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Applying blockchain technology in multi-sided platforms to enable business model innovation

An explorative case study on decentralized sharing platforms

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An explorative case study on decentralized sharing platforms

By

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“Everything that can be decentralized, will be decentralized.” – David A. Johnston, 2014

Preface

For the past seven months I had the opportunity to complete my Master's programme in Management of Technology by studying the impact of blockchain technology on multi-sided platforms in the sharing economy. It was a real pleasure to explore how blockchain technology could enable new business models. This research allowed me to get a solid understanding of blockchain technology, cryptocurrencies and smart contracts.

The final phase of my graduation period was challenging, but mostly valuable. I learned a lot, but there is much more to learn. The quality of this report would definitely be nowhere near its current state without the feedback of my supervisor prof. dr. Harry Bouwman. Your feedback challenged me to reflect on my writing style and the practical implications of the research. This resulted in overall improvement of the thesis. Thank you for your investment to re-read this report multiple times and keep looking for improvements. Moreover, your help led me to conduct my research at Peerby. It was a very pleasant time at Peerby and I would like to thank everyone from the team. I would especially like to express my gratitude to Daan Weddepohl – Peerby's Founder & CEO – for his dedication and enthusiasm for this project. Our discussions on the future of sharing economy and entrepreneurship gave me interesting insights. Furthermore, I appreciate that you involved me in different other projects during my time at Peerby.

Finally, I would like to thank my family and friends for their support and encouragement. In particular referring to the intensive dedication from my mother. I am grateful for the fact that you are always supporting my decisions, combined with a healthy dose of critique. You encourage me to remain conscious of my actions. In special, I would like to thank Savannah for her immense support and patience during the final period of writing this report. Over the past months I learned to accept how crucial resting is for me to achieve my goals. Our conversations continuously allow me to develop myself and help me to find the right balances in life.

The last mile was definitely the longest, but I am excited to finally present this report to you.

Frank Christiaan Ribbens
Castricum, August 26th 2018

Executive summary

The competiveness between businesses is continuously increasing and multi-sided platforms seek to reduce cost, increase efficiency and improve the quality of products and services. A multi-sided platform is a technology solution that solves coordination problems in market exchange by facilitating direct interactions between two or more distinct groups of individuals, where each group is affiliated with the platform. Research suggests that the technical capabilities of blockchain technology can be a driver for innovation (Giaglis & Kipriotaki, 2014; Catalini, 2017; Johansen, 2017; De Filippi, 2017). However, there is no scientific literature that describes how blockchain technology can be used by multi-sided platforms. Blockchain technology is a data storage system that represents a digital ledger of records that are linked to each other and distributed across all actors in a network that must consent on validity of information without the need for a trusted third party (Bond, 2017). Multi-sided platforms could have significant benefits if the use of blockchain technology is clarified. The research objective was to explore the impact of blockchain technology on multi-sided platforms and evaluate the viability and feasibility of a decentralized business model for Peerby. The following research question was formulated to realize the research objective:

> *How can blockchain technology enable business model innovation of peer-to-peer multi-sided platforms and can decentralized business models be viable and feasible?*

This qualitative case study involved a literature review, semi-structured interviews and a business model stress test workshop. The interview results analysis of the data collection revealed the impact of blockchain on each business model component. The research outcomes revealed how blockchain technology could be used to enable business model innovation. The interview results were used to design a decentralized business model for Peerby according to the STOF (service, technology, organization, finance) business model ontology.

Blockchain impact on service domain

Blockchain technology improves the value proposition of multi-sided platforms. The transactions between individuals in the sharing economy involve access to a good or service in exchange for money. Interacting individuals always required a trusted third party that intermediates in the exchanges of value. A multi-sided platform needs to be decentralized to benefit from the technical capabilities of blockchain technology. The value proposition of a centralized multi-sided platform (“as-is”) is similar to a decentralized multi-sided platform (“to-be”). Decentralized sharing platforms use token systems, an application of blockchain technology, to reward users that contribute to the value network. A token system is a means for individuals to engage in direct transactions without the need for an intermediary. Tokens must be distributed across users that can contribute to the token utility. An Initial Coin Offering helps to distribute the tokens while raising funds that can be used to develop the platform. Token holders can be compared with shareholders of a normal company. Therefore, the distribution of tokens also distributes the power of the platform. Tokens eliminate currency exchange rates across borders. Consequently, decentralized sharing platforms can equalize fees globally.

Blockchain impact on technology domain

Users of a multi-sided platform always require a trusted third party that facilitates interactions between individuals. This makes conditional transactions a valuable business function of decentralized sharing platforms. The research outcomes showed that smart contracts could be used to facilitate transactions under certain conditions. Storing a set of rules or logic on a blockchain creates smart contracts, allowing that the trust in a third party is placed in the technology. Moreover, smart contracts eliminate data verification costs. The use of smart contracts is essential to the decentralization of a multi-sided platform. The current state of development of blockchain technology allows that smart contracts facilitate conditional transactions without a third party. The other business functions that decentralized sharing platforms could offer are less practical to implement. These business functions use smart contracts for the automation of identity verification, reputation systems and dispute settlement.

Blockchain impact on organization domain

The technical architecture describes the functions of the platform and shows interconnected components. The business processes of the multi-sided platform are closely related to the platform architecture, because these enable interaction between technical components and the users. Business functions of the platform offer the technical functionalities to the end-users. Users need to engage in value activities to let the value network of the platform grow and realize positive network effects. These value activities relate directly to the business functions that were identified during the interviews. It is of significant importance that users interact and use tokens engage in transactions. Decentralized sharing platforms need to stimulate their users to engage in value activities. The token system can be programmed to reward contributing users with tokens, which is described as economic incentives. This study identified a causal relation between economic incentives and platform growth by means of network effects. However, the effectiveness of economic incentives is not yet fully understood, due to the novelty of decentralized business models and blockchain technology.

Blockchain impact on finance domain

Multi-sided platforms usually have a revenue model that is based on transaction fees. The research outcomes revealed that multi-sided platforms should lower transaction fees to let users benefit from the elimination of data verification costs. Decentralized sharing platforms need to look for new ways to earn income, because this decision impacts the revenue stream. The result outcomes indicate that opt-in services and third party commissions are the best solution to make the business model viable. The value proposition is improved by offering complementary services of third parties. These opt-in services do not require blockchain technology, but are important for decentralized business models to create a sustainable revenue model. The Initial Coin Offering is not a revenue model, but is relevant to the finance domain. Initial Coin Offerings are crucial for decentralized sharing platforms to collect the necessary funding for the development of the platform.

The early stage of development of blockchain technology comes with barriers for large-scale diffusion. Therefore, the viability and feasibility of the decentralized business model were addressed during a business model stress test workshop. The main activity of the business model stress test is the confrontation between the business model components and selected stress factors. Three stress factors that were identified during interviews were included in the business model stress test. The following stress factors were selected: (1) societal trust in blockchain technology, (2) stability of token value and (3) changing regulatory environment. The business model stress test revealed that the decentralized business model is neither viable nor feasible with negative stress factor outcomes. Positive stress factor outcomes affect the business model components without negative implications. Strong trust in blockchain technology and a stable token value is very important to make the business model viable and feasible. However, negative stress factor outcomes made multiple business model components not feasible or not viable. Overall, It can be concluded that it is too soon to use blockchain technology to decentralize business models, as the decentralized business models appeared to very not robust.

The main contributions of this study were made to the combined field of blockchain technology and multi-sided platforms. The findings of this research have different implications for peer-to-peer multi-sided platforms, like Peerby. Thereby, this study contributes to the future of multi-sided platforms within the sharing economy. The interviews helped to describe how business model components could change from blockchain technology. The results and conclusions are the foundation of a whitepaper for Peerby on blockchain technology. The content of this whitepaper describes how Peerby intends to use blockchain technology to improve the services for its users. The use of smart contracts to decentralized business processes could help Peerby in the acquisition of users. The elimination of data verification costs could be users to decrease transaction fees that users need to pay to use the service. This helps to increase the rate of retention of users. Decentralized sharing platforms use token systems to facilitate transactions between individuals, without the need for a third party. These tokens are sold through an Initial Coin Offering to distribute the tokens among users and collect funds. Peerby could use these funds to develop the platform. Overall, blockchain technology has positive implications for multi-sided platforms.

The limited number of interviews decreases the external validity of this research, but some generalizations can be made. The research outcomes could be translated to different types of multi-sided platforms in different industries. This research also has implications for multi-sided platforms that facilitate selling and buying of goods, rather then lending or renting. The use of a token system and smart contracts can bring similar results to peer-to-peer goods trading platforms (e.g. eBay) or business-to-customer platforms (e.g. Amazon). It can be concluded that this research brings a new perspective to business model innovation by designing a decentralized business model. This knowledge could be exploited by multi-sided platforms to realize a competitive advantage. The insights from the business model stress test workshop suggest, however, that blockchain technology is to dependent on trends and uncertainties. Peerby could study how the decentralized business model could be improved to make it more robust. Furthermore, it could be argued that decentralizing business models reduce the total environmental impact by people. Multi-sided platforms could scale more easily if the value proposition and corresponding revenue streams. Increased sharing of underused goods would reduce consumption and production of goods that accounts for approximately 38% of the total environmental impact.

