asking the right question it is also important to interview the appropriate person. Therefore there are several criteria for the interviewee were set up;

- Willingness to give an interview
- Have a position/experience in business development (in practice this criteria cannot always be fulfilled)
- Allowed to discuss the topics raised by the interviewer

Before an interview takes place, the interviewer should discuss with the potential interviewee what information he can share and is willing to share. Thus before conducting the interview the questions have been offered to the interviewee for inspection. During the interview the interviewer has recorded the interview, to make sure answers are not subjected to alterations in making notes or when recalled from memory.

The interviews in this research followed a semi-structured approach. This means an interview protocol has developed which contains the questions on the topics to be discussed. These questions form a guideline for the interview, based on the responses or insights during the interview questions can be omitted or added. This also contributes to keeping the interview a natural conversation. The transcribed interview based on this protocol can be found in the external Appendix.

The interviewees are representatives of three out of the four companies, and one external party with knowledge on car sharing. See Table 4.3 below. The aim was to interview one representative for each company. Interviewing one representative allowed to gain enough additional insight and answers to questions that arose during the desk research. Moreover, the companies are relatively small and are asked for many researches. Therefore they can and mostly will dedicate only a certain amount of time to a particular research. These arguments were also the reason why MyWheels was unable to participate in the research.

In an effort to gain additional insight, the researcher of the Copernicus institute for sustainability was interviewed.

Table 4.3 overview of interviewees

Field of employment	Role/position
Energy company (VandeBron)	Account manager
Energy company (Qurrent)	Business developer
Car sharing company (Greenwheels)	Managing position
Copernicus institute for sustainability (car sharing sector	Researcher (PHD)

After each interview the interviewee was asked for their willingness to participate in the workshop. Also after transcription the interviews have been made available for the interviewees for inspection.

Case data:

The data on these various business model elements has been documented in the Envision case study protocol. This allows for a clear and unified representation of the various cases, which ensures focus on each element and allows for a more structured comparison between the cases.

The research sheet of this protocol is given below.

Research sheet	
Responsible researcher	Nico van Ginkel
Project research period	May until August 2016
Data collection tools used	Desk research Semi-structured interview
Data-analysis	No explicit coding used
Transcripts of interviews	Appendix
Transcripts of observations	Not done
Usage of codes and coding	Not explicitly done
Coding steps	Not explicitly done
Memo`s used for harmonization	No
Software used for analysis	No
Validation of interviews and results	Yes
Review by contact person	Yes
Review by external reviewers	Not done
Expert opinion requested	No
Review by co researchers	No
Type of business model	The business models of the four companies can be characterized as a business models for sustainability.
BM characterization	Business model ontologies do not explicitly take into account sustainability aspects.

BM ontology used **: Adapted STOF ontology**

Original business model elements of the STOF business model ontology			
Service domain • Customer • Target group	**Technology domain** • Technologic al	**Organization domain** • Actors	**Financial domain** • Investments • Costs

• Value proposition • Service offering • Context of use • Effort for the customer • Customer relationships	functionality • Architecture • Channels • Applications (apps) • Devices • Service platforms	• Actors • resources and capabilities • Value activities • Strategic interests • Organizational arrangements	• Revenues • Financial arrangements • Risk
Business model elements added to the STOF business model ontology			
1. Environmental value 2. Social value	3. Negative value of technology	4. Value added for stakeholders outside the value chain	5. Focus on Shared investments 6. Insights 7. Environmental and social risks that affect business
Generic sustainability aspects			
8. Having a sustainability leader 9. Having a sustainability strategy 10. Motivate customers to take action/responsibility towards sustainable behaviour			

Next to the case studies, the stress testing workshop is an important data collection method. The workshop consists of two parts, firstly a brainstorm session on success factors and secondly the actual stress testing exercise. This next part elaborates on this workshop.

4.3.2 Stress testing workshop

This part firstly discusses the setup of the workshop as a whole, before separately discussing the two parts of the workshop i.e. the brainstorm session and stress test exercise.

Participants of the workshop are ideally the interviewees of the companies and several persons with expertise in the field of sustainability. During the workshop the central question was: 'What factors positively contribute to the various business model aspects'. Therefore the first part of the workshop focuses on the identification of these factors and the second part on the positive contribution of the business model to these success factors.

Criteria set up for the workshop were the following:

- Combination of companies and external experts
- Minimum of three people for the workshop
- Affiliation with energy or car sharing sector
- Or people with experience in field of sustainability

These criteria have been met, however due to unforeseen events one of the three initial participants cancelled. The other companies were not willing to participate in the workshop.

The workshop had three main steps, the first two are part of the brainstorm and the last is the stress testing exercise itself.

1) The identification of success factors.

2) Derivation of a top 4 of success factors. Only four factors have been chosen, since otherwise the stress testing exercise would become to elaborate. These factors provide the input for the stress test.
3) Performing the stress test yielding a heatmap

In the end two people participated in the workshop, in addition one person hosted the workshop and one person recorded the data.

- The first participant was: Account manager at VandeBron
- The second participant was: Employee at RVO
- The workshop host was: Senior advisor at Innovalor
- The researcher, recorded the data

Brainstorm session

At the start of the workshop participants were familiarized with the idea behind the STOF ontology, success factors and critical design issues by means of a brief presentation. The success factors have been identified through a brainstorm session, in which the participants were asked to give success factors that contribute to a business model for sustainability. In order to give the participants some direction, the concept of a business model for sustainability was explained as a business model that takes into account environmental, social, negative value and external network value i.e. added value for stakeholders outside the value chain.
Other elements have not been explicitly mentioned as to keep the list of success factors manageable considering the time frame for the workshop. Furthermore, these four have been chosen to refrain from biasing the participants, since some of these can be interpreted as success factors or push the brainstorm too much in one direction. These value elements that have been mentioned are still relatively broad and open for interpretation. The focus thereby been placed on generic success factors, instead of industry specific or even case specific.

After a set of various success factors were found, previously identified success factors from the literature were introduced and added to the set of success factors. Having followed the discussion during the brainstorm and having an overview of the various factors, a set of 4 factors was selected to be used as input for the stress testing exercise. The factors selected were mentioned on different occasions by the participants and therefore cover the most important success factors identified. The number of success factors has been limited to four, since stress testing is a time consuming exercise and the whole workshop was scheduled to take place in three hours.

Stress testing

The stress testing tool is elaborated upon before discussing the steps taken during the workshop. The exercise of stress testing with success factors involves 7 steps as depicted below, in Figure 4.2.

Figure 4.2 Steps in stress testing with success factors (Van As et al., 2012)

The first step has been taken by adapting the business model ontology STOF.
The second step is about the different aspects of the business model that need to be described in the chosen language. Of key importance here is to find the required information. This step has been performed by means of the case study. The third step is selecting success factors. This step has been done as part of the workshop, in a brainstorm session. Where the first three steps are preparing steps the following steps involve the actual stress testing.
The fourth step is to map the business models to the Success factors. The fifth step is creating a heat signature, this means evaluating the impact of the factors on the business model components. The stress test tool makes use of four gradations of impact expressed in four colours, see Figure 4.3

- *Green:* Positive effect on the SF.
- *Red:* Negative effect on the SF.
- *Orange:* Neutral effect on the SF (room for improvement).
- *Grey:* Not relevant, no influence on the SF.

Figure 4.3 Colors used to create the heat map based on the outcomes of step four(Van As et al., 2012)

This results in a heat map similar as to shown in Figure 4.4. From this heat signature one can see what parts of the business model deserve attention and what parts of the business model are under stress or do not comply with the success factor. For example, in figure 4.4 the value proposition negatively contributes to cost effectiveness. From the heatmap Critical design Issues can be derived.

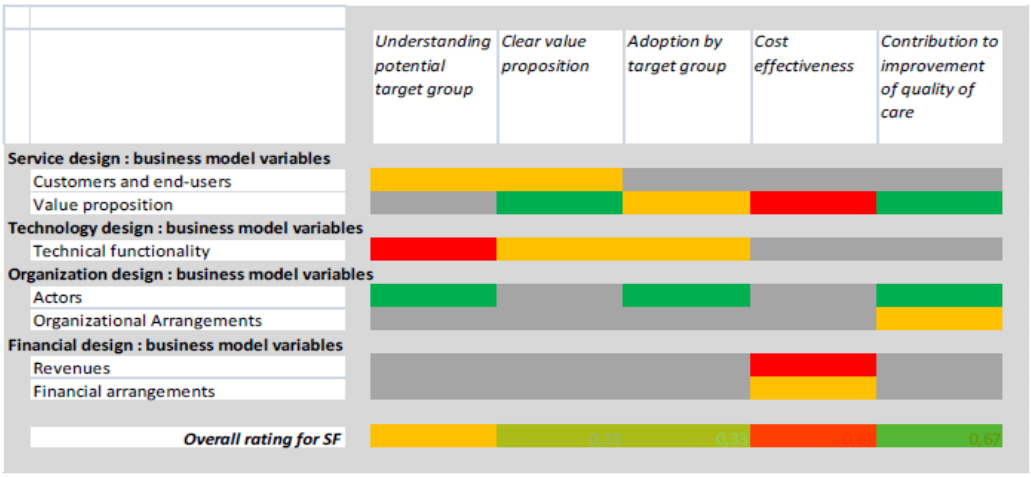


Figure 4.4 Generated heat map example (Van As et al., 2012)

Without making the business model elements concrete the stress exercise will likely yield trivial answers as the elements are an abstraction. That is why the business model of one of the energy companies has been stress tested.

Execution:

During the execution of the stress test the, central question was; “What business model elements contribute positively to the identified success factors?” Without making the business model elements concrete the stress exercise will likely yield trivial answers as the elements are an abstraction. That is why the business model of one of the energy companies has been stress tested.

Participants were provided a poster displaying the selected success factors and the chosen business model, together with a set of coloured sticky notes to indicate the impact. The reasoning behind the choices in the stress test have been recorded by the research in an excel sheet matching the poster. A more detailed workshop design elaborating on each element of the workshop is given in appendix E. The results of this workshop are elaborated upon in chapter 6.

Chapter 5 Results of the cross case comparison of the business models in STOF

This chapter involves step 4 of the methodology and discusses the cases on the four companies: Qurrent, VandeBron, Greenwheels and MyWheels, respectively. For each case the focus has been placed on the elements added to STOF and the findings are presented in a table at the end of each case. More elaborate case descriptions following the envision case study protocol can be found in Appendix A till D.

The results of each case are combined in one table giving an overview of the aspects that have been validated across the cases. In doing so this chapter provides the answer to sub question two. Moreover, the generic aspects that were added to the STOF model can be seen as potential success factors, as such they provide a first step towards answering sub question 3.

5.1 Qurrent

It can be argued that the value proposition of Qurrent is a mix of social, economic and environmental value. By only deploying renewable energy sources, Qurrent is capable of delivering environmental value. In doing so they directly contribute to a transition towards clean energy sources. Qurrent aims to actively engage people in contributing to this transition, through for example their product windtegoed. This product offering allows customers to gain ownership of part of an energy source. The energy produced by this part of their source, can be deducted before tax from their energy usage. In this way Qurrent has realized renewable energy sources in a financially attractive way and has found an **incentive for people to reduce their energy consumption** at the same time.

People are often price driven. We point people to the role they can play in the energy transition and indicate that our services can provide them with energy in a financially more attractive way than energy from the grid. (Interviewee 1, 2016 Role: Business developer)

Thereby, Qurrent delivers **environmental value** two fronts, i.e. reducing energy usage and producing energy in a renewable way. On the production side, Qurrent guarantees that the energy is 100% green and produced in the Netherlands. This is achieved by means of GVO`s (guarantee of origin). These are guarantees that the energy is green and that the amount of energy used by customers is indeed produced by Qurrent. The energy saving component is a self-reinforcing mechanism, due to energy savings the demand for energy goes down while the capacity grows or stays equal. This means that economically, renewable energy becomes more interesting.
In order to stimulate energy saving behaviour and allow people to save energy Qurrent has partnered with an external party that provides energy saving products e.g. isolation, solar boilers efficient lightning. Customers do however still have a choice, whether or not they wish to engage in this, Qurrent can also be the utility that provides access to 100% green energy without people having to change their habits or customs with regard to their energy. As such Qurrent offers people equal access to basic needs, stimulates sustainable behaviour and gives people the freedom to keep their habits and customs with respect to energy, thereby Qurrent delivers **social value.**

Even though the energy sources can be seen as producing 100% green energy, Qurrent is aware of the fact that **negative values** are attributed to their energy sources. That is why

Qurrent takes this into account when selecting projects. They aim to find dual functions and create a no netto loss. This implies that no additional losses are incurred, e.g. solar panels on a roof are preferred over occupying a green field.
For example, Qurrent engaged in a project where a solar park also provided space for sheep to graze and people to walk their dog. The people benefitting from these projects are not customers or stakeholders of Qurrent, yet value is delivered to them. Besides this , Qurrent is further looking into literature to gain more knowledge on this subject (Interviewee 1, 2016).

All actors in a value network can be characterized as being either Tier-1, Tier-2 or Tier-3 partners, (Bouwman et al., 2008).
Tier-1: Being essential and non-substitutable actors in the value network. They are of core importance in determining the intended customer value and the business model.
Tier-2: Provide services or deliver attributes that are needed for the service delivery, but do not affect the intended customer value or business model when substituted.
Tier-3: Provide generic goods and services which are needed in the value network, but which could be used in various other value networks.

For the realization of these projects Qurrent mostly interacts with tier-2 and tier-3 actors. Besides the added value for these actors Qurrent **does not add value for other actors outside the value chain**. In their choices they make for projects, reducing negative value and finding dual functions can add value for stakeholders outside the value chain. However, this is part of the choice for their project, and not per se stimulated by the business model itself.

Customers play an essential role within Qurrent. For starters it is up to the customers to start saving energy, but as owners of the energy sources and being a member of the cooperation customers have a say in what the company invests in and how it should handle its resources. One can however not really speak of **shared cost for investment in sustainable infrastructure,** since investments made by Qurrent, for say the windturbines at Hellegatsplein are still externally financed. Since customers own part of an energy source and the produced energy is deducted from their energy usage, **the financial model used by Qurrent gives people insight** in the price of energy and how much they are using. Qurrent provides this insight through the QBox and an App. The Qbox monitors the energy usage, while on the app people can see their real time energy production.

With respect to all these services **Qurrent can be seen as a leader or pioneer**, and even today Qurrent aims to stay on top of new technological developments.

For example the hourly prices as an instrument, is something we started off with relly quickly. However, this is not allowed yet nationwide, still we would like to offer this already as we aim to be a frontrunner (Interviewee 1, 2016)

This is emphasized by the fact that since new legislation was enacted, smartmeters are being installed by the grid operator, but before this new legislation Qurrent was already offering this service of energy monitoring. The reason for this being that Qurrent, before it was a utility company, solely focussed on providing energy saving services. The utility part stems from an initiative of Stichting DOEN, the climate bureau and the Nature and environmental federations. They aimed to find a different business approach for the energy

market and started the WeGenerate initiative. The merger of these two resulted in Qurrent as the company known today. Qurrent is thus based on a radically different business approach, driven by people with a vision to make a change in the energy market part and part of them are still working in Qurrent.

The energy market moves to slow and we wanted to bring a new player to the market. (Interviewee 1, 2016)

Qurrent thus has a **proactive sustainability strategy**. This also makes Qurrent difficult to compare with other utility companies, because it is in fact owned by many consumers and operates in their interest. It even could be the case that five years from now the member council could be the highest power organ within Qurrent (Interviewee 1, 2016). This is a totally different approach that discards conventional approaches and really places consumers in the driver seat.

We will give them insight, create awareness and give them negotiation perspectives (Interviewee 1, 2016)

Qurrent has a business model for sustainability in place that is able to deliver social and environmental value. There are however certain **risks** that Qurrent runs on these aspects,
With growing competition in the field of renewable sources, it might prove harder for Qurrent to always take into account negative value in their choice for projects. Also, a strong aspect of Qurrent is that they aim to make people more conscious about their energy usage and strive to make them reduce their energy usage. To really achieve this people need to change their habits and customs. With the approach of Qurrent saving energy makes the renewable sources more affordable, however when people are not inclined to start saving energy, the relative price for energy will stay high.