Finally, suggestions for future research were derived from the limitations and identified knowledge gaps. More interviews need to be conducted with individuals that have knowledge in the fields of blockchain technology, multi-sided platforms and the sharing economy. The results of these interviews could be very different than the results of this research. To increase the reliability of the results, these could be triangulated with other sources of evidence. Furthermore, another business model stress test workshop should be organized that includes all business model components and more stress factors. Including a broader perspective of trends and uncertainties gives new insights regarding the viability and feasibility of decentralized business models. The research outcomes identified new knowledge gaps that need to be filled in the future. The use of blockchain could result in new platform strategies that apply to decentralized sharing platforms. These strategies need to be explored to realize network effects for decentralized business models. Multi-sided platforms need to explore the costs of implementation of blockchain technology and the extent of decentralization that is optimal for the decentralized sharing platforms. Another suggestion relates to the impact of different blockchain types and consensus algorithms. Future research could explore how different blockchain types have different implications for decentralization of multi-sided platforms. Finally, the decentralized business model of Peerby needs to be improved to be more robust.

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1 Introduction

The main reason to conduct this research involved the development of blockchain technology and multi-sided platforms. The relation between blockchain technology and multi-sided platforms will be clarified throughout the report. Therefore, this chapter starts by defining and describing characteristics of blockchain technology and multi-sided platforms (1.1). The case description is followed by the research problem, which addresses the practical and academic problem that this research aims to resolve (1.2). The research objective is formulated after the research problem (1.3). The background of Peerby is described that clarifies the selected case that will be explored throughout this research (1.4). The research questions are based on Peerby and are derived from the research objective (1.5). This is followed by the research strategy that describes the activities that need to be undertaken in order to realize the research objective (1.6). This chapter concludes by presenting the thesis structure (1.7).

1.1 Blockchain technology and sharing platforms

This section introduces the core concepts of the research and describes the case of Peerby. These concepts must be clear to understand the relation between blockchain technology and multi-sided platforms. The following definition of **blockchain technology** is used in this research (Bond, 2017, p. 2):

> *"Blockchain technology at its core is a data storage system that represents a digital ledger of records (blocks) that are cryptographically linked (chained) to each other in historical sequence and distributed across all actors in a network that must consent on validity of information, such as a transaction, without the need for an intermediary that can interfere in this process."*

Section 2.1 describes the main technical capabilities of blockchain technology. The technical capabilities of blockchain technology can be summarized as follows and clarifies the relevance of blockchain technology for multi-sided platforms:

- Blockchain technology allows individuals to make transactions without the need for a trusted third party. The elimination of the third party from a process is also known as *disintermediation*. The data on a blockchain is stored across multiple actors in a *decentralized* network. Consensus mechanisms are used to reach consensus between actors to validate data.

- Transactions that are stored on a blockchain cannot be altered without consensus between the actors in the network, which makes data on a blockchain *immutable*. Transactions that are rejected by the actors in the network will not be stored on a blockchain. The correctness of the data on a blockchain is *secure*, because rejected transactions are not relied on.

- Data on a blockchain is *transparent* and visible to every actor in the system, due to the openness of the blockchain architecture. Every actor in the network can see changes on a blockchain.

- User *privacy* is increased, because blockchain technology allows that users no longer share data with third parties. Third parties will no longer have access to user data.

- Applications of blockchain technology can be used to decentralize and automate operational processes, which can *reduce data verification costs* for third parties.

- Blockchain technology enables the use of smart contracts. Smart contracts allow two parties to exchange anything of value without the need for a middleman. Smart contracts incorporate the technical capabilities of blockchain technology that are described before.

- *Decentralized applications* use a combination of multiple smart contracts to enable complex interactions between parties. This application of blockchain technology could be used to create decentralized multi-sided platforms.

A definition of multi-sided platforms helps to understand why the developments of blockchain technology could be applied by multi-sided platforms. The following definition of **multi-sided platforms** is used in this research:

> *"A multi-sided platform is a technology solution that solves coordination problems in market exchange by facilitating direct interactions between two or more distinct groups of individuals where each group is affiliated with the platform."*

In this research project we are interested in the role blockchain technology can play in multi-sided platforms. Multi-sided platforms solve coordination problems in market exchange, by aggregating supply and demand and allowing individuals to interact. Technologies like blockchain can enable digital transformations. Digital transformations refer to the use of technologies to resolve problems in new ways (Van Peteghem & Caudron, 2016). Technological developments can initiate business model innovation (Haaker, De Reuver, & Bouwman, 2018).

Section 2.2 describes the main characteristics of multi-sided platforms. The description of main characteristics of multi-sided platforms can be summarized in an overview. This overview adds clarity to the definition of multi-sided platforms. The main characteristics of multi-sided platforms are as follows:

- Multi-sided platforms aggregate the supply and demand side of a market and *facilitate direct interactions* between users. Multi-sided platforms have an intermediary role between both user groups.

- A multi-sided platform has *no ownership of the physical assets*, instead the goods are owned by platform users.

- There will be *no transfer of ownership* of goods between interacting users, but multi-sided platforms enable access to goods.

The research scope is further delineated to multi-sided platforms within the sharing economy, defined as peer-to-peer multi-sided platforms. This report uses the term sharing platforms to describe peer-to-peer multi-sided platforms. A definition of sharing economy gives more understanding about sharing platforms. The **sharing economy** is defined as follows (Botsman, 2015):

> *"An economic ecosystem that facilitates the sharing of underused goods or services, either for free or for a fee, directly between individuals or organizations."*

1.2 Research problem

The research problem of this thesis is twofold. The research problem comprises a problem statement and identified knowledge gaps in scientific literature. The problem statement clarifies why multi-sided platforms need to explore how the technical capabilities of blockchain technology can be a driver for innovation (1.2.1). The academic problem identifies knowledge gaps in scientific literature (1.2.2). The practical problem statement and existing knowledge gaps show the significance to conduct this research.

1.2.1 Problem statement

A general business problem relates to the realization of business model innovation. In order to remain competitive, multi-sided platforms should always be open to revise their existing business model. Business model innovation can be initiated from new technologies or strategy that can impact existing businesses (Haaker, De Reuver, & Bouwman, 2018). Multiple studies suggest that the technical capabilities of blockchain technology can be a driver for innovation (Giaglis & Kipriotaki, 2014; Catalini, 2017; Johansen, 2017; De Filippi, 2017). The technology in itself, however, does not drive a potential digital transformation (Kane, Palmer, Nguyen Phillips, Kiron, & Buckley, 2015). Reasons to innovate include reducing costs, improving products or services, increasing efficiency. Businesses around the world are already developing new applications of blockchain technology. The technical capabilities of blockchain technology indicate the potential use of blockchain technology for multi-sided platforms.

Blockchain technology could be used to develop decentralized peer-to-peer transaction systems and applications (Giaglis & Kipriotaki, 2014). Decentralized applications could be developed offering equal functions as the processes of multi-sided platforms and reducing costs. Blockchain technology could enable automatic payment processes without the need of an intermediary. This allows that individuals engage in direct peer-to-peer interactions managed by smart contracts (Vermeend & Smit, 2017). Multi-sided platforms would still able to add value to transactions, but through new processes that are characterized by the technical capabilities of blockchain technology. The market position of multi-sided platforms could be challenged when competitors are effectively implementing blockchain technology. Therefore, multi-sided platforms could have significant benefits when it is clear how blockchain technology could impact their business model.

1.2.2 Knowledge gaps

Research on blockchain technology shows how blockchain technology is disrupting multiple industries (Tapscott & Tapscott, 2016; Catalini, 2017; De Filippi, 2017). Exploratory research speculates that blockchain technology could make entire businesses obsolete. This research is mostly focused on blockchain technology in the financial services industry. The amount of scientific research on multi-sided platforms is increasing. Multi-sided platforms are recognized for disrupting traditional companies (Walter, 2017; Caillaud & Jullien, 2003). Moreover, there is no scientific literature that describes how blockchain technology can be used by multi-sided platforms. The implications of blockchain technology for the sharing economy are explored (De Filippi, 2017), but it remains unclear what the impact of blockchain technology can be on multi-sided platforms. The technical capabilities of blockchain technology indicate it can be a driver for innovation of multi-sided platforms, and many other businesses. Investigating the different applications of blockchain technology to improve business models of multi-sided platforms is a novel approach to blockchain research.

The significance of researching applications of blockchain technology to innovate business models of multi-sided platforms is backed by a research agenda for information systems (Giaglis & Kipriotaki, 2014). The relevant literature on multi-sided platforms and blockchain technology confirms that little knowledge exists in the combined fields. Most literature on blockchain technology is conducted from a technology-driven approach focusing only on the beneficial aspects of blockchain technology. A recent study researched the benefits and implications of blockchain technology in governmental organizations (Ølnes, Ubacht, & Janssen, 2017). This study recommends that research on blockchain technology shifts from a technology-driven approach to a need-driven approach. The need-driven approach implies that the research must focus on how multi-sided platforms can make use of blockchain technology that benefit the users (Ølnes, Ubacht, & Janssen, 2017). More applications of blockchain technology must be analysed to understand how the technology enable innovation of multi-sided platforms. The main contribution of this study will be made to the fields of blockchain technology, multi-sided platforms and the future of the sharing economy.

1.3 Research objective

The research problem is used to formulate a research objective. The research objective is the foundation of the research and will be used to formulate research questions (Verschuren & Doorewaard, 2010). The objectives of this research are formulated as follows:

> *Explore the impact of blockchain technology on peer-to-peer multi-sided platforms by designing a decentralized business model that allows users to share goods with each other.*

> *Evaluate the viability and feasibility of the decentralized business model that is designed by using blockchain technology as a driver for innovation of peer-to-peer multi-sided platforms.*

The deliverable of this research consists of recommendations to executives of Peerby. The recommendations describe how blockchain technology could be used to innovate the current business model of Peerby. This will be the first step to the development of a whitepaper for Peerby that describes how blockchain improves their business model. The evaluation of the business model helps to identify the strong and weak parts of the decentralized business model. The realization of the research objective helps Peerby with its long-term digital transformation. Section 1.4 gives a description of the case and clarifies the relevance and suitability of Peerby for the described problem statement.

1.4 Case description

The research problem relates to multi-sided platforms. Peerby is a sharing platform that facilitates sharing of underused goods between individuals. This goods-sharing service is offered through a peer-to-peer multi-sided platform. Peerby was founded in 2011 and has continuously pursued business model innovation. The company started as a platform for goods lending. This business model turned out to be not profitable, because the revenue model was not sustainable. Since 2015 a new platform service was launched that facilitated the rental of goods. Users were allowed to pay neighbours to rent their goods. This revenue model seemed more viable. However, since 2018 both platforms are combined into one Peerby service, allowing lending and renting of goods either for free or a fee. This new platform is available in the Netherlands, but is still under development. The brief history of Peerby shows that the company is innovative and aims to pursue new opportunities. The company downscale over the past years and seeks to scale with the new service. The problem statement of this research aligns with the practical problems that Peerby incur. New technologies could be used to reduce data verification costs and improve the value proposition of the multi-sided platforms. These reasons make Peerby a suitable case for this research. The research scope is based on the case of Peerby. Therefore, this research focuses on sharing platforms that facilitate sharing of underused goods between individuals, rather than organizations. These individuals are enabled by the platform to interact and make transactions. Individuals can request goods from their neighbours on Peerby's website. Neighbours can share these goods with the requesting individuals.

1.5 Research questions

The main research question (RQ) is formulated and then categorized into multiple sub-questions (Q). The research objective is used to derive the main research question. The answer to the main research question results in the realization of the research objective. The main research question is formulated as follows:

> *RQ: How can blockchain technology enable business model innovation of peer-to-peer multi-sided platforms and can decentralized business models be viable and feasible?*

The research explores the relation between blockchain technology and multi-sided platforms. The sub-questions are used structure this research. Each sub-question elaborates a different aspect of the main research question. The collective answer to the sub-questions will collectively answer the main research question.

> *Q1: What technical capabilities of blockchain technology are relevant to multi-sided platforms?*

The concept of blockchain technology needs to be clarified before being able to explore its relevance for multi-sided platforms. Therefore, a description of the main technical capabilities of blockchain technology is important for this research. The first sub-question will be answered by reviewing literature on blockchain technology. There is a limited amount of literature available about blockchain technology due to its novelty. Therefore, the literature review on blockchain technology will be complemented with other sources of data. The literature review on blockchain technology uses scientific literature, websites and published whitepapers that describe the technical capabilities of blockchain technology.

> *Q2: What are the main characteristics of multi-sided platforms and do these characteristics apply to Peerby?*

Knowledge about multi-sided platforms is required to understand the business model of Peerby. There are different characteristics that compose a viable and feasible peer-to-peer multi-sided platform. The main characteristics of multi-sided platforms need to be clarified to comprehend the relevance of blockchain technology for Peerby.

> *Q3: What types of multi-sided platforms within the sharing economy are similar to Peerby?*

There are different types of multi-sided platforms that exist within the sharing economy. Not every multi-sided platform type relates to Peerby. The literature review describes the criteria of multi-sided platforms to be included in the sharing economy. The different criteria will be related to Peerby. The research scope within the sharing economy will be clarified by answering sub-question 3. Interviewees should have knowledge about sharing platforms similar to Peerby.

> *Q4: What business model components could be changed by blockchain technology to design a decentralized business model for Peerby?*

The literature review focussed on scientific business modelling theories. This knowledge is input for the analysis and description of business model components. The STOF business model will be used to describe the business model components. The STOF business model helps to structure the interviews. The impact of blockchain technology on multi-sided platforms is discussed during the interviews. The interviews determine the extent of the relationship between blockchain technology and the business model components of multi-sided platforms. The decentralized business model design will be based on these interviews.

Q5: What steps need to be undertaken to determine the viability and feasibility of the decentralized business model?

The viability and feasibility of the decentralized business model will be evaluated. The decentralized business model is based on sharing platforms that apply blockchain technology. A business model evaluation method from scientific literature will be used to structure this process. The business model stress test method helps to identify the strong and weak parts of a business model.

Q6: What are relevant trends and uncertainties that can impact decentralized business models?

The business model is evaluated by confronting trends and uncertainties with the business model components. The trends and uncertainties are so-called stress factors. The most relevant stress factors are identified during interviews. The identified stress factors are input for the business model evaluation workshop. The viability and feasibility of the decentralized business model will be determined during the business model stress test workshop.

Q7: What impact could future trends and uncertainties have on the viability and feasibility of decentralized business models?

The causal relations between the stress factors and business model components are discussed during the business model stress test. The stress test workshop will determine the viability and feasibility of the decentralized business model. The selected stress factors will be confronted with the new business model design to understand causal relations. Causal relations are based on discussions during the stress test workshop. The insights from the workshop are used to develop a 'heat map'. The heat map is an overview that shows the impact of stress factors on the business model components. The strong and weak parts of the business model will be analysed. The heat map also shows the level of impact of the different stress factors. The last sub-question answers whether the business model is future proof.

1.6 Research strategy

The research framework is a schematic representation of the most important research phases (Verschuren & Doorewaard, 2010) (Figure 1). The research framework describes the appropriate steps that need to be undertaken in order to achieve the research objective. The research is categorized into three phases: (1) literature review, (2) business model design and (3) business model stress test.

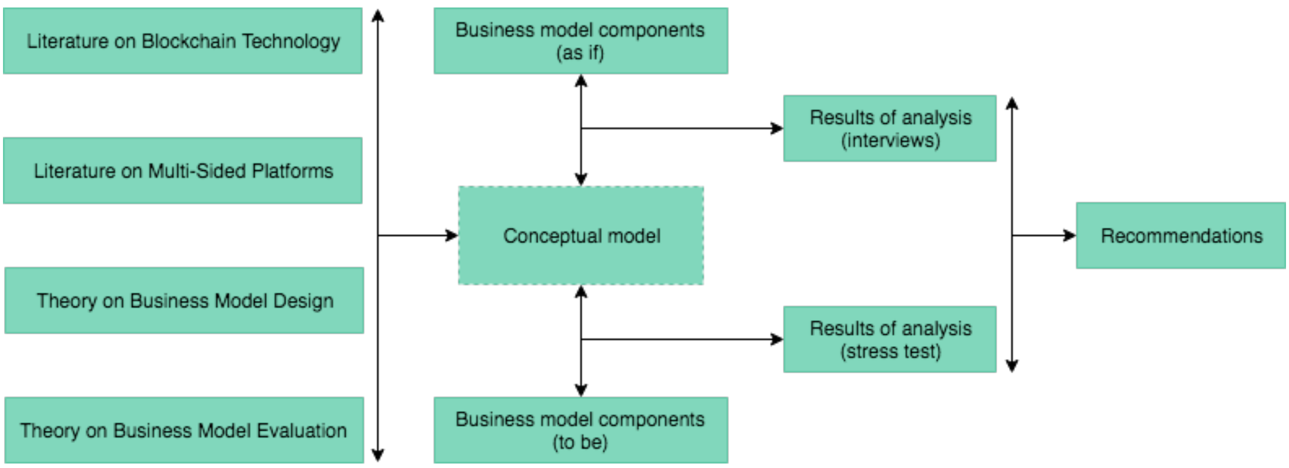

FIGURE 1 – RESEARCH FRAMEWORK (VERSCHUREN & DOOREWAARD, 2010)

The research objective aims to describe the impact of blockchain technology on peer-to-peer multi-sided platforms by designing a decentralized business model for Peerby. A conceptual model should contribute to the research objective. Such conceptual model comprises the assumed relationships between the core concepts of the research (Verschuren & Doorewaard, 2010). The initial conceptual model consists of four core concepts: blockchain technology, business model components, stress factors and business model robustness (Figure 2). Figure 2 is based on reviewed literature and preliminary research. The business model relates to a peer-to-peer multi-sided platform as was defined in section 1.1.