5.1.1 Conclusion

This part has given an overview of the business model aspects of Qurrent, where explicit attention has been paid to the 10 aspects as given in Table 2.3. The table below indicates whether or not the aspects, both Generic and for STOF, have been found back in the case study. Three gradations have been used

1. Yes the aspect has been identified (green)
2. No the aspect has not been identified (red)
3. The aspect has been identified partly(orange)

This table is used similarly for the other 3 cases.

Table 5.1 overview of the results as found from the case study on Qurrent

	Aspects added to STOF	***Identified in the case (Yes/No/Partly)***
Service	1. Environmental value	Yes (100% green energy)
	2. Social value	Yes (equality, stimulate sustainable behavior, not altering customs and habits)
Technology	3. Negative value of Technology	Yes (taken into account when selecting projects)

Organization	4. Value added for stakeholders outside the value chain	No (not identified)
Financial	5. Shared cost for investments in sustainable infrastructure	No (external investments not shared)
	6. Potential Environmental and social risks that affect business	Yes (negative value under pressure with increasing competition, voluntary behavioural change of consumer)
	7. Financial model that provides insight	Yes (use what you produce, insight through app and Qbox)
Generic aspects	8. Having a sustainability leader	Yes
	9. Having a sustainability strategy	Yes
	10. Motivate customers to take action/responsibility towards sustainable behaviour	Yes (offers financial incentive, and means to save energy.

5.2 VandeBron

VandeBron has been able to redefine the value proposition of a utility company, by directly connecting consumers with renewable energy producers.
In doing so VandeBron offers consumers transparency as to where their energy comes from and as to how it is produced.

We strive for traceability, transparency is what we stand for and we aim to give insight in to what is happening

This leaves consumers the freedom to make a deliberate choice for a renewable energy source. The transparency goes as far that producers are personally introduced on their platform. Producers tell their story behind the energy they offer, this adds a personal touch.
On the producer side VandeBron, offers the producers the freedom to determine the price of their energy, based on the market price while staying below the prices of the big three players in the market. Also, through the transparency it is also possible for a producer to actually sell its energy locally.

With this approach VandeBron facilitates a market place, making possible the direct connection between producer and consumer. VandeBron has no interest in selling more energy per user, instead they earn a monthly fee called “vastrecht”. This decouples the energy price from the prices paid to the grid operators and the utility company. This results in **clarity within the financial model** as to what is paid to the producer, VandeBron, and the grid operator. The only thing that is not fully clear, is the profit margin that is left for the producers. Any profit margin on the energy is given back to the producer by means of identity premiums, which makes investing in renewable sources more attractive. Producers get this identity premium by offering transparency, resulting in the various stories on the website (Interviewee 2, 2016).

The producers connected to VandeBron only offer renewable energy thus VandeBron has found a way to offer 100% renewable energy sources in an economically feasible way where people still have access to energy as they are used to. However, unlike Qurrent,

VandeBron does not stimulate a **change in consumer behavior**. Nonetheless, VandeBrons' value proposition contains components of environmental social and economic value.

Although VandeBron delivers **environmental value** through their renewable energy sources, negative value can be attributed to them. In a report by the consumentenbond biomass installations offered by VandeBron were seen as not fully sustainable as these can be fuelled by valuable products like wood or cattle feed. These **negative attributes** are taken into account by VandeBron in selecting their producers, as to prevent such biomass installations from delivering energy through VandeBron.

Bio-installations that process food is a form of negative value we do not support (Interviewee 2, 2016)

Moreover, similarly to Qurrent, VandeBron is researching the possibilities of further taking into account negative value. For example in setting up criteria for producers, who currently are judged upon their story.

For VandeBron it is important that our producers share our vision with respect to sustainability (Interviewee 2, 2016).

With connecting producers and consumers directly, VandeBron follows a peer2peer approach. This means that they support **shared cost for investments in sustainable infrastructure.** On a larger scale through the producers that have invested in their renewable energy sources and on a smaller scale through people with solar panels who offer their surplus power. The latter approach is called zonnecollectief and allows even consumers to contribute to sustainable energy supply on a small scale. This also means that the role of consumer changes to consumer/producer. In connecting producers and consumers directly no **additional value** is created besides the value for these two parties.
With this peer to peer approach VandeBron, is dependent upon the two parties to use their platform. The **risk** they run with rising competition is that their influence upon the type of renewable energy and at the same time the negative value attributed to this source becomes less. Producers determine what sources they use for their energy, and if the criteria of VandeBron are too strict in comparison to competitors, VandeBron might not be able to supply 100% green energy to their consumers. At the same time since consumers are price sensitive VandeBron needs to stay price competitive.

With the approach taken, VandeBron is **a pioneer in the market**, in fact the concept is already being copied by Nuon. The idea for this stems from four entrepreneurs who raised the question whether it would be possible to directly buy energy from the producer. They took up this task and came up with the business approach of VandeBron. Which can be seen as a proactive **sustainability strategy**, as indicated by (Schaltegger et al., 2012).

5.2.1 Conclusion

The case of VandeBron yields the following findings as displayed in the table below. The findings on Social value deserve some further explanation. Social value has not been fully identified within VandeBron. Yes VandeBron offers equal access to a commodity, and does not really change habits and customs with respect to energy usage. However, VandeBron does not stimulate sustainable behaviour, like Qurrent does therefore the social value delivery of VandeBron has been partly identified, meaning there is room for improvement.

Table 5.2overview of the results as found from the case study on VandeBron

	Aspects added to STOF	*Identified in the case (Yes/No/Partly)*
Service	1. Environmental value	Yes (100% green energy)
	2. Social value	Partly (no focus on sustainable behavior)
Technology	3. Negative value of Technology	Yes (taken into account when selecting producers)
Organization	4. Value added for stakeholders outside the value chain	No (not identified)
Financial	5. Shared cost for investments in sustainable infrastructure	Yes (peer2peer approach)
	6. Potential Environmental and social risks that affect business	Yes (compliance with their criteria for sustainable sources)
	7. Financial model that provides insight	Partly (on the consumer side yes, but on the producers side no)
Generic aspects	8. Having a sustainability leader	Yes (founded from the conviction to do it different)
	9. Having a sustainability strategy	Yes
	10. Motivate customers to take action/responsibility towards sustainable behaviour	No (no real incentives identified)

The previous parts have shown both Qurrent and VandeBron, both belonging to the energy sector. The following two parts discuss Greenwheels and MyWheels respectively these both operate in the car sharing sector.

5.3 Greenwheels

Greenwheels has a business model archetype that focuses on functionality rather than ownership and can thus be qualified as a business model for sustainability. The **environmental value** delivered by Greenwheels stems mostly from a reduction in usage of cars and the ability to deploy fuel efficient cars. This reduces the amount of cars on the road thereby reducing emissions and enhancing liveability in cities.

The **social value** is delivered on two fronts. Firstly, making use of Greenwheels` services stimulates sustainable behaviour. Instead of owning a car one now shares a car, which might not always be available at desired times. This nudges people to make use of alternative transportation modes. Secondly, Greenwheels offers the ability for people to have access to travel by car in a financially approachable way. However, Greenwheels` customers cannot be found in all layers of society, but in order to make the company more approachable Greenwheels has recently changed its course. As such the age limit of 24 has been lowered, and a subscription with a monthly fee of 0 euro`s has been introduced, meaning people only pay for usage of the car. Together with reduced emissions and enhanced liveability, the value proposition can be placed at the intersection of social, economic and environmental value.

Next to customer value, the business model of Greenwheels also delivers **value to actors outside the value chain**. Municipalities and the Dutch railways (NS) find added value

through cooperation with Greenwheels. For municipalities cooperation with Greenwheels can reduce traffic congestions and improve local air quality.

Congestion due to urbanisation is a growing problem we can offer part of the solution for this (Interviewee 3, 2016, Managing position)

The business models of the NS and Greenwheels complement each other, customers traveling by train can make use of a shared car to travel from the train station to the desired destination.

Negative value as such is not considered by Greenwheels, but rather the improvement over car ownership. Nonetheless, Greenwheels strives to deploy fuel efficient cars. Not only is this beneficial for the environment it also reduces the costs per driven kilometer.
The financial model of Greenwheels allows users to have clear insight in what they pay per kilometer on fuel, distance traveled and other expenses, as a result they will not needlessly drive extra kilometers since they directly pay for each driven kilometer.

Because there is clear insight in what costs are attributed to a driven kilometer and you pay for this usage. People are driving more conscious, leading to less kilometers and less emission. (Interviewee 3, 2016).

However, since Greenwheels has introduced new subscriptions with free initial mileage, this insight and effect has been reduced. By doing so they not only undermine the insight for consumers, but also environmental value is reduced. Another problems lies in the fact that people need to be able to compare these costs but "*…information on what a car actually costs is not very well known. People think driving here costs me only the gas, but obviously that is not the case" (Interviewee 4, 2016, Researcher at Copernicus institute for sustainability)*.
Thus, although Greenwheels gives their people clear insight as to what a car at Greenwheels cost the relative insight is still low.
There is not only a financial incentive that stimulates more sustainably responsible behavior. As said car sharing nudges people towards the use of alternative transportation modes. Not only because a car is not always available, but also because people need to make a reservation and pick up and return the car. For shorter and spontaneous trips other modes of transport likely become more interesting. As such the business approach of Greenwheels contributes to a **change in behavior** of the customers. Moreover, Greenwheels provides a solution for people who do not own a car to travel by car.

If these people are reached early, then a solution is provided for them to maybe never buy a car (Interviewee 3, 2016)

Greenwheels thus activates people to think about their travel behavior and make conscious decisions about car usage. Yet still, Greenwheels car are mostly used for recreational purposes, e.g. visiting family, shopping, moving heavy loads. Greenwheels` cars have not replaced all common functionalities of the car. The main barrier towards growth in adoption can be attributed to ignorance.

People actually do not know how car sharing works, car ownership is still logical, the challenge is how do we get the 1% to more than 1%. (Interviewee 3, 2016)

Another aspect that hampers adoption is the lack of marketing. Greenwheels does not do much in marketing or approaching its customers, but this can be an important tool to increase the user base. Where a social **risk** is the ignorance of people the opposite could pose an environmental risk. An increase in user base, could result in a rebound effect. Meaning that due to the fact that many shared cars are offered, people prefer taking a shared car over waiting ten minutes for the bus. This is a severe environmental risk.

Overcoming the ignorance is also one of the purposes of the Greendeal. This is a joint initiative set up by the Dutch government to make car sharing grow, with the goal of 100.000 shared cars in 2020. Every car sharing company has its own role to play in educating the users, but this can also be related to municipalities. Creating awareness can be coupled to parking spots in crowded cities. Often these spots are expensive and have waiting lists, here a potential role for municipalities could be to inform these people about the benefits of car sharing over car ownership (Interviewee 3, 2016). This could increase awareness and potentially reduce the demand for parking spots in cities.
The role of Greenwheels within this greendeal revolves around sharing knowledge, with 20 years of experience Greenwheels has a lot of insights and knowledge, in that sense Greenwheels can be seen as a natural leader. Greenwheels, 20 years back already had a forward view, rather than offering car sharing as a service, there was a bigger goal behind it, i.e. enhance liveability, and in doing so look at deploying more and more sustainable cars. In 2010, they already did a pilot with EV`s, which was not successful. But in that sense you could say that Greenwheels is a frontrunner. And the **conviction of its founders, really drove sustainable development** within Greenwheels.

5.3.1 Conclusion

Table 5.3overview of the results as found from the case study on Greenwheels

	Aspects added to STOF	***Identified in the case (Yes/No/Partly)***
Service	1. Environmental value	Partly (undermined by free mileage)
	2. Social value	Partly (car sharing requires drastic change in behavior)
Technology	3. Negative value of Technology	No (not taken into account)
Organization	4. Value added for stakeholders outside the value chain	Yes (Municipalities, NS)
Financial	5. Shared cost for investments in sustainable infrastructure	No (cars are bought by Greenwheels)
	6. Potential Environmental and social risks that affect business	Yes (ignorance of people, rebound effect)
	7. Financial model that provides insight	Partly (pay per km, but undermined by free mileage)
Generic aspects	8. Having a sustainability leader	Yes (Founders were driven to make a change)
	9. Having a sustainability strategy	Yes (totally different business approach when founded)
	10. Motivate customers to take action/responsibility towards sustainable behaviour	Partly (yes financially incentivised, yet undermined by free mileage)

5.4 MyWheels

Just like Greenwheels, MyWheels has adopted a business model for sustainability. However, MyWheels has adopted a hybrid form. Meaning they have two approaches towards car sharing. For one they engage in a B2C approach, with their MyWheels fleet of smart wheels, but the biggest part of MyWheels revolves around P2P car sharing.

The **environmental value** of MyWheels mainly revolves around a reduction in cars needed to fulfill transport needs of the peers. However, how big this environmental value will be is largely dependent on choices made by the users regarding, type of fuel and type of car they use from the platform. What is certain is that through p2p no new cars need to be fabricated in order to fulfill the travel needs of peers. MyWheels delivers **social value** in various ways for one through enhanced livability of neighborhoods, e.g. lesser cars.. But also through offering people access to a car that otherwise would not be able to. Moreover, MyWheels offers the opportunity for communities to be formed, and use the platform within their community on customized terms.

On the downside car sharing does require a change in behavior or habits with respect to car ownership. Neighborhoods that start such a community are likely to interact more and have a more socially interactive neighborhood. Other transport modes are also made more approachable since they are offered in the same neighborhood, and are shared with common and familiar people. MyWheels thus has a strong social component in their value proposition. As such it can be concluded that the 3 components of sustainability are present in the value proposition.

Most **negative value** can be attributed by the cars deployed through MyWheels. This is mostly attributed to emissions and occupied parking space. However, in contrast to Greenwheels, production cost of cars deployed though MyWheels on a peer to peer basis do not need to be considered as these cars are there irrespective of MyWheels, as such it is not negative value added by MyWheels. MyWheels only has control over its own fleet, and here they deploy only A label cars, which limits emissions up to a certain extent. But it is difficult to say whether they include the concept of negative value in their decisions, as MyWheels was not willing to cooperate in giving an interview.

Next to delivering value for its customers and the environment MyWheels is able to deliver **value for other actors outside the value chain**. MyWheels has a similar value proposition for municipalities as does Greenwheels. In the sense that they can provide a solution to overcome congestion and lack of parking spots in cities. Moreover, since they offer an open platform other car rental companies, or different business cases for car sharing for example (drive moby), can benefit from the platform. Anybody who has an initiative, but lacks the IT infrastructure can contact MyWheels, as such they contribute to making car sharing grow. In this respect MyWheels can be seen as a frontrunner. Henry mentink the founder of MyWheels, started with the initiative of Wheels4alls in 1993 and initiated MyWheels in 2010. Also in those early days he helped Greenwheels in their initial phase, thus Henry Mentink can be seen as a **sustainability leader** driven by a vision to grow car sharing and increase livability in cities, that strongly contributed to the success of MyWheels.