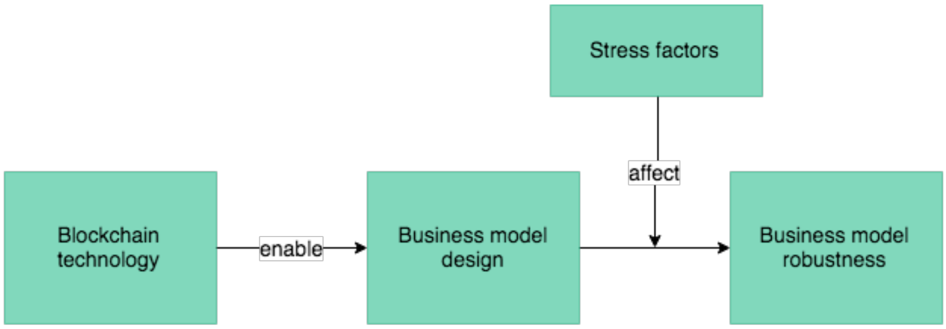

FIGURE 2 – INITIAL CONCEPTUAL MODEL

The first phase comprises an extensive literature review. The literature review is used to develop the conceptual model. The conceptual model validates the assumed relationships between the core concepts. The research scope towards the business model of Peerby requires a detailed description of the different platform typologies within the sharing economy. This description helps to select interviewees. The literature review also includes reviews business modelling approaches that are used in this research. The business modelling approaches structure the interview themes and questions.

The second phase of the research consists of semi-structured interviews. The STOF business model will be used to develop a list of themes and questions. The list of themes and questions structures the interviews. The impact of blockchain technology on the business model components is discussed during the interviews. The analysis of interview results give understanding how blockchain technology impacts peer-to-peer multi-sided platforms. The interview results will be used to design a decentralized business model. The business model design is described following the STOF business model.

The third phase involves a business model stress test. The business model stress test method helps to structure the process of evaluating the decentralized business model. The goal of the stress test workshop is to identify the strong and weak parts of the decentralized business model. The business model stress involves the selection of stress factors. The stress factors are identified during the interviews. The impact of the stress factors on the business model components is analysed. The analysis determines the robustness of the business model.

1.7 Thesis structure

The remaining chapters in this thesis report are structured as follows:

- Chapter 2 provides the reader with literature review on the core concepts and business modelling theories;
- Chapter 3 presents the research methodology and the case study protocol;
- Chapter 4 provides an in-depth analysis of the findings and concludes with interpretation of the data;
- Chapter 5 discusses the research outcomes, reflects on the academic contribution and implications of the research and discusses limitations and future research.

2 Literature review

This chapter presents the literature review to clarify the relation between blockchain technology and multi-sided platforms. The literature review begins by describing the technical capabilities and applications of blockchain technology (2.1). This will be followed by a description of the characteristics of multi-sided platforms (2.2). This knowledge discusses the relevance of blockchain technology for multi-sided platforms. Subsequently, the different types of multi-sided platforms within the sharing economy will be described (2.3). The literature review also includes a description of the used business modelling approaches (2.4). The literature review concludes by presenting the conceptual model of this research (2.5).

2.1 Blockchain technology and decentralized applications

This section aims to clarify blockchain technology and its technical capabilities. Therefore, the first generation of blockchain technology will be introduced and a definition will be given (2.1.1). The main technical capabilities of blockchain technology will be discussed to explain this definition (2.1.2). The section continues with a description of smart contracts and introduction of decentralized applications (2.1.3). The concluding subsection reflects on the role of blockchain technology as a driver for business model innovation of multi-sided platforms (2.1.4).

2.1.1 Defining blockchain technology

The history of blockchain technology is not long. Blockchain technology is the fundamental technology of Bitcoin, the first cryptocurrency, being a public decentralized ledger platform (Swan, 2015; Davidson, De Filippi, & Potts, 2016; Dooley, 2017). Bitcoin was introduced ten years ago and defined as *"a pure peer-to-peer digital currency that allows direct transactions between users without the need of an intermediary"* (Nakamoto, 2008, p. 1). Cyptocurrencies are the first generation of blockchain applications.

The complexity of blockchain technology allows for many misinterpretations of what blockchain technology actually offers. Different definitions of blockchain technology are formulated over time as new applications emerge. This research uses a comprehensive definition of blockchain technology (Bond, 2017, p. 2).

> *"Blockchain technology at its core is a data storage system that represents a digital ledger of records (blocks) that are cryptographically linked (chained) to each other in historical sequence and distributed across all actors in a network that must consent on validity of information, such as a transaction, without the need for an intermediary that can interfere in this process."*

This definition is explained by a description of the technical capabilities of blockchain technology. Subsection 2.1.2 describes the relevant technical capabilities of blockchain technology for multi-sided platforms.

2.1.2 Technical capabilities of blockchain technology

Blockchain technology is an innovation that is a combination of different pre-known technologies: peer-to-peer networks, decentralized consensus mechanisms, distributed data storage and cryptographic algorithms (Wright & De Filippi, 2015). Some of these concepts need further elaboration to understand the technical capabilities of blockchain technology. Literature on blockchain technology highlights six technical capabilities that could be useful for data process improvement (Tapscott & Tapscott, 2016; Frøystad, 2016; Mattila, 2016; Johansen, 2017; Catalini & Gans, 2017). In theory, these technical capabilities of blockchain technology could be relevant for multi-sided platforms. The following technical capabilities will be described to explain blockchain technology: decentralization, immutability, security, transparency, privacy and costless data verification.

Decentralization

The differences between centralized, decentralized and distributed networks need to be elaborated upon to understand blockchain technology and its technical capabilities (Figure 3). Blockchains are validated records of information that are authenticated by distributed users over the network (Frøystad, 2016; Johansen, 2017). Distributed ledgers refer to the storage of data that is spread across multiple actors in the network (Government Office for Science, 2016; Buntinx, 2016; Buntinx, 2017). Copies of the same information are shared on multiple locations within the network, hence the distributed nature of blockchain technology.

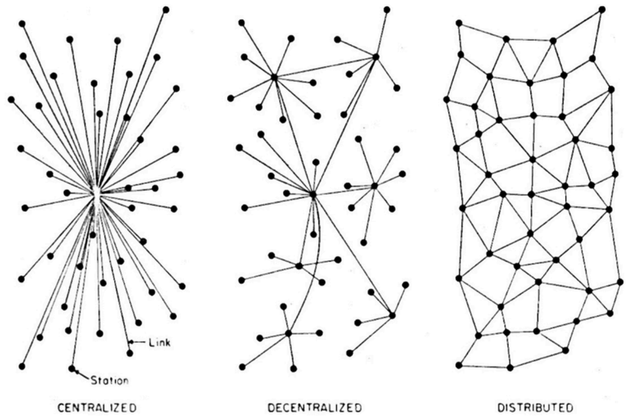

FIGURE 3 – CENTRALIZED, DECENTRALIZED AND DISTRIBUTED NETWORKS (BARAN, 1964)

Decentralized networks are characterized by that something is withdrawn from the centre, mainly relating to dispersion of power from central to local authorities (Baran, 1964). There is a significant difference between centralized and decentralized networks. Multi-sided platforms, as they exist today, are centralized. The information access and corresponding boundaries of what actors are allowed to do are centrally organized. Multi-sided platforms that are centrally organized determine the ways actors in the network can interact (Solaimani, Bouwman, & Itälä, 2013). In a decentralized network multiple actors can come to different outcomes on one shared decision. All actors have independent perspectives on the outcome of this decision (Khare, 2013). In either a centralized or distributed network one decision has the same implications for every actor in the network. This makes decentralized networks fundamentally different from both centralized and distributed networks (Khare, 2013).

Immutability

All data can be stored on a blockchain as it tracks changes in information about any physical or digital asset (Bond, 2017). Transactions are recorded in the blockchain after verification (Catalini & Gans, 2017). Once data is stored it cannot be altered in any way. Data is verified through consensus mechanisms. The consensus mechanisms make data on a blockchain immutable. One aspect of the consensus mechanisms relates to the transparency of blockchains. The blockchain architecture has open source licences, making the data in the system transparent and visible to every actor in the system. Every transaction in the blockchain is time stamped and all information is publically shared with all participants in the network after each data entry. The participants must agree upon the pieces of information. However, a participant does not have full access to all background information (Catalini & Gans, 2017). This allows data verification while maintaining privacy of users. The combined pieces of information create a unique identity that will ultimately be verified by users in the decentralized network.

Security

Security is an important technical capability of blockchain technology that relate to multi-sided platforms. Currently, peer-to-peer transactions trust third parties by relying on their control over the data. Blockchain technology verifies data through consensus mechanisms, making it impossible that incorrect transactions are accepted. There exist no security risk in the correctness of data in the blockchain, because rejected transactions are not stored on a blockchain. If changes are made to a blockchain every actor in the network will see these changes happen. All actors in the network need to reach consensus that the data changes are correct. Most blockchain that exist today are permissionless blockchains (Swan, 2015). Permissionless blockchains are characterized by open source access, where anyone can join and participate in the network (Mattila, 2016). All actors in the network of permissionless blockchains are responsible to validate data, as described before. Permissioned blockchains offer similar technical capabilities as permissionless blockchains, but make different trade-offs (Table 1). This blockchain archetype allows only trusted members of the network to participate in the verification process. This decision follows that only a fraction of actors have permission to participate in the data verification process. Compared to the permissionless blockchains, permissioned blockchains are fast, energy-efficient and scalable (Mattila, 2016). It is important for multi-sided platforms that the database is tamper-proof. Therefore, this research is limited to permissioned blockchains. This decision compromises immutability and censorship-resistance.

TABLE 1 – TRADE-OFFS BETWEEN DIFFERENT TYPES OF BLOCKCHAIN ARCHETECTURES (MATTILA, 2016)

	Permissioned	**Permissionless**
Fast	Yes	No
Energy-efficient	Yes	No
Easy to scale	Yes	No
Censorship-resistant	No	Yes
Tamper-proof	No	Yes

Swan (2015) presents seven technical challenges and limitations of blockchain technology. One of these challenges is described as the scalability trilemma (De Jong, 2018). Blockchain architectures allow only two of the following three characteristics: security, scalability and level of decentralization. The scalability trilemma is one example of a technological development. This research aims to identify the potential impact of trends and uncertainties on the decentralized business models.

Privacy

Actors in the network come to a shared decision by means of consensus algorithms. Traditionally, there is need for a trusted intermediary to ensure market safety. With blockchain technology, the trust in the intermediary is no longer centrally focused, but decentralized to all actors (Buterin, 2013). This is what makes blockchain technology different than other distributed ledger technologies. If a multi-sided platform would use blockchain technology it means that data is also no longer shared with third parties resulting in increased privacy for the platform users. This privacy model can be made clearer by comparing it with the privacy model of traditional intermediation (Figure 4). This comparison shows direct peer-to-peer data transfer without having to trust an intermediary. The trusted third party is replaced by the underlying code and consensus rules. These consensus rules determine how blockchain manages its data verification process by defining the how distributed network reach agreement on the true state of the shared data (Catalini & Gans, 2017). The consensus algorithms provide incentives for collaborative efforts without need for direct interactions or trust between each other.

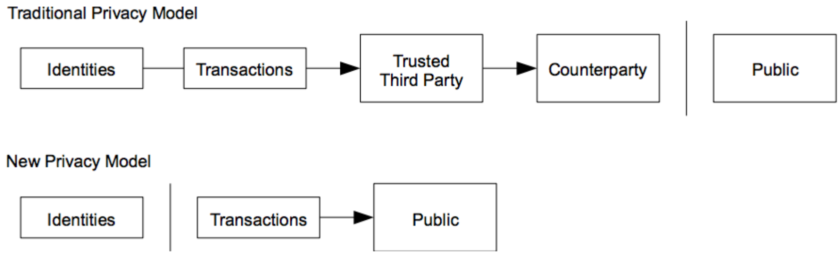

FIGURE 4 – NEW PRIVACY MODEL ENABLED BY BLOCKCHAIN TECHNOLOGY (NAKAMOTO, 2008)

Costless data verification

Blockchain technology fundamentally changes the data verification processes of databases (Tapscott & Tapscott, 2016; Frøystad, 2016; Catalini & Gans, 2017). Data verification is a labour-intensive process that is executed by a middleman (Catalini, 2017). When using the services of multi-sided platforms, users always have to disclose some personal information. This personal information is verified by the intermediating platform before allowing users to make transactions (Catalini & Gans, 2017). The consensus rules of blockchain technology make the data verification process fundamentally different from traditional databases (Figure 5). Where traditional databases assess the state of the database at a particular point in time, the rules of blockchain technology relate to the legitimacy of transactions. A recent study on the economics of blockchain elaborated on the cost of verification of blockchain technology (Catalini & Gans, 2017). Catalini and Gans (2017, p. 2) state the following: *"Any transaction attribute or information on the agents and goods involved that is stored on a distributed ledger can be cheaply verified, in real time, by market participants"*. Blockchain technology enables that verification services of intermediaries can, in theory, be replaced by applications of blockchain technology. Blockchain technology can prevent information leakage by decentralizing the intermediary from the process and allow data verification by market participants (Catalini & Gans, 2017). The data verification costs of multi-sided platforms could be reduced from decentralization (Tapscott & Tapscott, 2016; Catalini, 2017).

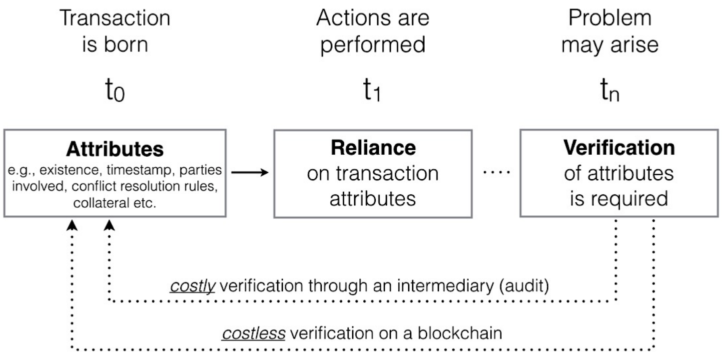

FIGURE 5 – VERIFICATION THROUGH INTERMEDIARY VERSUS A BLOCKCHAIN (CATALINI & GANS, 2017)

The technical capabilities of blockchain technology can be relevant to multi-sided platforms. Multi-sided platforms need to know how blockchain technology can be used if the technical capabilities are relevant. Therefore, the main applications of blockchain technology are explored. Subsection 2.1.3 introduces smart contracts and decentralized applications. Smart contracts incorporate the technical capabilities of blockchain technology and could be used by businesses.

2.1.3 Smart contracts and decentralized applications

In 1994, Nick Szabo introduced smart contracts as a computer program that is able to automatically secure, enforce and execute arbitration of agreements between parties (Szabo, 1994; Kore, 2018). The technical description of a smart contract is: *"a computerized transaction protocol that executes the terms of a contract"* (Szabo, 1994, p. 1). The general objectives of smart contracts are to satisfy common contractual conditions. The introduction of blockchain technology made the concept of smart contracts practically possible. Smart contracts now allow to *"exchange money, property, shares, or anything of value in a transparent, conflict-free way while avoiding the services of a middleman"* (Baldimtsi, 2017, p. 8). Blockchain technology allows the smart contracts to be enforceable, requiring multiple parties to validate a transaction between two parties (Kore, 2018). Smart contracts are labelled as the next generation of blockchain technology, or blockchain 2.0. A smart contract offers more than just transaction between parties by allowing virtually any form of value exchange. The terms and conditions that comprise a contractual agreement between parties are programmed into a smart contract. This data is stored on a blockchain (von Haller Grønbæk, 2016; Mattila, 2016). The interactions between platform users of a platform are the main asset of a multi-sided platform.

Smart contracts could facilitate similar interactions between users via decentralized processes. Interactions between parties could involve transactions, logistics, insurance, arbitration and many other forms of value exchanges. Smart contracts have the potential to change the way multi-sided platforms offer value to its users by incorporating the technical capabilities of blockchain technology into the service of these businesses and lowering operating costs. Smart contracts can be used to develop decentralized applications that could be applied by multi-sided platforms.

Decentralized applications (dApps) combine multiple smart contracts to enable complex interactions between parties (Buterin, 2013). A decentralized application differs from traditional applications, as they run on a peer-to-peer network of computers instead of a single computer. This means that the backend of the application relies on blockchain technology, including the smart contracts. (Buterin, 2013; Mattila, 2016). New use cases of decentralized applications being developed. One example relates to the decentralization of marketplaces. The business model of eBay is an example of such marketplace that is a multi-sided platform. There are different applications of blockchain technology that involve smart contracts that could be used to create decentralized multi-sided platforms (Buterin, 2013). Only the relevant applications will be elaborated in this research. A literature review on multi-sided platforms aims to clarify relevant applications of blockchain technology.

2.1.4 Conclusions

This subsection concludes by addressing the first sub-question of this research. The relevance of blockchain technology for multi-sided platforms is explored by describing the technical capabilities of blockchain technology. The technical capabilities of blockchain technology are: (1) decentralization, (2) immutability, (3) security, (4) transparency, (5) privacy and (6) costless data verification. **Decentralization** allows that individuals can interact with each other without a trusted third party. The data on a blockchain is distributed across all actors in a network. This data cannot be altered without consensus from the actors in the network, which makes data on a blockchain **immutable**. Consensus mechanisms are used to validate data, for example transactions. The correctness of this data is **secure**, because incorrect data will be relayed on. The data on a blockchain is **transparent** to every actor in the network. If incorrect data is stored on a blockchain, every actor in the network sees these changes. Blockchain technology increases **privacy**, because users can control whether to share data with third parties. Users are in control of their own data and determine which parties outside the network can access their data. Decentralized data verification excludes third parties from data verification processes. In theory, this makes data verification **costless** that third parties would otherwise incur.