The **strategy** opted by MyWheels in offering their platform open source can be considered radical and proactive in helping car sharing grow. For MyWheels it does not matter that other parties and maybe even competitors in the car sharing market make use of their platform. Because MyWheels does not earn its money on the kilometers or hours driven, but rather on the number of cars that are shared through the platform. Thus the more cars and the more often cars are shared on the platform the better it is for MyWheels. Although the prices are determined by the car sharer. **The financial model**, gives peers clear insight for what they pay each other. The tariffs incurred by MyWheels are clear, 12,5% of the fare

for insurance purposes. And €2.5 euro per peer per trip, which used to maintain the business. However, with a growth in user base this fee can turn in a substantial revenue stream, which will have to be reinvested in MyWheels. One could think of expanding the fleet of MyWheels` smartwheels. As such MyWheels would not require outside investments to expand its business. Overall MyWheels does not require much investments only seed capital has been used. But regarding its fleet, it strongly depends upon the users who privately bought a car and offer it for sharing, as such this can be seen as a form of **shared investment** that makes the service offering possible. A very strong point of the MyWheels platform is that it strongly nudges its people to think about the modes of transport they use, thereby stimulating **sustainable behavior**. In using a car via MyWheels the user directly has to pay for its usage, since next to the €2,5 the user will pay a certain amount for gas or mileage unless otherwise agreed with the owner. Sometimes people give free mileage of a 100km, irrespective of the amount you drive between 0 and 100km you will pay a fixed price. This will however blur the insight in what people are paying for, and it makes people less conscious about their car usage. In this sense MyWheels does not differ much from Greenwheels, were it not the case that MyWheels also offers for example OV-bikes. Users are triggered to participate on the MyWheels platform for two main reasons, first there is the financial incentive. Meaning people can earn money on their car where it otherwise would remain idle in the drive lane. And Secondly people wish to do their bit in the sharing economy and participate in doing things together. Just like Greenwheels, MyWheels is also part of the Greendeal, in which the goal was stated to have 100.00 shared cars by 2020. And peer to peer car sharing might be the way to reach this number. Peer2 peer car sharing has seen rapid growth, however there are still hurdles toward further adoption and as of yet around 1% of the population in possession of a driver's license is engaged in some form of car sharing. While in peer2 peer car sharing, most people offer their car on the platform this does not mean that these cars are in fact also being shared. Thus offering 3000 cars on the MyWheels platform does not mean 3000 cars are shared among people. Offering a car on MyWheels is relatively easy, one can freely upload their car and wait for people to respond. Whereas using a car via MyWheels first requires a deposit of €250 and the steps of engaging with an unfamiliar person to use his/her car. Thus MyWheels in that sense is more approachable for the car owner. However, MyWheels is working on an approach in which user do not have to make this deposit. But overall MyWheels is an open and quite approachable platform that can play a big role in facilitating an easy way for various actors to engage in car sharing.

5.4.1 Conclusion

Table 5.4: overview of the results as found from the case study on MyWheels

	Aspects added to STOF	***Identified in the case (Yes/No/Partly)***
Service	1. Environmental value	Partly (undermined by free mileage)
	2. Social value	Partly (requires change in habits and customs towards cars)
Technology	3. Negative value of Technology	No (not idenfied)
Organization	4. Value added for stakeholders outside the value chain	Yes (municipalities)
Financial	5. Shared cost for investments in sustainable infrastructure	Yes (peer2peer approach)

	6. Potential Environmental and social risks that affect business	Yes
	7. Financial model that provides insight	Partly (people know what they pay for, but can differ from car to car)
Generic aspects	8. Having a sustainability leader	Yes (founded by person with vision to reduce number of cars on the road)
	9. Having a sustainability strategy	Yes (radical different approach)
	10. Motivate customers to take action/responsibility towards sustainable behaviour	Yes (everyone can use the platform, and community forming is supported)

5.5 Cross case comparison

Service domain

1) Environmental value

Both companies have been able to deliver 100% green energy from the Netherlands by means of renewable sources. Where Qurrent mainly focuses on Solar and Wind, VandeBron currently also offers electricity produced form biogas installations.
Greenwheels and MyWheels have cars that run on non-renewable fuel They can thus improve its environmental value delivery by focusing on deploying more efficient cars or better yet electric vehicles. Greenwheels is looking in that direction, but deploying electric vehicles has proven financially not possible without subsidy. For MyWheels this might prove more difficult as they depend on the type of cars offered by the peers. Yet car sharing does reduce emission. As such Environmental value has been validated.

2) Social value

On a social sustainability level there are some differences between the companies. Although, both energy companies do not require a change in habits or customs towards energy, they differ on making people aware of their behavior towards sustainability and providing the means to do so. Qurrent actively focuses on this aspect, and provides energy saving products and insight in energy production and consumption. VandeBron does not show any of such initiatives. This likely stems from the fact that Qurrent started as a company focused on energy saving products, while VandeBron recently stated as a new utility company.
On this point the car sharing companies do not differ much, both offer people who cannot own a car access to a car. They enable a change in behavior, by making people more aware of their choice of transport mode as they have to pay every time they use the car. On the downside this means that people have to adapt their habits and customs toward cars.
Some form of social value has thus been identified in VandeBron, MyWheels and Greenwheels although there is room for improvement, while Qurrent does deliver social value. As such social value has been validated

Technology domain

3) Negative value

On this point energy companies perform equally well since Negative value is taken into consideration. In practical terms this means that Qurrent strives to reduce negative value associated to their projects as much as possible. For VandeBron it means they are developing selection criteria for the producers displayed on their platform

In contrast to the energy sector the companies in the car sharing sector have not been found to consider negative value as such, but rather the improvement over car ownership. The only thing that can be considered to overcome this is deploying the most efficient cars.
Both companies do however deploy fuel efficient cars in their fleets, but this is not per se environmentally driven. It also increases the range of the cars, increasing user experience and driving down the costs per KM.
The findings on Negative value usage, result from the interviews taken with the respective companies. However, no interview has been conducted with MyWheels, it thus might be the case that they do consider negative value. Nonetheless two companies strongly emphasized the role of negative value for sustainability, as such this can be considered validated.

Organizational domain

4) Added value for stakeholders outside the value chain

Both companies in the energy sector do not provide value for stakeholders outside the value chain. Although Qurrent did see opportunities to achieve this, it has likely has to do with the fact that the role of the two companies is that of a utility company, their core business consists of handling the steps that come into play when connecting a consumer with the electricity net. This does not involve or concern many other parties.
Adding value for stakeholders outside the value chain is something that both car sharing companies do achieve. Greenwheels delivers value to the NS and municipalities and MyWheels also delivers value to municipalities. Moreover, by letting other parties use their platform they deliver value to any car owning party that shares via MyWheels. Hence, this aspect can be considered validated.

Financial domain

5) Shared cost for investments in sustainable infrastructure

On this point a clear difference appears, which stems from the business approach. VandeBron and MyWheels as a peer to peer approach pool energy supply and cars, which can be seen as shared cost for investments for sustainable infrastructure by the separate producers and users, respectively.
In contrast Qurrent and Greenwheels invest in the renewable sources and cars, respectively. And they do this as a company or using external investors.
However, because cars sharing adds value for other parties outside the value chain one can see the potential forms of shared investments/ costs. The example given for Greenwheels was that municipalities can reduce the fees for parking spaces of shared cars, thereby indirectly bearing the cost.

6) Potential Environmental and social risks that affect business

The risk run by the companies are quite similar, the difference is that Qurrent still has more control over the energy they deliver. While VandeBron is dependent upon its producers, and thus has less control over negative value attributed to the sources.
For both car sharing companies the biggest concern is overcoming the ignorance of people towards car sharing. Furthermore, people engaging in car sharing must be willing to adapt towards a different behaviour in using the car. For both car sharing companies the social risk involves around consumer adoption. For Qurrent and VandeBron this risk is less, as consumers do not need to change their customs and habits per se, although it is an important aspect of the value delivery of Qurrent.

7) Financial model that provides insight

Both energy companies have a financial model that provides insight. One difference is that at VandeBron there is no real insight as to what profit margin goes to its producers.
VandeBron brokers between two parties, while at Qurrent there is one vested party which are the members of the cooperation. For the cars sharing companies the financial models provide a level of insight, in the cost attributed to driving a car. However, the insight at MyWheels is lower since people can determine the payment. Moreover, both companies offer free mileage this will reduce customer insight in the costs of driving, and make people less conscious about the kilometers driven since they will pay the same price.
All models provide some level of insight, as such this aspect has been validated.

Generic aspects

8) Having a sustainability leader

Having a sustainability leader was identified in all companies. The initial founders that drove the realization of the companies really believed in a sustainable business approach.
Greenwheels and MyWheels both have been founded from an ideal of reducing the amount of cars on the street and increasing livability in cities. These founders were entrepreneurs and maybe even pioneers in car sharing.
Qurrent and VandeBron were founded by people who envisioned a different approach in the energy sector. Qurrent by with giving ownership of energy sources to the consumers and VandeBron with connecting consumers with producers directly. It were the founders that really made these ideas to the businesses they are today.

9) Having a sustainability strategy

All companies have taken a radical different approach towards business in their sector and have been able to deliver services that deliver value on social, financial and environmental aspects. This is what characterizes a proactive sustainability strategy.

10) Motivate customers to take action/responsibility towards sustainable behaviour

It are Qurrent and MyWheels that strongly motivate customers to take action towards sustainable behaviour while Greenwheels and VandeBron do not.
For Qurrent this might stem from the fact that Qurrent has more of an intrinsic financial motive to do so since Qurrent has a direct benefit if people use less energy, because more people can be connected to one power source, which increases their revenue stream with the same amount of capacity. Moreover, before Qurrent became a utility company its core business revolved around providing people means to save energy.
Car sharing in itself is already an example of responsible sustainable behaviour, but there is a difference between the companies on this point. Greenwheels does not actively engage with its customers and is mostly focussed on providing the car sharing service. MyWheels in contrast, allows customers to take initiatives and allows communities to be formed who share cars or other transport modes on the platform at reduced tariffs.
As such in two companies in two different industries with two different business approaches this aspect has been identified.

An overview of the findings of the case studies and cross case can be found in the Table on page 64.

5.6 Conclusion and Discussion

This chapter provided an overview of the case study performed on the business models of four companies expressed in the adapted STOF ontology. These four business models have been separately analysed, where special attention was paid to the sustainability aspects as added to the STOF ontology at the end of chapter 2.
Not all aspects have been identified across all cases, however all aspects have been identified in at least 2 cases. Three aspects were identified across all cases. Also some aspects were identified, but only partly.

All aspects identified thus do play a role in business models for sustainability and as such these aspects should be considered in the STOF model. The generic aspects identified cannot be incorporated in the STOF model, they can however be used in the next part of the research.
Until this point two of the four sub questions have been answered. The first sub question: "what aspects characterize business models for sustainability according to literature?" Has been answered at the end of chapter 2. Based on this the STOF business model ontology has been adapted, resulting in a STOF ontology that is suitable to describe business models for sustainability.
The results of the case studies presented in this chapter provide the answer to the second question: "What aspects found in literature can be validated in existing business models for sustainability?" It was found that all aspects identified in literature were confirmed in at least two cases or more.
Thereby the first goal in the research has been achieved namely, developing a business model framework suitable for describing a business model for sustainability.
The second goal in this research is to identify critical design issues, this can be done by stress testing a business model with success factors. To achieve this goal this chapter provides the validated business model framework in which the business model is expressed, but success factors still need to be identified.
Some potential success factors have been identified in this chapter: These are the following:

- Shared cost for investment (5)
- Having a financial model that provides insight (7)
- Having a sustainability leader (8)
- Having a sustainability strategy (9)
- Motivate customers to take action/responsibility towards sustainable behaviour (10)

Although the first two can be incorporated in the business model framework the specific description of what the financial model should provide can be seen as success factor.
As such these aspects will be incorporated in identifying success factors. In the first part of the workshop i.e. the brainstorm session, these factors can be validated , while in the second part they might be used in the stress test.

Table 5.5: Giving overview of the results as derived from this chapter.

	Aspects added to STOF	*Energy Sector*		*Car sharing sector*		
		Qurrent	*VandeBron*	*Greenwheels*	*MyWheels*	
Service	1. Environmental value	Yes	Yes	Partly	Partly	For all models environmental was identified, although for cars sharing there is room for improvement
	2. Social value	Yes	Partly	Partly	Partly	For all models except Qurrent social value was partly identified.
Technology	3. Negative value of Technology	Yes	Yes	No	No	Negative value is considered by the utility companies, but not by the car sharing companies.
Organization	4. Value added for stakeholders outside the value chain	No	No	Yes	Yes	The car sharing companies add value to stakeholders outside the value chain, the utility companies do not.
Financial	5. Shared cost for investments in sustainable infrastructure	No	Yes	No	Yes	The C2C approaches have been found to have shared cost for investment, while the B2C approach make their own investments.
	6. Potential Environmental and social risks that affect business	Yes	Yes	Yes	Yes	For all companies potential social and/or environmental risks were identified
	7. Financial model that provides insight	Yes	Partly	Partly	Partly	Qurrent's financial model does provides most insight. The others to a lesser extent.
Generic aspects	8. Having a sustainability leader	Yes	Yes	Yes	Yes	The companies were found to have sustainability leaders in the firms
	9. Having a sustainability strategy	Yes	Yes	Yes	Yes	The companies were found to have sustainability strategy.
	10. Motivate customers to take action/responsibility towards sustainable behaviour	Yes	No	Partly	Yes	Qurrent most strongly motivates customers to take responsibility/ action to reduce their energy usage, VandeBron does not. While engaging in car sharing automatically means people are more sustainable, conscious or not. Yet free mileage does not motivate sustainably responsible environmental behavior.

Chapter 6 Results stress testing workshop

Whereas the previous chapter focused on the validation of the aspects found in literature and the developed adapted STOF model, thereby answering sub question 2. This chapter is focused on providing the answers to sub questions 3 and 4. As discussed in the methodology chapter, step 5 and 6 will be performed by means of a workshop.

The first part of this chapter revolves around step 5 which involves the identification of success factors. This has been done by means of a brainstorm session on success factors that could be related to: *Environmental, social and negative value and also added value for stakeholders outside the value chain.* Chapter 5 has already yielded some potential success factors that have also been introduced after the brainstorm.

The last part of this chapter focuses on step 6, which involves the derivation of critical design issues based on the heatmap that resulted from the stress test exercise.

6.1 Brainstorm on succes factors

The participants of the stress test workshop were asked to brainstorm on potential success factors that positively contribute to a business model for sustainability. In this brainstorm focus has been placed on a selection of the business model elements that are part of a business model for sustainability. These were *environmental value, social value, Negative value, external stakeholder value* As indicated in chapter four, only four have been chosen to keep the amount of factors manageable within the given timeframe of the workshop. Furthermore, as some aspects can be seen as potential success factors they have been left out as to prevent biasing the participants. This resulted in a list with a variety of factors for each element. An overview has been given inTable 6.1

Table 6.1 Various factors identified in the brainstorm session.

Business model element			
Service domain	***Service domain***	***Technology domain***	***Organization domain***
1. Environmental value	***2. Social value***	***3. Negative value***	***4. External stakeholder value***
Climate agreements	Transparency /insight	Accountability	Sharing costs
Reduction in CO_2, NO_x and Methane	Positive feeling to contribute	Transparency	Joint initiatives for sustainable value
Reduction emissions in transportation	Social entrepreneurship	Impact of the value chain	
Waste reduction/circularity	Civilian participation		
Take into account bio-diversity (Human & animal)	Intrinsic motivation		
Lengthen life-cycle of products	Giving employers power		
Cradle to cradle approach	Leadership and working together		
Value chain impact			
New services/products catering to sustainability			

Next to the success factors given in Table 6.1. The following potential success factors have already been found from the literature study and have been added after the brainstorm upon

discussion with the participants. These are aspects numbers *5, 7,8, 9,10* see Table 6.2 below, the others are not seen as success factors and were not mentioned in the table.

Table 6.2: Aspects added to list of success factors after brainstorm.

	Aspects added to STOF
Service	
Technology	
Organization	
Financial	5. Shared cost for investments in sustainable infrastructure
	6.
	7. Financial model that provides insight
Generic aspects	8. Having a sustainability leader
	9. Having a sustainability strategy
	10. Motivate customers to take action/responsibility towards sustainable behaviour

Where the factors; *sustainability strategy(9)* and *sustainability leader in the firm(8)* are more general factors, which were not explicitly mentioned by the participants. The other three factors have in a way been mentioned by the participants. *Shared cost for investment(5)* has been mentioned during the discussion in relation to cooperation or joint initiatives. The specific factor *a financial model that provides insight(7)* has not been mentioned as such, but transparency has been mentioned on two accounts and also joint initiatives could be related to this aspect. *Motivate people to take action(10),* can be related to intrinsic motivation of consumers to contribute to sustainability.
Thus the factors *10 and 5* have been mentioned by the participants, while the insight or transparency has not explicitly been mentioned in relation to the financial model. The factors *8 and 9* have not been identified during the brainstorm.

6.2 Stress testing with success factors

From the success factors derived from the stress test, a set of 4 success factors has been chosen as input for the stress testing exercise. Not all factors have been chosen to make the stress test exercise not too extensive and time consuming.
The following four factors have been chosen, by the researchers in correspondence with the participants based on the discussions after the brainstorm session. The choice has been based on the level of discussion, and the how often the factor has been named in relation to one or more elements.

1. Value/supply chain arrangement
2. Accountability/transparency
3. Intrinsic motivation
4. Joint initiatives

The first factor has been mentioned in relation to both **Negative value** and **Environmental value a**nd was seen as an important factor during the discussion. The value chain arrangement has been coined in relation to impact reduction and increasing lifecycle, cradle to cradle and the reduction of the impact of the value chain. This factor captures the essence of these various aspects mentioned.

The second factor has been related to **Social value** and **Negative value.** Transparency is concerned with openness towards information. However, this information should be accessible, and relevant, moreover it should be timely and accurate (Transparency Accountability Initiative, 2016). Just giving access to random information does not reduce opacity. Related to transparency is accountability meaning people or institutions can be held responsible for their actions. When there is low transparency accountability will generally be low too. Both aspects have been mentioned explicitly by the participants, however Accountability has been named as a common denominator during the workshop for all the factors related to transparency and insight.
The third factor has been named in relation to **social value** and was seen as key to achieve behavioral change toward supporting sustainability.
The fourth factor, has been named in relation to **external stakeholder value**, but also has been identified as a possible result of transparency. Due to the openness parties are more inclined to cooperate since there is no hidden agenda or an unknown profit margin (in case of VandeBron). Moreover, to rearrange the value chain joint initiatives might be required.

The results of the stress testing exercise have been given reported in an excel sheet in a similar fashion to Table 6.3. The results have been compressed to Table 6.4. For clarity reasons the blue color has been exchanged with grey. The elaborate version can be found in Appendix F.

Table 6.3 Original format of stress test result as documented in excel sheet

	Business model	Keten Inrichting	Accountability /transparency
Service Domain			
Target group	Small energy consumers Energy producers	VandeBron does only a small part of the chain. Energy production is for example not done by VandeBron, as this would give rise to a conflict with the consumer, in the sense that VandeBron would like to sell more energy. The chain is determined by the proposition.	VandeBron has criteria for their producers. VandeBron focuses on community building.

Unfortunately due to time pressure not all business elements have been related to the success factors, as such Actors, strategic interests, costs and risks, have not been included in the stress test.

Table 6.4: Output of the stress testing exercise done during the stress testing workshop

	Chain arrangement	Accountability /transparency	Intrinsic motivation	Joint initiatives
Service Domain				
Target group				
Value proposition				
Environmental Value				
Social Value				
Service offering				
Effort for the customer				
Technology Domain				
Technological functionality				
Technology accessed				
Negative value reduction of Technology				
Organizational Domain				
Actors				
Strategic interests				
Value added for stakeholders				
Financial domain				
Investments				
Costs				
Revenues				
Risks				
Environmental and social risk				
Overall Rating				

	Green: Positive effect on the Success factor
	Pink: Negative effect on the Success factor
	Orange: Neutral effect on the Success factor (Room for improvement)
	Blue: Not relevant, no influence on the Success factor

6.3 Overview of the results

This part discusses the result as found in the heatmap and elaborates upon the reasoning made by the participants. The text discusses the business element contribution for each success factor. Also an overall rating of the impact of the business model elements on the success factors has been given. In the workshop success factors have been identified and mapped to the various business model elements of VandeBron. An overall rating has been given for the four success factors, in table Table 6.4.

Value/supply chain arrangement:

For the success factor value/supply chain arrangement the conclusion is that the business model elements have a positive or no relevant influence on the success factor, resulting in an overall positive rating.

VandeBron as a platform breaks the linear value chain by placing both consumer and producer at the same level. The incomes of VandeBron are decoupled from consumption by

directly connecting producer and consumer, making no profit on energy consumption. With no incentive to gain a profit based on consumption, consumers and producers are equally important as customers. Further, it is the technological functionality, i.e. the platform on which consumers have an overview of the various producers that makes this different arrangement of the value chain possible. Also, the arrangement of the revenue scheme with the fixed fees to be paid by the customers, makes that for VandeBron both consumer and producers can be seen as a customer and not as customer and supplier.

Accountability:

With respect to Accountability six business model elements contribute positively to the success factor, while two are neutral and the rest was found not relevant. This results in an overall positive rating.

VandeBron has certain criteria which their producers must comply to. This directly limits their target group of producers, as such their target group contributes positively to accountability. The value proposition of VandeBron revolves around offering a transparent marketplace in which consumers have clear insight in where their energy comes from and how it is produced. This transparency as argued, is required for accountability and thus positively contributes to this success factor.

Transparency is one of the main value deliveries of VandeBron, this also comes back in the Environmental value where people have an open choice for the desired energy source. The choice of VandeBron between the various forms of energy offered by the producers is connected to the criteria. For example, a choice is to be made in biomass from food versus waste. These choices are in turn related to the level of negative value reduction and all positively affect accountability in case of VandeBron.

The revenues streams of VandeBron are transparent, for both producers and consumers, but also to exogenous parties. However, value creation for parties outside the value chain has not been identified, although it might help in accountability since the interests of various parties are involved. The effect of choice for investment upon accountability was seen as neutral, although a potential negative affect could be the choice for investment funds that also invest in for example warfare technology.

Intrinsic motivation:

Intrinsic motivation refers to the motivation of the consumer to engage in sustainable behavior and practices. This was strongly supported by the business elements of VandeBron resulting in a positive overall rating.

The customer makes the choice for a certain producer and in the end for VandeBron, but this does not mean this choice is not price driven. VandeBron does however, target people that presumably have this intrinsic motivation. Due to the transparency offered, people are likely to be more motivated to participate in sustainable behavior. This transparency is of course brought about by the online platform on which people can see the personal stories of the producers, contributing to the motivation to engage in renewable energy. The platform now also makes it possible to get energy from a local producer. VandeBron aims to be approachable and leaving little effort for the customer. The low effort needed for the customer also contributes to the motivation of people to participate. In conclusion VandeBron, does have aspects in place that contribute to the intrinsic motivation of people.

Joint initiatives:

The success factor joint initiatives is not supported much in the business model of VandeBron, in fact only two elements contribute positively and six have a neutral contribution this results in an overall neutral rating. Negative value reduction in VandeBron contributes positively. The choice to engage in renewable energy sources only, has led to the fact that Tesla takes their energy from VandeBron. In a way Tesla is just a customer, but one can see that both companies share the vision to work towards a more sustainable environment. Another positive contribution can be found in the revenue streams, related to solar collectives. People with excess solar power can be pooled to form a new energy source. VandeBron gives these people a fixed amount per KWH, and people using this pooled source a discount on their fee. Rather it is not so much the revenues, but rather the costs/investments made by VandeBron that contribute to these joint initiatives.

Looking at the sustainability elements in the business model, the following can be found from both the brainstorm and the stress test session. Various success factors have been identified during the brainstorm that are related to the four business model aspects that contribute to sustainability. In the figures below the dotted red lines give the connections made during the brainstorm, while the non-dotted lines give the results as found in the stress test on the business model of VandeBron.

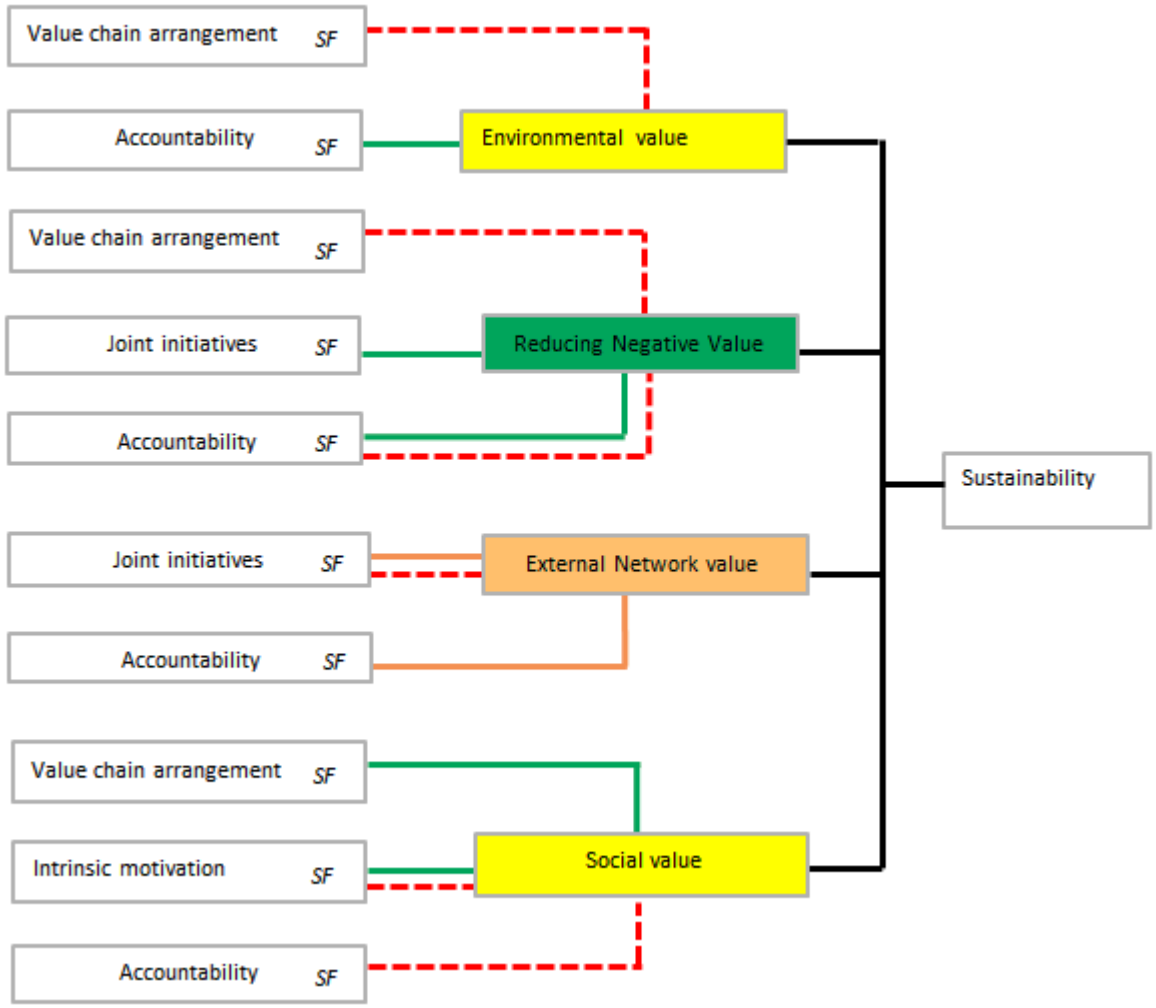


Figure 6.1 overview of relation between success factors and business model elements (red dotted line gives findings from brainstorm, full lines give findings from the case, the green and orange relate to the contribution as given in the heatmap)

6.4 Critical success factors and critical design issues (CDI)

The concepts Success factor and Critical design issue are closely related, a success factor contributes to business model viability and a critical design issue can be seen as an issue that cannot be omitted from the business model. One can see it as a parameter that the company can alter to affect the success factor. To give an example the CDI *pricing* affects a success factor be price competitive.
This part will discuss for each success factor the findings from brainstorm and the stress test exercise, thereby focusing on the four value elements as added in STOF. In the derivation of critical design issues attention is paid to the business model elements that positively contribute to the success factors.

Success factor Value chain arrangement:
The value chain arrangement was identified in the brainstorm as a potential success factor relating to environmental and negative value. However, in the case study only social value was seen as contributing to this success factor.

Diving into the reasoning behind the positive contributions identified in the stress test exercise, the following table can be created. The left column shows the business model elements that positively contribute to the success factor, while the right column shows the code derived from the reasoning given by the participants.

Table 6.5: Coding of argumentation behind positive contribution to success factor

Value chain arrangement	
Business model element	***coding***
Social value	Equal treatment consumer and producer at the same level
Service offering	Market place, thus consumer and producer at the same level
Technological functionality	Platform
Revenues	No conflict in interests in dividing profits.

Equality between the parties is mentioned on several accounts. More specifically, *equal treatment, and equal interests from the company perspective.* In the case of VandeBron the customers (consumer and producer) are placed at the same level of being a customer.
Thus a design issue is: **Customer equality**

Success factor Accountability:
Accountability has been mentioned as success factor in the brainstorm related to social and negative value. While from the case it shows that instead of these elements it are negative value and environmental value that were found to contribute positively to accountability. Also external network value could have a potential positive effect, but this has not been identified in the case of VandeBron.
The term transparency is mentioned on several accounts as part of the positive contribution.
Moreover transparency has also been identified in the literature as a potential success factor where it was related to the financial model.
Another aspect mentioned is are the *development of criteria* for the target group and technology choice. It can also be related to negative value reduction, since within VandeBron the reduction in negative aspects of technology is achieved by setting up these criteria.
Thus design issues are: **Transparency and selection criteria** *for technology and target group.*

Table 6.6 Coding of argumentation behind positive contribution to success factor

Accountability	
Business model element	***coding***
Target group	Criteria development
Value proposition	Transparency between consumer and producer
Environmental value	Green energy in a transparent way
Technology enabled	Choice of technology (criteria)
Negative value reduction	Reduces negative aspects of technology
Revenues	Transparency due to absence of profit margin

Success factor Intrinsic motivation:

Zooming in on the four sustainable value elements then intrinsic motivation is however only found back in social value, to which it was related in the brainstorm and the heatmap.

Looking at the reasoning given for the positive contribution to intrinsic motivation by the business model elements than, transparency plays an important role again. Also targeting the right people is identified, this is similar to developing the right criteria. Another aspect that was mentioned to contribute strongly was the fact that VandeBron is approachable.

Thus design issues are for intrinsic motivation of the customer are; **Transparency, approachability and selecting the right target group.**

Table 6.7 Coding of argumentation behind positive contribution to success factor

Intrinsic motivation	
Business model element	***coding***
Target group	Target the right people
Value proposition	Transparency causes involvement and leading to motivation
Social value	Equal treatment and transparency
Service offering	Transparency in marketplace on the platform
Effort for the customer	Approachability/low effort
Technological functionality	Personalisation of the product through the platform, personal touch.

Success factor Joint initiatives:

Joint initiatives has in the brainstorm only been connected to *value for stakeholders outside the value chain*. While in the case is was not *value for stakeholders outside the value* , but reducing negative value that was found to contribute positively. Joint initiatives was found to be a success factor that was supported by two business model elements. Looking at the explanations given for these positive contributions, then the only thing that can be mentioned is that shared interests can lead to joint initiatives. However, this is not a design issue. As such no design issues are derived based on the success factor joint initiatives.

Table 6.8 Coding of argumentation behind positive contribution to success factor

Joint initiatives	
Business model element	***coding***
Negative value reduction	Shared interest and cooperation
Revenue	The way revenues are arranged for solar collectives stimulates joint initiatives.

In conclusion the following design issues have been derived:

1. Transparency 2x
2. Selection criteria for both technology and target group 2x
3. Approachability 1x
4. Customer equality 1x

Transparency and selection criteria for both technology and target group, have both been identified twice. While approachability and customer equality have been identified once.
These critical design issues have been related to the success factors, thereby expanding Figure 6.1.