The technical capabilities that are identified relate to the first generation of blockchain technology, which involves direct transactions between individuals. The second generation of blockchain technology enabled the concept of smart contracts. A smart contract is a computerized transaction protocol that follows rules that are programmed on a blockchain. This application of blockchain technology allows that two parties can exchange anything of value without the need for a trusted third party. Blockchain technology is no longer limited to data, but facilitates exchange of value via smart contracts. A combination of smart contracts can be used to develop decentralized applications. Decentralized applications can enable complex interactions between parties. The relevance of the technical capabilities and decentralized applications for multi-sided platforms require more understanding of multi-sided platforms. Blockchain technology is in an early stage of development, which comes with barriers for large-scale diffusion. Consequently, it is important to assess the potential impact of future trends and uncertainties on decentralized business models.

2.2 Multi-sided platforms

This section describes explains the characteristics of multi-sided platforms. This will help to understand how the technical capabilities and applications of blockchain technology can be used by multi-sided platforms. Therefore, this section starts by formulating a definition based on literature (2.2.1). The economics of multi-sided platforms will be described to explain the definition of multi-sided platforms (2.2.2). Platform strategies will be described to clarify the focus and activities of multi-sided platforms (2.2.3). Strategy helps multi-sided platforms to remain competitive. The section continues with a description of the technical architecture of multi-sided platforms (2.2.4). The section closes with a description of different dimensions of platform governance (2.2.5). The concluding subsection reflects on the characteristics of multi-sided platforms that need to be considered when revising business model components (2.2.6).

2.2.1 Defining multi-sided platforms

Research on multi-sided platforms has been done in the fields of industrial economics and technology strategy. Literature on multi-sided platforms describes the main characteristics of multi-sided platforms. Both research perspectives are consistent in describing the characteristics of multi-sided platforms (Evans, 2003; Caillaud & Jullien, 2003; Amstrong, 2006; Hagiu & Wright, 2015; Moazed, 2016). This research uses the following definition of multi-sided platforms:

> *"A multi-sided platform is a technology solution that solves coordination problems in market exchange by facilitating direct interactions between two or more distinct groups of individuals where each group is affiliated with the platform."*

This definition is further explained by a description of the main characteristics multi-sided platforms. Subsection 2.2.2 describes the economics of multi-sided platforms.

2.2.2 Economics of multi-sided platforms

The purpose of this subsection is to identify the main characteristics that distinguish multi-sided platforms from linear, or one-sided, businesses. Literature shows that multi-sided platforms gain market traction in a very specific way that differs from traditional businesses (Evans, 2003; Amstrong, 2006; Rochet & Tirole, 2006; Gawer & Cusumano, 2013; Wright & De Filippi, 2015; Van Alstyne, Parker, & Choudary, 2016). The following characteristics are described to explain multi-sided platforms: multi-sided markets, network effects and self-reinforcing feedback loops. These characteristics describe how multi-sided platforms are able to expand their network.

Multi-sided markets

A multi-sided platform has distinct characteristics. A multi-sided business is an advanced business model that is characterized by multi-sidedness (Baldwin & Woodard, 2008). Multi-sidedness reverts back to the facilitation of interactions between two or more groups of individuals (Caillaud & Jullien, 2003; Riemer, Gal, Hamann, Gilchriest, & Teixeira, 2015; Hagiu & Wright, 2015). Evans (2003, p. 1) defines multi-sided markets as follows: *"having two or more different groups of customers that businesses have to get and keep on board to succeed"*. A schematic illustration of the relationship between actors in this network helps to understand the role of a multi-sided platform (Figure 6). The actors in multi-sided markets are the platform users and the platform owner. The platform users represent supply and demand sides (Hagiu & Wright, 2015; Dreyer, Lüdeke-Freund, Hamann, & Faccer, 2017). These platform users are the customers of the multi-sided platform and take up different roles in the network (Haaker, De Reuver, & Bouwman, 2018).

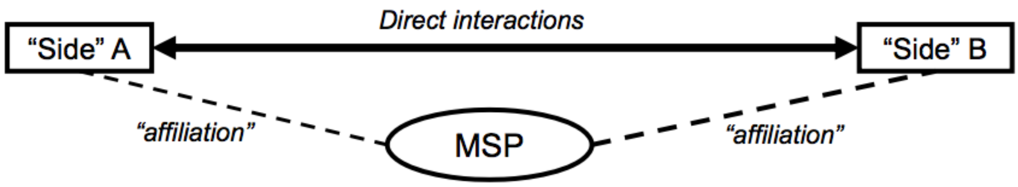

FIGURE 6 – SCHEMATIC VIEW OF MULTI-SIDED PLATFORMS (HAGIU & WRIGHT, 2015)

Figure 7 clarifies the role of the intermediary in this network. The customer groups in the network ensure value creation and exchange between users (Van Alstyne, Parker, & Choudary, 2016). The multi-sided platform has a connection with both groups. These groups are interconnected and able to interact directly via intermediation of the platform. Before multi-sided platforms emerged, intermediaries already exist. These intermediaries operated on a small scale in local networks. Examples of traditional intermediaries vary from real estate brokers and credit card companies to gaming consoles and newspapers. The technical capabilities of the Internet enabled multi-sided platforms to operate effectively in multi-sided markets on a global scale (Caillaud & Jullien, 2003; Amstrong, 2006; Moazed, 2016). The Internet eliminated geographical barriers that prevented individuals to find each other. Multi-sided platforms enable its users to find the other side of the market. Multi-sided platforms offer value to their users by solving such coordination problems in market exchanges (Amstrong, 2006; Hagel, 2015). Multi-sided platforms do this by bringing together supply and demand (Catalini, 2017). Based on shared interests, individuals are enabled to find each other and allowed to make transactions (Afuah & Tucci, 2003; Langley & Leyshon, 2016).

Network effects

Businesses thrive from scale. Linear businesses grow different than multi-sided platforms. Linear businesses offer value to a single group of individuals by creating products or services (Moazed, 2016; Caillaud & Jullien, 2003). In order to scale, linear businesses should increase the sales volume in order to decrease average costs (Krugman, 2008; Van Alstyne, Parker, & Choudary, 2016). This means that cost savings increase proportionately with production growth. This decrease in costs as a result of growth is called economies of scale, or supply-side economies of scale (Krugman, 2008). This characteristic makes linear businesses scalable (Tiwana, 2014). Multi-sided platforms are also scalable. In the past two decades multi-sided platforms have been proven to be effective in capturing market demands. This is a result of network effects, which is the driving force behind the growth of multi-sided platforms. Network effects refer to the expansion of the value network as the amount of platform users increase (Osterwalder & Pigneur, 2010; Gawer & Cusumano, 2013; Van Alstyne, Parker, & Choudary, 2016). Liebowitz and Margolis (1994, p. 2) defined network effects as: *"The circumstance in which the net value of an action (e.g. consuming a good, subscribing to a telephone service) is affected by the number of agents taking equivalent actions".* The Internet enabled multi-sided platforms to exploit network effects. Multi-sided platforms are able to expand their network of users by strengthening network effects. Network effects are positively affected by enabling technologies that expand the network (Van Alstyne, Parker, & Choudary, 2016).

There are four types of network effects, each with different properties (Figure 7). The network effects that are described before refer to positive network effects. If a multi-sided platform produces disincentives for its users as the network expands, network effects can also be negative (Tiwana, 2014). This means that attracting new users makes the platform less valuable for existing users.

	Same Side	Cross-side
Negative	Adding someone **decreases** appeal to all existing users on the **same** side	Adding someone decreases appeal to all existing users on the **other** side
Positive	Adding someone **increases** appeal to all existing users on the **same** side	Adding someone increases appeal to all existing users on the **other** side

FIGURE 7 – FOUR TYPES OF NETWORK EFFECTS IN PLATFORMS (TIWANA, 2014)

Network effects have another characteristic. This characteristic relates to the direction of the network effects. In other words, additional platform users are does not always change value on every side of the platform (Figure 8). Same-side network effects occur when a platform adopts one additional user and this is valuable for the existing users in this group (Tiwana, 2014). For example, if a user makes a Facebook profile, the peers of this person can interact with a new person on this social media platform. Cross-side network effects occur when the value to users on the other side of the platform increase or decrease. The following example of Amazon describes cross-side network effects. The more books are offered by publishers, the more books are available to people who want to buy these books. In return, due to the increase amount of customers, more publishers are incentivized to sell their books on the platform.

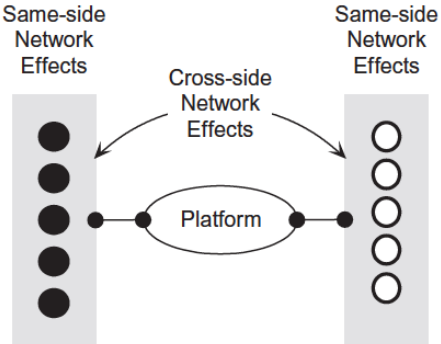

FIGURE 8 – SAME-SIDE VERSUS CROSS-SIDE NETWORK EFFECTS (TIWANA, 2014)

Network effects do not conveniently arise when a new multi-sided platform starts its business and a small group of users adopt the platform. A minimum amount of users must be active on a platform before the demand-side economies of scale become present. Literature on multi-sided platforms and network effects refers to this user amount as the critical mass (Evans, 2003; Amstrong, 2006; Rochet & Tirole, 2006; Tiwana, 2014). A critical mass is required for users to perceive sufficient value from the platform.