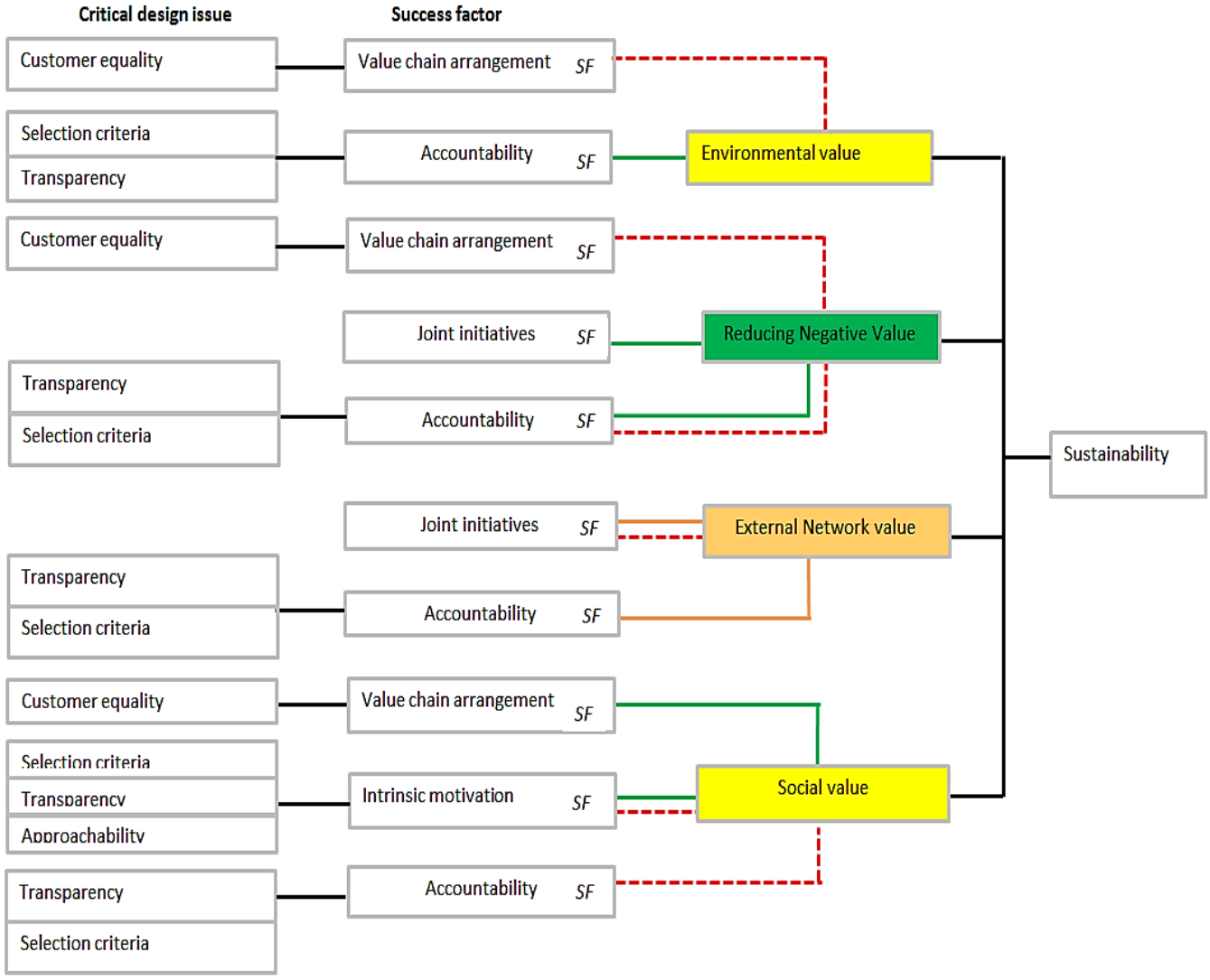


Figure 6.2 Elaboration of figure 6.1, including the identified critical design issues.

6.5 Conclusion

This chapter has discussed the results found during the stress testing workshop in which the participants were asked to brainstorm on success factors related to sustainable business model elements. Next to that a stress test with a selection of these success factors has been performed on the business model of VandeBron. The brainstorm session has yielded the following four success factors (1) Value chain arrangement, (2) Accountability (3) Intrinsic motivation (4) joint initiatives. Of these four success factors only the first three were supported by the business model while the fourth was only supported by two business model elements. Based on the insights from the stress testing exercise a set of four critical design

issues have been derived e.g. (*1) transparency (2) selection criteria (3) approachability (4) customer equality .*
Now that step 5 and six of the research approach have been taken sub questions 3 and 4 have been answered.

Chapter 7 Findings and Discussion

Despite the fact that both sustainability and business models receive much attention in literature, knowledge on business models for sustainability is relatively limited. This research contributes to this field by identifying what constitutes to a viable business model for sustainability and in doing so adapting an existing business model ontology to make it suitable for business models for sustainability.
This research started with a literature study as to identify what characterizes business models for sustainability. This was followed by empirical research on business model for sustainability and success factors contributing to business model viability in order to answer the main research question.

What makes a business model viable under incorporation of sustainability aspects?

The findings of this research are presented in section 7.1. After which the findings are discussed in section 7.2. Followed by limitations and future research in section 7.3

7.1 Findings

To support this research question four sub-questions have been derived. The first sub-question has been stated with the goal to identify what aspects characterize business models for sustainability.

Sub question 1: *What aspects characterize business models for sustainability?*

In literature various forms of a business model for sustainability have been found, and Bocken et al. (2014) has given an overview of these various business models and divided them into archetypes. This overview allowed for the identification of business models for sustainability. From various authors, aspects and factors that constitute a business model for sustainability have been found. These have been listed below.

	Aspects added to STOF
Service	1. Environmental value
	2. Social value
Technology	3. Negative value of Technology
Organization	4. Value added for stakeholders outside the value chain
Financial	5. Shared cost for investments in sustainable infrastructure
	6. Potential Environmental and social risks that affect business
	7. Financial model that provides insight
Generic aspects	8. Having a sustainability leader
	9. Having a sustainability strategy
	10. Motivate customers to take action/responsibility towards sustainable behaviour

A distinction has been made between the aspects that were found. The elements 1 till 7 can be considered business model elements. The generic aspects as such cannot be incorporated in STOF, but are considered potential success factors and have been incorporated as such in the stress test workshop.

Sub question 2: What sustainability aspects can be validated in business models for sustainability?

The cross case comparison of four cases (Qurrent, VandeBron, Greenwheels and MyWheels) has been used to validate whether these aspects can also be found in existing business models for sustainability. The conclusion of this exercise is that each aspect is identified at least once in each case.

The aspects that have been found across the four cases are: (9) *Having a sustainability strategy,*(8) *Having a sustainability leader in the firm* and (6) *potential environmental and social risks that affect business.*

Both, (1) *Environmental* and (2) *Social Value* have also been found across the four cases, however there is room for improvement especially for the car sharing companies. (7) *A financial model that gives insight* has also been found across all cases, yet for 3 out of 4 cases there was still room for improvement. For all the other aspects there was at least one case where the aspect was not identified, but at the same time in at least two cases the aspect was confirmed.

As such all aspects have been validated in business models for sustainability.

Sub question 3: *What success factors regarding business models for sustainability do companies and experts from the field consider?*

The first two sub questions were focussed on business model aspects that constitute a business model for sustainability. By means of a literature study and a cross case analysis these aspects have been validated. The third research question focuses on success factors and specifically what success factors companies and experts from the field consider to be important.

From the brainstorm session during the workshop a list of potential success factors has been developed. The participants were asked for success factors that contribute to the four elements incorporated in STOF i.e. *Environmental Value, Social Value, Negative value, and Added Value for stakeholder in or outside the value chain*. The generic aspects found in literature and confirmed in four out of four cases e.g. *sustainability strategy and sustainability leader in the firm* were not mentioned during the brainstorm by the participants. *Shared cost for investment, Motivate people to take action* have been mentioned in the discussion. While *insight in the financial model* was not mentioned as such, but rather overall insight or transparency. So, three out of five of the potential success factors identified in literature, were also mentioned by the participants in the workshop. For all factors identified, Table 6.1, can be consulted.

Based on the inputs from the participants, four success factors have been selected to be used during the stress test exercise. These are: *Value chain arrangement, Accountability, joint initiatives, and intrinsic motivation.*

Sub question 4: *What Critical design issues can be derived, from these factors, to move towards a viable business model for sustainability?*

The business model elements of VandeBron have been tested for their positive contribution to the four success factors selected. The previous three sub-questions looked at sustainable business model elements and success factors as found in literature and as identified by researchers and experts from the field. The fourth sub question is about what these success factors tell us about business model design. Or in other words what critical design issues can be derived from the stress test with success factors. The positive contribution of the business model elements in the STOF model, to these success factors has been evaluated by the

participants. The participants have created a heatmap indicating the level of contribution to the success factor. Based on this heatmap the following four critical design issues have been derived: (1) transparency (2) selection criteria for both technology and target group (3) approachability and (4) customer equality. In order to move towards a viable business model for sustainability, these critical design issues should be taken into account.

The main research question: *What makes a business model viable under incorporation of sustainability aspects?*

The four sub questions have been set up to support the answer for the main research question. The first research question helped in identifying sustainability aspects, but also success factors. These findings were validated by means of answering sub question two.
The aim of the third sub question was to identify success factors as recognized by practitioners. The fourth supporting question has been set up to derive a set of Critical design issues that are important to a business model for sustainability.
The business models chosen for the case studies are all examples of viable business models for sustainability. From literature sustainability aspects have been identified and incorporated in the STOF framework. In the stress test the business model of VandeBron has been used to look at viability with respect to these aspects identified. Four success factors have been identified that play a role in a viable business model for sustainability, however only three have been found back in the stress test. These are, the success factors *Accountability, Intrinsic motivation and value chain arrangement* that contribute to making a viable business model when incorporating sustainability aspects. Incorporating these success factors, by paying attention to the critical design issues derived for the case should yield a viable business model.

7.2 Discussion

The findings of this research are based upon an in depth qualitative research using both primary and secondary data. To achieve an in debt study triangulation of information has been used. The sustainability aspects were firstly identified from literature, and then validated by the desk research and also the interviews. This increases the internal validity of the research. External validity is low, however since the research is explorative in nature its results are not meant to be generalized across other cases.
The research set out to find what makes a business model viable while incorporating sustainability aspects. An overview of the findings has been given in the previous part, the following parts will discuss these findings with respect to literature and look at limitations and possibilities for future research.

7.2.1 Sustainability aspects in literature on sustainability

In literature, sustainability and business models have been connected by Stubbs & Cocklin. (2008). Before that, sustainability was mostly concerned with ways to make business more sustainable, but not with business models for sustainability as such. Most literature focusing on this subject, aims to define or characterize what constitutes a business model for sustainability. This research builds upon these authors by using their identified sustainability aspects that characterize business models for sustainability and connecting it to the field of business model ontologies. Combining the findings of previous literature allowed the development of a comprehensive set of sustainably aspects. As such this research provides insight as to what sustainability aspects are considered important in literature.

Nonetheless, an important question remains whether all relevant aspects are incorporated. Based on the cases study all aspects identified have been validated to play a role in business models for sustainability, but likely other aspects do also play a role. For example, an aspect that was not mentioned in the literature, is the consideration of environmental and social risks that might affect the business. Building on the STOF model that already considered financial risks this business model element has been expanded with environmental and social risks. The findings show that when companies need to incorporate environmental and social value in their value proposition, they also run environmental and social risks that might jeopardize the business.

In contrast two aspects that were found important in literature and which were confirmed in the case study were not found to play a role in the brainstorm session i.e. having a proactive strategy and a sustainability leader.

These factors can be seen as too obvious, as one can assume that when engaging in sustainable practices one should be proactive and intrinsically motivated and have a decision maker behind the initiative. However, as it was the starting point for all companies in the case study their importance should not be ignored. It might however be the case that in different cases these factors do not play a role at all, or that according to other practitioners these are actually considered imperative.

Another discussion revolves around the definitions of the aspects identified. In this research, environmental value has been seen as value delivered to nature and the planet as a whole, which plays an important role in sustainability. However, one could also argue that environmental value should consider the livelihood of people or other stakeholders.

Moreover, social value can also be viewed from various perspectives. In this research three forms of social value are considered. Firstly, there is *Development social sustainability* which is concerned with basic needs and equality. Secondly, there is *bridge sustainability* which is concerned with behavioural changes as to achieve environmental goals. And thirdly there is *maintenance sustainability* which is concerned with the preservation of social cultural characteristics. However, one can also consider the way a company treats its workforce or players in the value chain as a component of social value.

7.2.2 Business model ontologies

An important contribution to the field of business for sustainability is the development of the STOF ontology for business models for sustainability. The original STOF ontology considered consumer and network value, the adapted ontology has incorporated more value considerations. With this ontology the stress testing tool has been developed to test business model robustness and viability. The latter has been used in this research to assess business model viability. However, with the addition of sustainability elements to the STOF model it can be argued that the STOF model now also can be used to assess not only viability, but also business model sustainability. In this respect this research goes further than previous ontologies developed, as the findings not only show what makes a viable business model for sustainability by means of the added aspects, but also allows for the verification of its sustainability by means of critical design issues and success factors.

From the outset business model ontologies do not explicitly take sustainability aspects into consideration. Therefore, this research started with identifying what constitutes a business model for sustainability and based, on the aspects found in literature the STOF business model ontology has been adapted. However, other ontologies could have been used to achieve the same goal. For example, the CANVAS business model framework would have

been an understandable choice, as this framework is widely recognized and used in respect to business models. If the CANVAS model had been chosen, the main difference would have been the level of detail in the analysis. Where the STOF model has its four domains elaborately defined, the CANVAS model leaves much room for interpretation, as nine key blocks have been defined that constitute a business model. Although, a cross case comparison would have been possible, the STOF model allows to look at more detailed aspects of the business model. Moreover, the aspects added could be confined within the domain to which they were added, for example negative value was confined to negative value related to technology.

Next to adapting established ontologies efforts are made to develop new sustainable business frameworks, Bocken & Short (2016) have developed a sustainable business model framework based on the concepts value proposition, value creation and value capture.
The same authors also provided the concept of negative value, but this has not been identified in their sustainable business model framework. On the other hand various sustainability aspects identified in their research have also been considered this research. Such as environmental and social value and value for key actors including environment and society. Although this could have been a useful ontology this research has identified more aspects that play a role in business models for sustainability thereby contributing with a more elaborate business model for sustainability framework.

7.2.3 Critical design issues

This research has found four critical design issues, and when comparing these with previous research done on Critical design issues with STOF, a commonality was identified. This research has identified the CDI *selection criteria for the customer.* This can be interpreted as having the right target group something that was already identified as a CDI in previous research on (general)business models. It can thus be argued that this CDI is not critical for achieving a viable business model for sustainability, but rather that it a CDI for business models in general, sustainable or not. Thereby, this research has also validated findings from previous research on the STOF business model ontology.

7.3 Limitations and future reserach

As described in the methodology chapter the research has six steps. The first step involved the literature review. A thorough literature review has been performed covering Business models, Business model ontologies and literature on sustainability. The latter body of literature provided the source of sustainability aspects that needed to be covered by the business model framework that was developed in step 2. However due to bounded rationality it might be the case that relevant aspects have been missed by the researcher.

The third step and fourth step involved the case selection and the case study itself. Much information could be obtained through the desk research, however some aspects required further clarification during the interviews. Getting the interviews, in hindsight, was not that troublesome. Only one company refused to cooperate in the research, therefore an external researcher with knowledge of that field was interviewed. The aim was to get into touch with people with knowledge of the business model or in the area of business development. This criterion has not always been met, which resulted in a difference in insights gained from the interviews. For example the interview with the external researcher did not allow for gaining

more insights on the business model of MyWheels, but it did allow for a more generic view upon developments in the field.
Steps 5 and 6 revolved around the stress testing workshop.
The initial approach for the workshop was to perform stress testing with scenario`s, but in the end a stress test with success factors was performed. For the workshop all parties that have been interviewed were invited, but performing a scenario stress test upon a car sharing company would not be interesting for the energy companies. Therefore, a choice has been made to look more specifically at success factors. Hosting two workshops could have prevented this change, but it takes a considerable amount of time to set up a workshop and find a suitable date for all parties willing to participate. Therefore the choice has been made to take a more generic approach, looking at success factors that play a role in business models for sustainability. The difficult part in hosting the workshop proved to find participants willing and/or able to participate at the indicated time. The biggest hurdle faced was availability.
Three persons confirmed to take place in the workshop, but unfortunately one participant had to cancel last minute. As a result two people participated in the workshop the presence of more people would likely have resulted in a greater variety of factors identified in the brainstorm, due to the difference in background and sharing of ideas. The same holds for the stress testing exercise, a greater number and variety in people would have yielded more discussion and more insights as to why a success factor is supported by a business model or not. The upside is that due to the presence of one company, the business model of this company could be used during the session without having to worry about confidentiality or interests of the other companies. Despite having reserved a timeslot of 3 hours, this still proved to be on the short hand. Therefore, the stress testing exercise had to be finished in a shorter period of time than initially planned. The effect was that the discussion on the positive impact of business model elements on success factors did not go in depth. Moreover, a quick decision had to be made as to what business model elements had to be incorporated in the discussion as to yield to best results. As a result four business model elements have not been incorporated in the workshop. i.e. actors, strategic interests, costs and risks.
Another aspect that proved difficult in preparation of the workshop was the level of abstraction with regard to the success factors. Setting up a workshop with companies from different backgrounds for identifying success factors would not pose a problem, but when it comes to the impact of the business model elements on these success factors a certain level of conceptualization is needed as to get a valuable analysis. Staying on generic level likely results in a stress test heatmap, where every business model element could positively contribute to the success factors.
Instead of hosting a workshop another approach could have been to individually interview the various intended participants, the main advantage would have been that most parties would have been more willing and or able to receive the researcher for an interview rather than hosting a workshop. This interview would consist of taking the steps taken in the workshop, but then with only one participant. This could have yielded more results, but this approach leaves out the added value that a discussion brings. In a one on one brainstorm, people will generally come up with success factors for their specific sector, and furthermore stay in their own bounded rationality. Moreover, the added value of the workshop host Timber Haaker, should not be underestimated. His experience in hosting stress testing workshops ensured that the intended results were indeed found and that the discussions did not yielded redundant findings.

However, for a following workshop it might be worthwhile to separate the stress testing and the identification of success factors and performing the stress test with one sector or company. This makes the results more concrete, and would likely take away the time pressure as both the stress testing and the brainstorm do take a considerable amount of time.

7.3.1 Future research

Some limitations mentioned provide the basis for future research. Firstly, there can be other elements that play a role in business models for sustainability. Further research will have to establish whether there are other business model elements that should be considered that have been missed in this research. Similar reasoning holds for further validation of the STOF ontology that has been adapted based on the identified aspects.

The identification of success factors has been done on three accounts, firstly through the literature review, secondly through case studies and thirdly through a brainstorm in the workshop. However, the selection of the four success factors has to a large extent been based on insights from the workshop participants. Therefore future research that pays specific attention to what are success factors for business models for sustainability, might be worthwhile.

Also, the critical design issues have been derived based on the findings from one particular case. That is why more stress testing should be done on the same or different cases, for starters the other three cases in this research could be used. This would be a validation step with respect to the CDI`s identified in this research.

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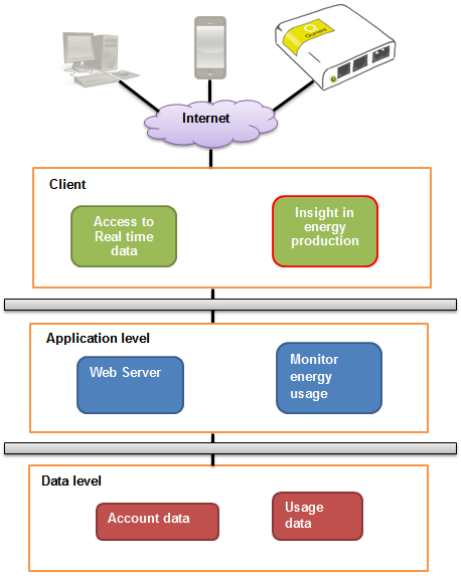
Appendix A Qurrent

Company Profile Qurrent	
Name of the company	Qurrent
Legal status	Cooperation
Contact person	-
Address	Willem Fenengastraat 23 Amsterdam, 1096 BL Nederland
E-mail	-
Tel	0887771234
Background	Qurrent in its current form is an energy company with the aim to let people use as little energy as possible. Before it was an energy company Qurrent was a service company that helped people save energy. Qurrent merged with the WeGenerate initiative of Stichting doen, and as of now Qurrent is a 100% daughter of Stichting Doen.
Company focus	The company focuses creating renewable sources in a cooperative fashion, while at the same time paying attention to saving energy.
Year of foundation	2006
Size	11-50
Location	Amsterdam, The Netherlands
Industry	Sustainability and environment
Ownership	Stichting Doen
Sustainability orientation	Qurrent is strongly oriented towards sustainability, as it strives to let people produce the energy they use and at the same time they aim to help people save energy. Their vision is to work towards an energy neutral society, and their belief is that this cannot be achieved when utility companies earn more when you increase your energy usage as a customer. What is being saved does not need to be produced(De groene zaak, 2016).
Markets	B2C
Geographical market	Qurrent operates in the Netherlands
Phase of company; start up, roll-out, mature, declining	Mature.

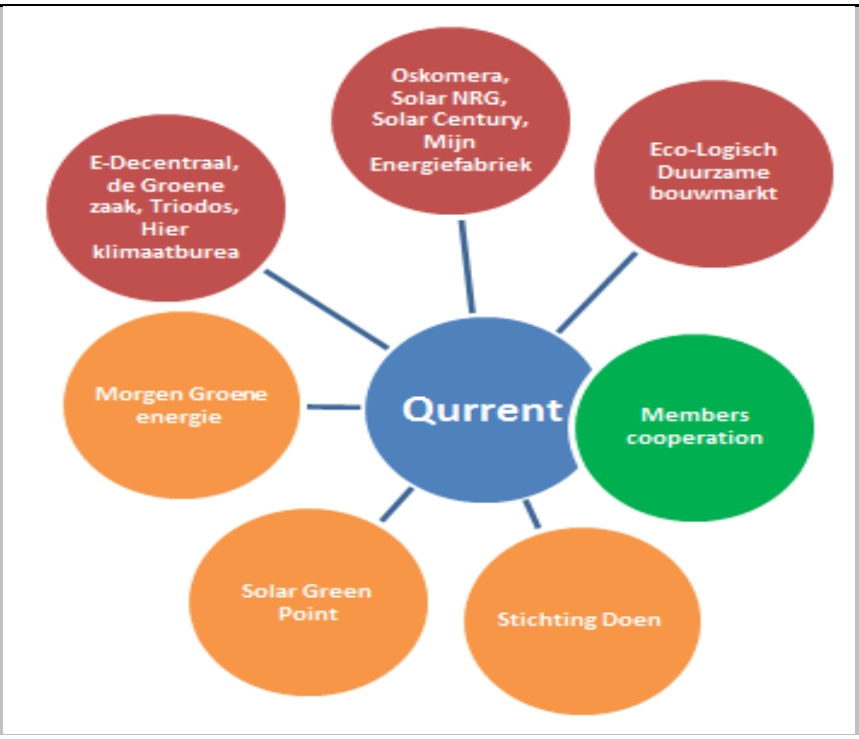
Business model of the company	
	Service domain
Customer	Any household that is a small user, having no more than 3x80 ampere and/or a gas connection no more than 40m3.
Target group	In essence any customer that fits the description of small user falls within the target group, however Qurrent wishes to get their customers to join in on generating and saving energy. Thus people that are not merely choosing their utility company, every year, based on the cheapest deal.
Customer base	Around 70.000
Value proposition	Connecting people to 100% green energy that can be produced by the consumers themselves in the Netherlands in a cooperative way. And next to this Qurrent offers their customers ways to reduce their energy consumption. Customers can deal with a single party for both energy saving as well as energy generation. Qurrent provides a straightforward way for people to engage in renewable energy sources without additional effort.
Environmental value	Qurrent decouples income from energy usage of the consumers. They offer

	consumers a quota and by giving people insight in their energy consumption they are triggered to reduce it. The energy delivered by Qurrent is 100% green, as is guaranteed by GVO`s (garanties van oorsprong). By focusing on customer sufficiency, Qurrent can connect more people to lesser energy sources, reducing the energy price and service costs even further. Which allows more room for new projects.
Social value	Qurrent provides insight in where their energy comes from and provides true green energy. Next to this Qurrent gives people the option to produce their own energy as member of the cooperation, which directly gives them a say in the decision making of the cooperation. This also means that the company does not take action towards the interest of a few, but for the interests of the members of the stakeholders(Interviewee 1, 2016). Although the arrangement with the consumer is different in case of windtegoed or having a part of a solar park, on the consumer end nothing really changes compared to any other utility company. People still register in a same way and their billing is done following a similar system. Users are merely triggered to change their behaviour in order to save energy, but it is not required.
Service offering	The activities of Qurrent can be divided into three categories. 1. Provide products and service for private and local energy production.(windtegoed, zone parken) 2. Provide green energy from the Netherlands at production price. 3. Provide products and service for reducing energy consumption. There are three forms in which people can take energy from Qurrent 1. Customers directly take green energy from Qurrent. In this form customers pay the production price for green electricity. They have the option to fix the monthly price per kWh for a period of one, two or three years, or they can leave it variable. The latter means that the price can be adjusted due to market fluctuations 4 times a year. 2. Customers buy part of a windturbine (wintegoed) or solar park In this form consumers get ownership of part of a wind turbine or solar park. Electricity produced by their part is deducted from their usage. Any excess production will be fed to the grid for which Qurrent pays a fixed amount per kWh. Use what you produce. In combination with a subscription customers are, upon deposit, provided a real time energy monitor, the so-called Qbox. In connection to offering insight in consumption patterns, Qurrent offers discounts on energy saving products, such as an electric vehicle charging station, a solar water heater or insulation for your house. Even on a smaller scale energy saving solutions are provided, which are offered through a web shop on their website.
Effort for the customer	Being a customer of Qurrent requires no extraordinary effort. Qurrent will take care of the transfer from another utility. In case people wish to use the QBox they will need to install this in their homes.
Customer relationships	Qurrent is a cooperation, this means that from the outset consumers have a chance to be more involved in the company. They can attend the member meeting and be elected board member. Qurrent will approach their customers with options to save energy and offer them windtegoed. Where some customers might be price driven, Qurrent still tries to make them aware of and engage in the environmental value of Qurrents' products and services. Windtegoed is most efficient for a 5 year period, as such Qurrent can maintain its customers for a longer period.
Technology Domain	

Technology used	Apart from the energy supply (windmills, solar etc..) Qurrent offers customers insight in their energy usage by means of the Qbox. This device is connected to the internet and the grid in the home. Real time data can then be accessed via web browser or app. The figure gives an overview of the technical architecture. 
Negative value of technology	Even renewable energy sources have negative value attributed to them. For example using wood or cattle feed for biomass installations can be seen as negative value. But also when placing a solar park and using up biodiversity. Qurrent takes negative value into account and is currently diving into the subject further. As such they recently engaged in a project where there was a combined function, a solar park, but also a park where sheep can walk and a place where people can walk their dog. There is a realization that energy sources take up space, but that there can be found combined functions.

Organizational Domain

Actors in network All these actors can be characterized as being either Tier-1, Tier-2 or Tier-3 partners, (Bouwman et al., 2008). Tier-1: Being essential and non-substitutable actors in the value network. They are of core importance in determining the intended customer value and the business model. (green) Tier-2: Provide services or deliver attributes that are needed for the service delivery, but do not affect the intended customer value or business model when substituted. (orange) Tier-3: Provide generic goods and services which are needed in the value network, but which could be used in various other value networks. (red)



Strategic interests at stake	
Stichting doen	*Enhances social image of lotteries.*
Triodos bank	Get early stake in potentially successful company. Or loan
Hier klimaat bureau	*Engage the Netherlands in solving the climate problem*
De Groene Zaak	*Jointly develop ways towards sustainable business. But also solve political or legislation related hurdles*
Members cooperation	Wish to have affordable yet sustainable electricity supplied to their homes.
Qurrent	*Through Qurrent access to large amount of customers that jointly finance solar parks*
Solar Greenpoint	Make projects for smaller amount of users locally, by joining with larger cooperation Qurrent.
Morgen groene energie	*Access to lager market, with no extra costs by maintaining a web page on the Qurrent website.*
Eco-logisch duurzame bouwmarkt	Increase adoption of renewable sources in the Netherlands
	Expanding market, increase brand recognition
E-decentraal	Expanding market, increase brand recognition
Oskomera solar power solutions	*Expanding market, increase brand recognition*
	Expanding market, increase brand recognition
Solar NRG	*Expanding market, increase brand recognition*
Solar century	
Mijn energiefabriek	
Added value for actors in network	Since Qurrent also focuses on helping people save energy in and around the house. They have contact with a wide range of parties that are capable of delivering such services and produces. For these parties Qurrent provides a larger customer base. Moreover, since Qurrent is a company that works with green energy from the Netherlands only it cooperation with Qurrent has to potential of enhancing other parties green image.
Financial Domain	
Financial investments	The main investments are made in order to set up new renewable energy projects. Initial financial investments came from stichting doen, of which

	Qurrent is 100% daughter company. Other investments came from Triodos bank for the creation of the windpark at Hellegatsplein.
Costs/revenue structure	Of the energy bill the delivery cost is a fixed amount that goes directly to Qurrent. Other costs involve energy at production price, grid maintenance and taxes. Next to the normal energy bill, Qurrent sells windtegoed at €55 a piece. for solar parks this price depends upon the project, but as of now they range from €350 to €500 a year. For the self-producing customer, Qurrent pays 10 ct per overproduced KWh and gives a discount on the delivery cost of €0.0137 per KWh up to €36,30 a year. the income of Qurrent thus mainly stems from selling energy products and the delivery costs that every person pays to any utility company. The cost of Qurrent involve the investments made on the energy sources and keeping the business running.
Risks	As Qurrent claims to deliver only 100% green energy from the Netherlands, they have to be able to keep producing the amount of energy they sell. That is when the customer base grows they need to be able to supply these customers with 100% green energy. And in the case of people taking windtegoed, there need to be placed new wind parks. Another potential risk hast to do with Qurrent being a cooperation and taking out loans. As a non-profit cooperation taking out a loan. Banks might be hesitant towards giving a loan to a non-profit cooperation as liability might be an issue. However, banks do have so called greenfunds with more favorable conditions, as banks know sustainable initiatives often bear a higher risk. Also as Qurrent is backed by the Stichting doen. Some parties accuse them of false competition, and they might face charges. However, there will always be resistance to business approaches that challenge conventional ways. Copying the business idea of a young company as Qurrent by bigger players forms a potential risk, therefore it is good Qurrent aims to connect their customers for 5 years with their solar and windtegoed.
Environmental and social risks	Over the last years Qurrent has grown substantially. And other players are also looking at renewable sources in the Netherlands. Therefore Qurrent might run the risk of getting more competition and find it harder to get loans and permits for their energy sources, as a result they might need to resort to less favourable projects. E.g. compromise on taking into account negative value. On a social level it shows that people are strongly price driven and actually spend little time on selecting their utility company. Qurrent can run the risk of not being able to retain customers because they are out priced, as renewable energy is generally more expensive than non-renewable energy. Moreover, Qurrent wishes to make people conscious about their energy usage and provide them the means to take action, however saving energy will mostly require a change of habits and customs. This is something people might not be willing to do, as such this part of the service offering might not prove worthwhile.