Self-reinforcing feedback loops

Continuous and exponential growth of the network is ensured by self-reinforcing feedback loops. The history of Amazon shows a multi-sided platform that effectively exploited network effects by means of positive feedback loops. The concept of feedback loops is clarified with an example. Amazon brings together two markets: book readers and publishers, respectively the demand-side and supply-side. Users of platforms have larger expected gains as the number of users increase (Caillaud & Jullien, 2003; Gawer & Cusumano, 2013). The platform is better able to aggregate and match supply and demand when there is more data about the users. Subsequently, more users are incentivized to use the platform, in return creating more value (Van Alstyne, Parker, & Choudary, 2016). These positive feedback loops results in an exponential growth curve for the e-commerce and service sales from 2004 onward (Figure 9). Amazon has a 37% market share of the total U.S. e-commerce market and is expected to grow to 50% market share within two years (Statista, 2018).

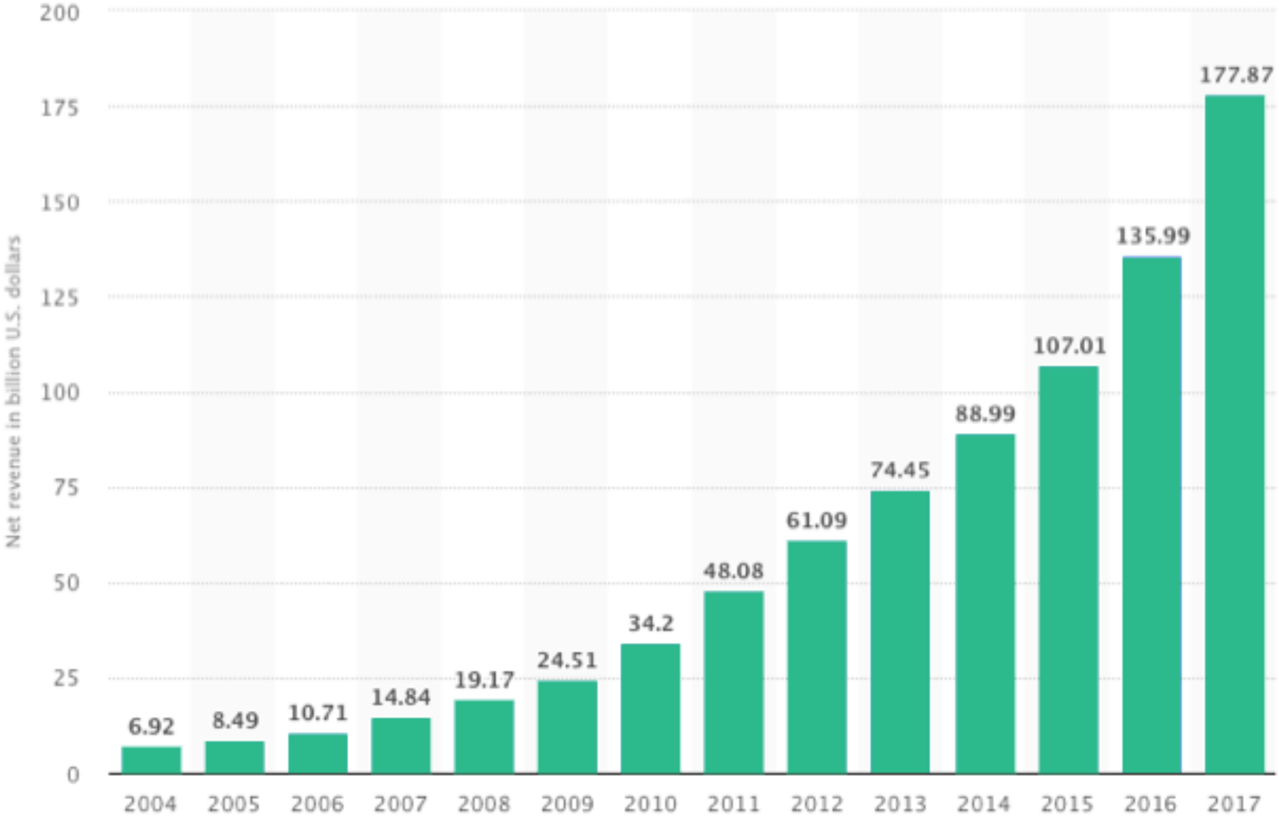

FIGURE 9 – NET SALES REVENUE OF AMAZON FROM 2004 TO 2017 (IN BILLION U.S. DOLLARS) (STATISTA, 2018)

Demonstration in many markets illustrates the broad acceptance of multi-sided platforms (Ellen MacArthur Foundation, 2015). The most familiar industries are the transportation and accommodation industry, respectively being disrupted by Uber and Airbnb (Choudary, 2015b; Botsman, 2015). Multi-sided platforms that have more active users than its competitors are more valuable for the platform users, because each transaction offers higher average value (Van Alstyne, Parker, & Choudary, 2016). Positive feedback loops and network effects explain why the average value is higher. A large network is better than a smaller network in its ability to aggregate demand and match both groups on the platform (Van Alstyne, Parker, & Choudary, 2016). The demand and supply-side data is enriched if the platform expands. The exploitation of network effects implies that value creation on a platform is two-way and continuous. This virtuous feedback loop often results in so-called platform monopolies (Langley & Leyshon, 2016). Therefore, industries with multi-sided platforms are often called 'Winner-Takes-All' markets. Increasing returns to adoption is the main reason why there is often only one dominant design in platform industries. If a platform, technology or application is more adopted by users, it becomes more valuable. This results in a so-called dominant design. The dominant design is more used than alternative, resulting in further improvement of this dominant design (Tiwana, 2014). Tiwana (2014) explains that superior or inferior competitors have no impact on the further development of an established dominant design. Also more complementary goods will be developed for the dominant design. The dominant design relates to the development of technologies, however, the mechanisms of self-reinforcing feedback loops are similar to development of dominant design. Self-reinforcing feedback loops are crucial for the development and expansion of multi-sided platforms (Gawer & Cusumano, 2013). Evans and Schmalensee (2007) argue that network effects in multi-sided platforms are not durable. Platform monopolies incur pressure from competitors. To maintain durability a clear strategies are required.

2.2.3 Platform strategy

This subsection describes strategies that are focused on the economics of multi-sided platforms. These strategies help multi-sided platforms to exploit multi-sided markets, reach a critical mass and stimulate self-reinforcing feedback loops.

Strategic focus

Multi-sided platforms follow different strategies to maintain competitive durability. The strategies are based on the strategic focus of multi-sided platforms. Linear businesses have a different strategic focus than multi-sided platforms. Multi-sided platforms need to reach two main goals: (1) establish a large network of platform users and (2) ensure a high rate of retention. A high rate of retention means that platform users remain active on the platform. The transition from linear businesses to multi-sided platforms involves three shifts. The first shift relates to the change in the control of resources. Multi-sided platforms need to orchestrate their resources. These resources are no longer their products, but the capabilities of the platform users (Osterwalder & Pigneur, 2010; Van Alstyne, Parker, & Choudary, 2016). The capabilities of platform users comprise the value they bring to the other market side. Therefore, platforms need to attract both groups. The second shift involves the facilitation of interactions, or matchmaking between customer segments (Osterwalder & Pigneur, 2010). Linear businesses focus on organizing employees and resources. Multi-sided platforms focus on the external interaction by facilitating interactions between the different groups. Therefore multi-sided platforms no longer aim to reduce costs of the value chain, but aim to decrease transaction costs (Afuah & Tucci, 2003; Van Alstyne, Parker, & Choudary, 2016). Transaction costs involve the total costs of channelling transactions through the platform, which reverts back to data verification costs that can be minimized by blockchain technology (Osterwalder & Pigneur, 2010). The third shift focuses on the expansion of the value network. Rather than optimizing lifetime value of the product or service, platforms aim to maximize the total value of the network by attracting both groups of users (Van Alstyne, Parker, & Choudary, 2016). Multi-sided platforms can use different strategies to achieve their goals. Extending functionalities on the platform or strengthening the network effects can ensure competitive durability (Evans & Schmalensee, 2007).