Appendix B VandeBron

Company Profile VandeBron	
Name	VandeBron
Legal status	Private limited company
Contact person	-
Address	Herengracht 551, 1017 BW Amsterdam, Nederland
E-mail	-
Tel.	-
Company Background	The company is a utility market place that provides a market place for energy by connecting consumer directly to the producer. It has been founded with the idea of making it possible to directly buy your energy from its source.
Company focus	The company focuses on providing consumers a transparent overview of the various renewable energy sources.
Year of foundation	2014
Size	Around 50-200 employees
Location	Rotterdam, The Netherlands
Industry	Renewables and Environment
Ownership	-
Sustainability orientation	VandeBron has the mission to move toward 100% renewable energy as soon as possible. Inside the company all employees have affinity with renewable energy.
Markets	Facilitating C2C
Geographical market	VandeBron operates on the Dutch market
Phase of company; start up, roll-out, mature, declining	Roll-out

Business model of the company	
Service Domain	
Customer	VandeBron connects energy producers and consumers. Energy producers are people or organizations that own a sustainable energy source. And the consumers are so called small users meaning they do not use more than 3x80 amperes and over 40m3 of gas per hour. Next to this, there are customers with their own production capacity but not enough to become a producer. Next to consumers of energy, there are the producers of energy. This are organizations, private companies etc.. who produce energy.
Target group	VandeBron targets any small user. Further, they target producers with their own production capacity. These are sustainability driven producers of which the profile should match a sustainable company. e.g. An animal unfriendly chicken farm is not likely to become a producer on the VandeBron platform.
Customer base	Around 75.000 consumers and 76 producers.
Value proposition	For the producers VandeBron provides a market place where they can sell their energy, as VandeBron does not make a profit on the energy sold any profit margin is left for the producers. And consumers gain insight and a choice as to where their energy comes from. In other words VandeBron

	offers transparency and an open market place where energy is offered.
Environmental value	The environmental value delivered by VandeBron is stimulation of usage and production of renewable energy. The approach taken by VandeBron has an indirect effect. VandeBron gives producers direct access to the consumer market and allows them to sell their renewable energy at a financially more attractive price. As a result they face shorter returns on investments and lesser risk in investing in renewable sources.
Social value	The transparency offered by VandeBron allows consumers to put a face on the energy source to which they are connected, as such friends and family of a producer can get energy from this producer. The service of VandeBron does not require any changes from the consumer side. VandeBron is in principle still a utility company. However, for the smaller producer VandeBron offers a viable approach for producing energy on a smaller scale.
Service offering	VandeBron facilitates an open market place, where producers offer their energy to consumers. Consumers can then choose between various suppliers and various prices. When consumers choose VandeBron as their energy provider, they can choose between three contract forms; a variable one, or a fixed one for either 1 or three years. In a fixed contract the rates are fixed for the duration of the contract, while with a variable contract these rates can be altered twice a year (van de Bron, 2016b).As of now consumers can choose between wind, solar and bio energy. The prices are determined by the market price. Producers have the freedom to deviate from this number, but they can raise the price per kWh with 1ct maximum, while staying below the prices of the three biggest players in the market. Moreover, people with excess production power but too little to be a producer can sell their excess energy to VandeBron.
Effort for the customer	To become a customer at VandeBron, customers can sign up on the website. VandeBron will then take care of the transfer from the previous utility company. Producers that wish to be on the platform can contact VandeBron for an initial meeting. What matters here is a compelling story of the producer, producers need to strive for sustainability just like VandeBron.
Customer relationships	VandeBron strives for a personal touch. That is why they let producers share their story with on the platform. Producers can for example share what drove them to invest in renewable energy. On the consumer side, VandeBron actively approaches potential customers via face to face marketing. VandeBron aims to retain its customers by connecting producer and consumer. They will make people from Amsterdam aware that they can get energy produced

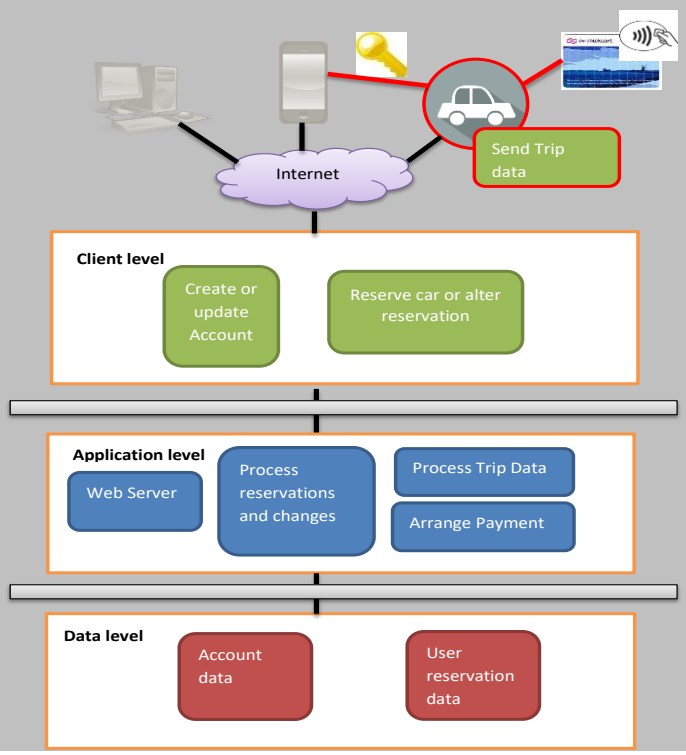
	by sources around the city, they show people the products that are being produced by a farmer with a windmill. In doing so, VandeBron strives to make customers more loyal. In order to stay in touch VandeBron has recently started a pilot in Nijmegen. A physical store has been opened where people can come with questions or to become customers.
Technological Domain	
Technology used	The backbone of VandeBron is their platform. This platforms gives an overview of the various producers, their story, their energy source and the price.
Negative value of technology	VandeBron is aware of negative value attributed to energy sources. As such bio installations that are fuelled by food will not be offered through VandeBron. VandeBron looks at the how the business is run and how the energy is produced as such a product at the end of the chain is more interesting.
Organizational Domain	
Actors in network	
Strategic interests at stake *Dutch Greentech Fund* Triodos Bank Groenfonds *Consumenten bond* Energy providers *Customers with excess solar power* ICT providers, Sungevity Nederland *TU Delft,* *University of Wageningen* Wereld natuur fonds *AKEF, Amsterdamse klimaat en energie fonds*	 *Get early stake in potentially successful company.* Get early stake in potentially successful company. *Helping initiatives that benefit consumers forward* Have access consumers, and sell at price level with higher profit margin. *Get financial benefit.* Additional customer base in the Netherlands *Possibility to do research in a new type of energy company* Supporting and speed sustainable initiatives. *Help improve image of Amsterdam as green city.*
Added value for actors in network	Producers have more freedom in determining their prices and can earn better margins on their products. Consumers with excess production power can sell this back to VandeBron. For other parties in the network like sungevity,

	VandeBron provides additional customer base.
Financial Domain	
Financial investments	VandeBron facilitates a market place online, as such it does not own production power. However, the company has received seed-capital and investments for further growth. As a service provider, VandeBron does not invest in energy sources.
Costs/revenue structure	Consumers their monthly energy bill, of which a part is the fee for VandeBron. VandeBron thus makes more money if more producers and consumers make use of the platform. The operational costs that need to be covered with the fee revolves around developing and maintaining the platform and connecting new customers and attracting new producers.
Risks	VandeBron is a facilitator, they connect demand and supply. And in contributing to a sustainable society they are thus dependent upon the sources being created and offered through the platform. Another potential risk, something that has already happened, is that other parties will imitate the concept. Further, the role of IT in the energy market is ever growing. However, this is being outsourced. This means that potential core competencies that make the value proposition possible are not established in-house which could cause a certain degree of dependency.
Environmental and social risks	VandeBron in itself cannot influence what type of renewable energy is being offered. Although biomass can be seen as less environmental friendly, it might be the case that there will be several new producers engaging in this form of energy and there is little VandeBron can do about it. VandeBron has grown rapidly over the past years, however it is key to retain these customers. As customers are price driven in their choice of utility company, and generally do not spend much time on energy. In that sense, the transparency and the green energy that VandeBron offers still has to be price competitive.

Appendix C Greenwheels

Company Profile Greenwheels	
Name of the company	Greenwheels
Legal status	Private limited company
Contact person	-
Adress	Westersingel 73 3001 KD Rotterdam
E-mail	-
Tel	+31 (0) 610469015
Background	Collect car B.V, better known by its trademark Greenwheels, was founded in 1995, and thus has been in the car sharing business for over twenty years. Greenwheels is operating following the classical car sharing approach, owning a fleet of 1700 cars in the Netherlands. Till date the company is operating in over a hundred cities in the Netherlands and is offering its services in 25 cities in Germany. Greenwheels has also been operating in the UK, but these operations were terminated in 2013. Its headquarters is located in Rotterdam, and their entire workforce consists of less than 50 people. The private limited company was founded by two entrepreneurs, but since has been taken over by two external parties.
Company focus	The company focuses on providing everyone 24/7 access to the transport mode car in European metropolitan areas.
Year of foundation	1995
Size	Around 50 employees
Location	Rotterdam, The Netherlands
Industry	Leisure, travel and tourism
Ownership	PON Holdings B.V. and VW financial services
Sustainability orientation	Greenwheels was founded with the idea to enhance livability in cities. And offer people a reason to stop owning a car. From the outset the vision of Greenwheels has been connected to sustainability.
Markets	Greenwheels operates in both the B2C as the B2B markets.
Geographical market	Currently, Greenwheels operates in the Netherlands as well as in Germany.
Phase of company; start up, roll-out, mature, declining	Mature.
Business model of the company	
Service Domain	
Customer	Above average income, highly educated with an average age of 37.
Target group	People eligible to drive, and in need of a car that drive less than 10.000 km a year. Mostly people located in urban areas.
Customer base	<1% of population eligible for driving. Roughly 35.000
Value proposition	Takes away the need to own a car while still having access to a car.
Environmental value	Enhances livability in cities, by reducing the amount of cars needed thereby reducing traffic congestions and enhancing local air quality. Causes a reduction in driven kilometers of users overall.
Social value	Provides car access to people that otherwise did not. And enhancing live ability in cities. They enable a change of behavior, and make people think about their mode of transport.
Service offering	24/7 access to a nearby car, thereby taking away the need to own a car.

	The cars come with their designates parking spot and users can choose between three types of subscription. 1. Soms; users pay only for the cost of using no subscription fee 2. Regelmatig; users pay €10 p/m 3. Vaak; users pay €25 p/m
Context of use	Mostly recreational purposes, visiting family, or picking up heavy loads(moving). Thus most usage is not on a regular basis.
Effort for the customer	Registration online. Keep an eye on the gas level. Find a nearby available car Restricted by availability of cars
Customer relationships	Greenwheels has a weak relation with the customer they do little marketing and rely strongly on IT. However, Greenwheels aims to have a more closer relation with customers in the future, by for example offering them products based on their user behaviour.
Technology Domain	
Technology used	The Fleet of cars is partly owned and partly leased. Next to the fleet an important technological aspect is IT, which is the backbone of the service. An overview of the technical architecture has been given in the figure.
Negative value of technology	Negative value of fleet: emission production and disposal of cars is not explicitly taken into account. Greenwheels looks at the improvement of car sharing over car ownership.
Organizational Domain	



Actors in network	 Tier-1: Being essential and non-substitutable actors in the value network. They are of core importance in determining the intended customer value and the business model. -Green Tier-2: Provide services or deliver attributes that are needed for the service delivery, but do not affect the intended customer value or business model when substituted. - Yellow Tier-3: Provide generic goods and services which are needed in the value network, but which could be used in various other value networks. -Red
Strategic interest of actors *Volkswagen financial services* Pon Holdings B.V. *Dutch Railways (NS)* System Developers Info.nl *Tanks station owners* Municipalities *Teleperformance* *IT service provider* Insurance company *Car leasing company*	 *Incorporate car sharing in service offering of Volkswagen. Roll out car sharing on a large(global) global level.* Being able to supply and perform services for a player in a growing market. *Being able to provide door to door service, for people traveling by train. Thus increase travellers by train, especially business*. Income generation, binding client *Income generation* Less traffic parking congestions, lesser cars in cities Lesser pollution Fixed income for parking spot subscriptions. *Income* Access to clients *Income, big client for longer period of time*
Added value for actors in network	The value proposition adds value for municipalities, as it provides a potential solution for the shortage in parking spots, and solve traffic congestion problems. Business models of NS and Greenwheels complement one another, they connect two modes of transport. Next to actors in their value chain,

	Greenwheels also adds value to actors outside their value chain, by being part of the green deal. The greendeal can be seen as a step towards stakeholder engagement, various parties aim to work towards a common goal and overcome hurdles or difficulties for adopting car sharing.
Financial Domain	
Financial investments	Main investments done by Greenwheels revolves around the IT but also the fleet. A fleet of 1700 cars requires a big investment. As such part of the fleet is being leased and part is bought. Because the price of electric vehicles is still 3 to 4 times higher than a fuel car a transition to EV`s will require a substantial investment. Currently, Greenwheels is not capable of investing such an amount.
Costs/revenue structure	The revenues of Greenwheels come from the various subscriptions. Users pay per use (time, and mileage) there are three form of subscriptions tailored to user needs; sometimes, regular and often. A big cost is incurred by Greenwheels for the various parking spots, and maintenance and repair keeping the cars up and running. Other services like helpdesk and IT is outsourced by Greenwheels.
Risks	Greenwheels has changed their subscriptions several times over the years. Nowadays they have a wide variety of subscriptions, while they only offer three. This potentially causes inefficiencies and difficulties. Another risk is concerned with the various forms of car sharing that are coming up, offering users various ways to engage in car sharing, hence competition might be increasing.
Environmental and social risks	These two are closely connected since they have to do with user behavior. People might become familiar and open towards car sharing. This might cause a rebound effect, as people might prefer using a shared car over waiting 10 minutes for the bus. However, this would require a change of people's behavior when traveling by car, and it remains to be seen if the larger population will do so. Another risk is that people refrain from using the service and this will hamper further growth. In case of rapid growth it is key for Greenwheels to be able to deliver their service. Meaning there are enough cars available to be shared.

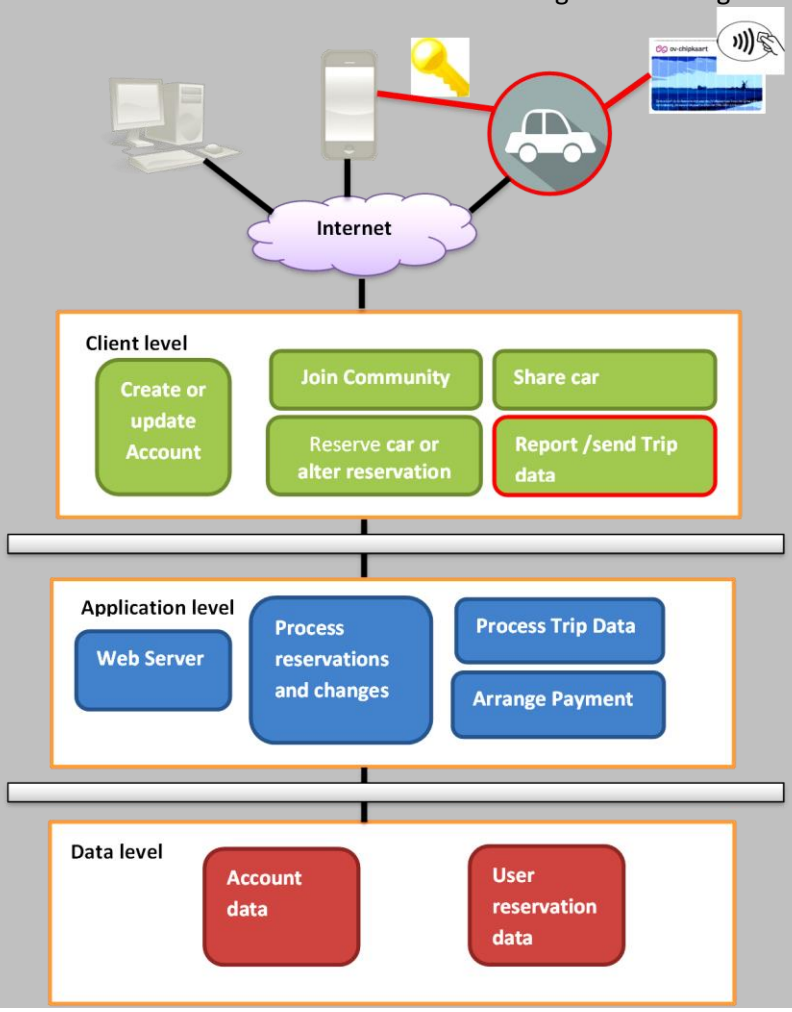
Appendix D MyWheels

Company Profile MyWheels	
Name of the company	MyWheels
Legal status	Private limited company
Contact person	-
Address	Keizersgracht 264 1016EV Amsterdam
E-mail	Info@wheels4all.com
Tel.	0228514824
Background	The initiative of Wheels4all, started in the 1990`s, when founder Henry Mentink started sharing his car in 1993. Later in 2003, a cooperation was founded and 6 cars were shared with 40 families. Over the years this number grew to about 200 bought cars in 2010. It was from that year onwards the Wheels4All continued under the name MyWheels, and since then the company has grown to a car sharing platform offering 2000 cars in august 2014 (Gitzels, 2014).
Company focus	MyWheels is a non-profit company that aims to enhance liveability in neighbourhoods by offering the MyWheels platform. As an open platform they allow various car sharing forms and transport modes to be offered. As such they also offer the OV-fiets. MyWheels mainly offers its services in a peer 2 peer form, however MyWheels also adopts a business to consumer approach by offering their own fleet in a similar form as does Greenwheels, around 200 cars are so the so called smart wheels owned by MyWheels (Mentink, 2014).
Year of foundation	2010
Size	Around 7 employees
Location	Amsterdam, The Netherlands
Industry	Leisure, travel and tourism
Sustainability orientation	MyWheels
Markets	MyWheels operates in both the C2C markets as well as B2C
Geographical market	Netherlands
Phase of company; start up, roll-out, mature, declining	Mature

Business model of the company	
	Service Domain
Customer	Being mainly a peer2peer platform, MyWheels has two customers. The people sharing their car on the platform and people using the cars offered. Also here the car sharers are highly educated and have an above average income. However, they are often younger than classical car sharers, have often one car or more, and are not mostly located in the urban areas.
Target group	Simply put the target group of MyWheels consists of people in need of a car but do not own one and people willing to share a car. MyWheels allows communities to be created and as such they target groups of people that are willing to share rather than the individual car sharers.
Customer base	In February 2016, MyWheels offered around 3000 cars, shared with 30.000 people. However, as registration on the platform is free this does not mean

	these 30.000 people are active users.
Value proposition	For the user of the cars on the platform MyWheels takes away the need for car ownership, and in return offers a wide variety of cars to use. For the people sharing their car, MyWheels offers a way to make car ownership more affordable. MyWheels allows communities to be formed that make use of the platform, this makes sharing within the neighborhood likely more approachable and easier in terms security and safety since people live within the same neighborhood.
Environmental value	The service offered by MyWheels, offers a reduction in the amount of cars needed to fulfill the transport needs of peers. This reduction in car usage means less cars on the road, hence it reduces the need for parking spots and expansion of infrastructure. This also means less emission, hence less polluted cities.
Social value	The platform delivers social value in two ways. Firstly, it gives people access to a car that otherwise could not. Secondly it allows people to make car ownership more affordable. It requires however a change in behavior for people who are used to car ownership and now start using a shared car.
Service offering	MyWheels offers a peer2peer sharing platform that facilitates in the sharing of cars between peers. On the platform users can decide to share a car or to use a car, for people sharing their car using the platform is free. While users pay a one time deposit. This makes that the platform offers a wide range of vehicles for the user to choose from. MyWheels supports community forming through their platform by offering registered communities several discounts and perks when using the platform. In order to support their decentralized approach of local cars, MyWheels deploys neighborhood coordinators. These neigbourhood coordinators are a point of contact for MyWheels users. MyWheels facilitates everything that could be needed in sharing a car. As such they also provide insurance within the rental time of the car, this includes insurance abroad. Next to facilitating p2p, MyWheels also offer smartwheels which is a form of classical car sharing.
Context of use	In contrast to the classical car sharing approach, peer2peer car sharing is not concentrated around urban areas. Car sharing is for most people not part of their everyday life. Also because a wide variety of users and cars, the context of use will also likely vary.
Effort for the customer	One can distinguish the effort for registration and the effort in usage of the service. Registration requires filling a online profile and making a €250 deposit (might be cancelled in future). However, the people offering their car do not have to make this deposit. In usage, most of the effort revolves around getting to the cars` location and transferring the keys of the car. For the car sharer, most of the effort lies in the arrangements with the users.
Customer relationships	For a peer2peer platform relationships are important not just the relation between MyWheels and its users, but also the relationship between the users. Bad experiences or a lack of mutual trust will cause users to be hesitant towards from using the platform.
Technology Domain	
Technology used	Partly owned cars, so called SmartWheels. Cars owned by MyWheels equipped with on board computer which shares driver data and allows opening with OV-chipcard.

Peer2peer fleet, which consists of a wide variety of cars as offered by the peers. An overview of the technical architecture has been given in the figure.



Negative value of technology	Also here negative value regarding the cars deployed revolves around emissions and production and disposal of the cars It would also prove hard to assess the exact negative value of MyWheels usage, due to the great variety in the cars and the way they are offered. Comparing P2P to car ownership, the environmental burden in terms of emissions will likely be greater. Simply due to the fact that owners will continue to use their car when required and in the other times will offer it on MyWheels.
Organizational Domain	

Actors in network	
Strategic interest actors	
Users offering their car	*Earning money*
Organizations offering cars (ANWB, Europcar, Mister Green, Autopia)	Engage in a new growing market, without having to invest in IT infrastructure.
Software developers	*Making money, participation in making MyWheels work*
(open source)	Income generation
Tanks card company	*Less traffic parking congestions, lesser cars in cities*
Municipalities	Lesser pollution Easy access to large customer base.
Insurance company Centraal beheer Achmea	*Enhances social image of lotteries.*
Stichting Doen	
Added value for actors in network	Also this car sharing approach offers value. Not only to its direct users, but also to municipalities. The platform can be part of a solution towards traffic congestion and air pollution in cities. Next to municipalities other companies can offer their cars on the platform. For these parties MyWheels is a way to reach more customers and enhance their image as a green company. These parties in return can add value for MyWheels, because people might be familiar with these companies which can enhance their trust and willingness to use and gives MyWheels a more professional image.
Financial Domain	
Financial investments	Main investments made in IT infrastructure, and in the Smartwheels The p2p approach can be seen as a form of shared investment done by the car owners.

Costs/revenue structure	For every car shared MyWheels takes €2,5 from both the sharer as the user. Next to this MyWheels offers a premium and super subscription at €10 and €100 respectively. Which come with their own benefits and reductions in fees. The main costs will be maintaining the platform, offering customer service and maintenance of the Smartwheels.
Risks	Being a non-profit organization MyWheels runs the risk of a low liquidity and not being able to withstand a sudden downfall or needed investment. MyWheels can only control their user experience up to a certain degree, since a large part is determined by the cars offered and the relationships between the peers.
Environmental and social risks	Because MyWheels relies strongly on their peers for shared cars, there is a great variety of cars available on MyWheels. It is therefore hard to see what the impact on the environment is of car sharing via MyWheels. For most car sharing practices, hence also Peer2peer, a change in behaviour or habit is needed when engaging in car sharing. Car owners must be willing to give up the 'freedom' that owning a car gives. And users must engage to mostly a personal level with sharers in order to get a car. These might be social barriers that hamper further adoption of p2p car sharing.

Appendix E: Stress test workshop design

Workshop overview:
The workshop takes place over a time span of 3 hours. In this time span companies and experts in the field of sustainability will discuss about success factors for business models for sustainability and the stress testing of such a model. The first part will revolve around the identification of business model success factors. The second part will revolve around stress testing the adapted STOF model against these success factors.

Participants:
Participant 1
- Accountmanager at VandeBron

Participant 2
- Employee at RVO

Timber Haaker (workshop Host)
- Senior advisor at Innovalor

Nico van Ginkel (reseracher)
- MOT master student

Criteria:
- Combination of companies and external experts
- Minimum of three people for the workshop
- Affiliation with energy or car sharing sector
- Or people with experience in field of sustainability

Preparation:
Before the workshop can take place, several preparations need to be made. To get the participants familiar with the STOF model and the concept of business models for sustainability a presentation will have to be given. Moreover, during the workshop the participants will make use of A1 posters, collared sticky notes and handouts with the STOF model.

Equipment and tools:
- A1 poster with Adapted STOF model on vertical column, and the success factors on the vertical row. Table A2
- Sticky notes in suitable colors.
- Whiteboard + markers
- Pens
- Computer + beamer

The workshop will follow the time table displayed in table A1

Table A1 Time Table

Pick up keys to room I	08:30	
Welcome participants offer them a cup of coffee	08:45 to 09:00	
Word of thanks and explanation of the idea for the workshop	09:00 to 09:010	
Introduce participants to the idea of a business model for sustainability and explain the idea of Success Factors. Ask participants to come up with success	09:10 to 09:45	Provide participants with pen and paper

factors for a business model for sustainability. Give sustainability value aspects and ask for factors that contribute to realization of them. This can be done for each aspect resulting in a wide set of factors, from which a top five van be derived.		
Discuss ideas and make a top 5	09:45 to 10:00	Write down top list on whiteboard
Introduce participants to STOF model Explain the interdependencies and the fact that sustainability is not explicitly incorporated. Introduce the participants to the adapted STOF model	10:00 to 10:10	Show STOF model on A1 poster.
First part of stress testing Discuss first two factors Give examples of how business model aspects are made concrete. E.g. (environmental value offering 100% renewable energy)	10:10 to 10:45	Hand out a separate color of sticky notes to each participant. Provide them with STOF on A4 as well. Let participants write down justifications for each position on the sticky notes.
Break	10:45 to 11:00	
Second part of stress testing Discuss last 3 factors	10:45 to 11:45	
Wrap Up	11:45 to 12:00	

Execution:
Timber Haaker will guide the workshop. Familiarize the participants with the timetable of the afternoon. Indicate that materials are provided for each step, but that these will/might be used for analytic purposes after the workshop.

Step 0: explanation of the afternoon and introduction to key concepts
The participants are introduced to the concept of a ***business model for sustainability*** . I.e. a business model where social and environmental values are being considered just as financial value. Moreover, the concepts ***Success factor*** and ***Critical design factor*** will be introduced.
Tools needed:
- Computer+ beamer

Step 1: Identify potential success factors
After the participants have been familiarized, with the concept. They are asked to brainstorm on what are success factors for a business model for sustainability.
If needed the following table can be used for further explanation.

Environmental value	1. Offers 100% renewable energy 2. Causes reduction in emissions and decreases the need for cars.
Social value	1. Contributes to a change in behavior towards energy consumption 2. does not require habits to be changed 3. provide more people in society access to transport modus car
Negative value	1. take into account negative aspects attributed to technology deployed
Added value for stakeholders	1. Service offering provides value outside or inside value chain. For example: car sharing provides potential solution to consumers, but also municipalities, and other transport parties like NS.

Tools needed:
- Whiteboard+ markers

Step 2: Create top 5 of success factors
After having identified a set of potential success factors. Researchers and participants will derive a top 5 listing of factors based on the discussion.
Tools needed:
- Whiteboard + markers

Step 3: Stess testing with success factors
First of all the stress testing process will be explained to the participants.
Having identified success factors, the next step is performing the stress testing. The central question is the following: Do the business model elements contribute positively to the success factors? The participants are asked to write the reasoning behind the color choice on the respective sticky note.
Tools needed:
- A1 poster with Adapted STOF model and success factors.
- Sticky notes in various colors
- Pens

Table A2: Stress test template of STOF model on A1 size

	Success factor	Success factor	Success factor
Service Domain			
Target group			
Value proposition			
Environmental Value			
Social Value			
Service offering			

Effort for the customer			
Technology Domain			
Technological functionality			
Technology enabled or accessed			
Negative value of Technology			
Organizational Domain			
Actors			
Strategic interests			
Value added for stakeholders			
Financial domain			
Investments			
Costs			
Revenues			
Risks			
Environmental and social risk			

Appendix F: Results workshop

The workshop has been held in Dutch as such the brainstorm results are listed in Dutch.

Step 1: Brainstorm on success factors

The Brainstorm on success factors has yielded the following list of success factors mentioned by the participants. Included in this list are the factors as found from the literature by the researcher.

1. **Environmental value**
   - Klimaatakkoorden
   - Alles wat bijdraagt aan een reductie in CO_2 NO_x en Methaan
   - Reductie in uitstoot in mobiliteit
   - Afvalreductie → circulair
   - Biodiversiteit, kwaliteit van het leven voor zowel mens als dier
   - Vergroten van levensduur van producten
   - Focus op gebruik bij de klant
   - Cradle to cradle aanpak
   - Andere keteninrichting
   - Keten verantwoordelijkheid
   - Nieuwe diensten/producten vanuit de sustainability
2. **Social value**
   - Transparantie, inzicht, marketing , incentives
   - Positief gevoel bij te dragen aan de wereld
   - Sociaal ondernemen
   - Burger participatie
   - Intrinsieke motivatie
   - Medewerkers in macht zetten
   - Leiderschap, samen MAEX
3. **Negative value reduction**
   - Accountability
   - Transparantie
   - Ketenimpact
4. **External stakeholder value**
   - Shared cost for investment
   - Gezamenlijke initiatieven voor sustainable value

Step2: selection on main factors.

In the creation of the list of potential success factors, various factors received more attention or were mentioned at multiple instances related to a variety of lines of thought and examples. Four success factors have been identified to be seen as important by the researchers and participants.

These are translated to English:

1. Supply/value chain impact.
2. Accountability
3. Intrinsic motivation of customers (citizen initiatives)
4. Joint initiatives between parties

Step 3: performing the stress test exercise

The original notes in Dutch have been organized and translated into English. Unfortunately due to a lack of time at the end of the workshop, a choice had to be made in the most important business model elements. Therefore, *Actors, strategic interests ,Costs and risks* have not been include in the stress-test.

Performing the stress testing on success factors

Table F1. Elaborate Heat map

	Business model VandeBron	Keten Inrichting	Accountability /transparency	Intrinsieke motivatie Of customer to be sustainable	Gezamenlijke initiatieven
Service Domain					
Target group	Small energy consumers Energy producers	VandeBron does only a small part of the chain. Energy production is for example not done by VandeBron, as this would give rise to a conflict with the consumer, in the sense that VandeBron would like to sell more energy. The chain is determined by the proposition.	VandeBron has criteria for their producers. VandeBron focuses on community building.	The choice for a producer is a choice of the customer. By targeting the people in the right places intrinsic motivation towards sustainability can be found. VandeBron aims to target such people	VandeBron cooperates with for example the beterleven keurmerk. For the keurmerk it is good that it is being used. However, the association desired is dependent upon the target group of VandeBron. However, not many initiatives are present.
Value proposition	Transparency between producer and consumer	n.v.t.	Transparency positively affects accountability	Due to transparency people are more involved with the vision and which leads to more intrinsic motivation to participate.	Neutral effect, although there can be positive contribution, it has not been identified.
Environmental Value	Offering 100% green energy	n.v.t.	Green energy in a transparent way. Moreover, consumers have the option to see and personally visit	n.v.t.	n.v.t.

			their producers.		
Social Value	Creating equality Requires behavioral change Preservation of cultural characteristics	VandeBron only has customers, but as a service platform they Mover from a line to a platform or triangle where both producer and customer are at the same level. VandeBron works with fixed fees, as such they do not have to divide profit between producer and consumer.	n.v.t.	Due to transparency, and equality participation is higher.	The choice of business model with the arrangement of the chain as a platform has a potential positive effect on cooperation as other parties can use the platform as well.
Service offering	Facilitating a market place between energy producers and consumers.	Same logic	n.v.t	Customers can make their choice in the producers they chose. The transparency it offers positively contributes to intrinsic motivation. Also for producers, a marketplace offers a seemingly fairer price.	The choice of business model with the arrangement of the chain as a platform has a potential positive effect on cooperation as other parties can use the platform as well.
Effort for the customer	Sign up on website. or on the street through face to face marketing	n.v.t.	n.v.t.	Approachability is high, low effort contributes to motivation. VandeBron wishes to take away worries and burdens. For example, when calling VandeBron there will be no call-centre in between.	n.v.t.
Technology Domain					

Technological functionality	Online platform	It has become a platform	n.v.t.	Personalisation of the product. People can see from who they get their energy. Producers post their stories online.	External parties can make use of the platform, but these are more tier-3 parties.
Technology enabled or accessed	Access to renewable energy sources	n.v.t	The choice of renewable energy source has an effect of accountability. For example Biomass installations can have Food or waste as input. VandeBron takes this into account	n.v.t.	The choice for a certain technology, can lead to certain cooperation's. Further, from the role of VandeBron new business cases can be realized .
Negative value reduction of Technology	Potential negative value of energy sources.	n.v.t.	Contributes positively to accountability	n.v.t.	Cooperation with Tesla, who is a customer of VandeBron. It is however a shared choice to become connected.
Organizational Domain					
Actors					
Strategic interests					
Value added for stakeholders	Parties that are not direct customer that benefit from the activities. In car sharing one can think of a solution	Outside of value chain	Adding value outside value chain can help accountability. But was not identified.	n.v.t	Can potentially contribute

	provided for municipalities.				
Financial domain					
Investments	No investments required in production capacity. Seed capital	n.v.t.	Choice for Green fund or not. Triodos for example only invests in Green projects.	n.v.t.	n.v.t.
Costs					
Revenues	Monthly energy bill	Rearrange the value chain, no interests at stake in dividing profits.	Create transparency due to the absence of profit margin.	Fixed payouts and fees, gives rise to security and trust, but not contributes directly to intrinsic motivation towards sustainability.	local communities, that set up an energy source. Or join the solar collective. Due to the platform, it is possible that people can get their energy from a local producer.
Risks					
Environmental and social risk					