Differentiating

Multi-sided platforms require a strategy on getting the different types of customers on board (Evans, 2003). The concept of product differentiation that applies to linear businesses is similar for multi-sided platforms (Evans & Schmalensee, 2007). According to the five forces of competition, businesses have to differentiate products to gain competitive advantage (Porter, 1979). There exist two forms of differentiation: vertical and horizontal differentiation. Vertical differentiation refers to the increasing of quality of the platform services. Platform users are willing to incur certain costs to use the platform. Users relate perceived benefits to incurred costs. Willingness to pay is defined as the perceived benefits versus the total costs of using the service of the platform. The perceived benefits must be higher than the incurred costs. Multi-sided platforms pursue vertical differentiation to increase the perceived value of users. Increasing the level of quality increased the willingness to pay of users. This means that platforms can differentiate from competitors by choosing quality levels (Evans & Schmalensee, 2012). Horizontal differentiation refers to extending of functionalities on a platform (Evans & Schmalensee, 2012). Extending functionalities on the platform need to be perceived as valuable by the users (Rochet & Tirole, 2006; Evans & Schmalensee, 2007). Platform users perceive value in several forms. Increasing the value that is perceived from the actual service offering of the platform. Horizontal differentiation allows users to pay for additional services (Evans & Schmalensee, 2007). A multi-sided platform could, for example, allow demand-side to pay for logistic services like home-delivery. Horizontal differentiation could result in increased competition from other service providers (Evans & Schmalensee, 2012; Van Alstyne, Parker, & Choudary, 2016). This could hamper platforms in becoming monopolies. A potential result of horizontal differentiation is multi-homing.

Multi-homing

Multi-homing is the situation where users choose to join more than one platform (Rochet & Tirole, 2006; Amstrong, 2006; Tiwana, 2014). A platform ideally has only users are 'single-homing', which means they only use one platform to fulfil their demands (Amstrong, 2006; Tiwana, 2014). Armstrong (2006) explains multi-homing by illustrating three cases that are relevant: (1) both groups single-home, (2) one group single-homes and one group multi-homes and (3) both groups multi-home. The cases depend on the incentives that users have. If the users receive value from interacting with the other side of the platform it is unlikely that the third case occurs. This example needs some clarification. The example describes a scenario where all users of one group join all platforms, or multi-home. The other group then no longer needs to join all existing platforms, but will ideally decide to join one platform, because there will be no benefits from also joining multiple platforms as they already are able to interact with the one group (Amstrong, 2006). If a user group want to interact with the other group, and this other group only uses one platform, there is no other option than to join the same platform. From a strategic stance, a multi-sided platform needs to provide access to their single-homing users. These single-homing users determine the decision of multi-homing users that wishes to interact the other group. In other words, platforms have monopoly power over multi-homing users by providing access to single-homers (Amstrong, 2006). Subsequently, multi-homers are being charged with high prices to access the platform its services (Amstrong, 2006; Rochet & Tirole, 2006). An economic analysis of these cases illustrate that multi-sided platforms must compete to adopt single-homing users, whereas the platform earns its profits from the large fees that multi-homing users have to pay (Amstrong, 2006; Tiwana, 2014).

Pricing

One parameter that has significant impact on adoption and retention of users is the pricing of a platform. Different pricing strategies can be applied to realize expansion of the value network (Van Alstyne, Parker, & Choudary, 2016). A critical mass is required before network effects become present. In order to reach this tipping point, new platforms usually have to subsidize one side of the platform to attract the other side. This is one of many strategies that can be applied to solve the so-called 'Chicken-and-Egg problem'. The chicken-and-egg problem always relates to multi-sided platforms, because the value proposition to one side of the platform is depends directly on penetrating the other side and vice versa (Choudary, 2015a). To solve the chicken-and-egg problem a platform must decide what prices to set for both sides of the platform.

Studies on multi-sided platforms suggest that a platform has to adopt an approach that charges different prices to groups of customers when cross-side network externalities exist (Evans, 2003; Staykova & Damsgaard, 2015; Van Alstyne, Parker, & Choudary, 2016). Parker & Van Alstyne (2005) argue that platforms usually have to cross-subsidize between groups. This means that a multi-sided platform can flow a proportion of payment from the revenue side to the subsidy side (Evans, 2003). The subsidy side of the platform is a group that is valuable for the revenue side (Staykova & Damsgaard, 2015). Earlier the concept of multi-homing and how it could impact pricing was explained. Again, the single-homers, subsidy-side, of the platform must be stimulated. Thus, a multi-sided platform needs to identify the subsidy and revenue sides of the platform before being able to set prices (Eisenmann, Parker, & Van Alstyne, 2011). A multi-sided platform has to incentivize this single-homing side in order to establish a strengthened position vis-à-vis its competitors. This side of the market needs to be subsidized by lowering costs to access the service of the multi-sided platform. The platform earns its profits from the other group and needs to use a large portion of this profit to stimulate single-homing users (Amstrong, 2006).

Effective pricing strategies can prevent that users will switch easily if another platform meets their needs better (Van Alstyne, Parker, & Choudary, 2016). A platform can usually charge two types of prices: usage fees and access fees. Users of multi-sided platforms require access to the intermediating service. In order to access the services of the platform a usage fee can be charged (Evans & Schmalensee, 2007). Businesses often refer to this usage fee as the transaction commission, a fee for facilitating interactions. High usage fees mainly affect the frequency of interactions between users (Amstrong, 2006; Evans & Schmalensee, 2007). The other price is an access fee. A platform can choose to charge new users that join the platform. Access fees affect the network of the platform differently than usage fees. High access fees hamper the amount of new users that join the platform (Evans & Schmalensee, 2007). Therefore, multi-sided platforms often do not charge any access fees until network effects are present.

The discussed platform strategies relate to the offered services, user groups and pricing strategies. The technological systems are relevant to discuss, because these systems are used by multi-sided platforms to bring the actual value to their customers. This internet-based technological system is known as the technical architecture. Section 2.2.4 describes the components of a technical architecture that determine the functions of the platform.

2.2.4 Technical architecture

The platform owner is the provider of the infrastructure that is accessed by the platform users. In order to understand the specific functionalities, or business components, of a platform a high-level description can be made (Haaker, De Reuver, & Bouwman, 2018). A multi-sided platform can be viewed as an internet-based solution to the demands of a market (Tiwana, 2014). This is a technological system that consists of different components. The architecture of a platform is the description of these technological components (Tiwana, 2014). Tiwana (2014, p. 25) defines architecture as: *"the conceptual blueprint that describes the structure of a technology solution"*. This definition does not explicitly define the relationship between components and how these evolve over time. This research focuses on the long-term innovation of multi-sided platforms. Therefore, this definition does not capture the complete perspective that this research tries to provide. Staykova & Damsgaard (2015) described that the structure of the technical architecture defines the functions of the platform and how the components are interconnected, including the constraints that controls the relationship between components (Staykova & Damsgaard, 2015). The core of technical architectures is argued to have a consistent design with little variety in its components (Baldwin & Woodard, 2008). The peripheral of the architecture, however, has a high-variety of components that complements the core of the technical architecture (Baldwin & Woodard, 2008). Consequently, following these definitions, the core components refer to the platform itself and the peripheral components refer to the complements of the platform (Baldwin & Woodard, 2008). When a platform has peripheral components this implies that third parties are allowed to provide additional features to the platform (Staykova & Damsgaard, 2015). For example, Airbnb offers short-term accommodation rental to tourists, which is facilitated by the core components of the platform. The core functions of the business are to enable suppliers to create a listing for their residential property, add information and set a price, and demanders are able to browse for accommodation, filter their search on price, date and time, and book a space via payment on the platform (Jungleworks, 2018). Complementary functions of the platform allow insurance and house cleaning services. The main business functions of a multi-sided platform often include, but are not limited to, user applications, management of customer profiles and privacy, security of accessible services (Bouwman, Faber, Haaker, Kijl, & De Reuver, 2008; Haaker, De Reuver, & Bouwman, 2018). This technical architecture is central to the operations of a multi-sided platform, because it facilitates the interactions between users (Hagiu & Wright, 2015). There are different ways to manage these interactions between users, determined by governance mechanisms.

2.2.5 Platform governance

The governance of the platform determines how the interactions between users are managed. This subsection describes governance mechanisms that could be impacted by using blockchain technology. Multi-sided platforms determine the rules that manage the ways users are allowed to interact. Platform governance concerns the mechanisms that organize the communication between different actors on the platform (Evans & Schmalensee, 2012; Hein, Schreieck, Wiesche, & Krcmar, 2016). The governance mechanisms can be seen as the rules that determine what every actor can do on the platform (Hein, Schreieck, Wiesche, & Krcmar, 2016). Hein et al. (2016) developed an overview from literature that categorizes six dimensions of governance and describes the corresponding mechanisms and sources:

- Governance structure
- Resources & documentation
- Accessibility & control
- Trust & perceived risk
- Pricing
- External relationships

The reliance on the platform continuously increases as the network of users expands. Most platform users did not have a prior connection, which makes data verification services of the intermediating platform more important and empowers the platforms (Catalini & Gans, 2017). The platform resources include, among others, application programming interfaces (API). These allow third parties to connect to the platform, which could assist the growth of the platform network (Staykova & Damsgaard, 2015). This strategic decision was earlier explained as horizontal differentiation.

Users of the platform must trust their intermediary to ensure safety of their transaction and enforcements of contracts. These contracts could include the agreement between users on an exchange of value, which could be any form of transaction. This enforcement of contracts means that intermediary role of the platform includes making sure that buyer of a good transfers actually pays for this and the seller of a good provides the good to its buyer (Catalini & Gans, 2017). Intermediaries usually charge a fee for their services, that participants are willing to incur because the expected cost of making a connection with each other on their own is significantly higher. This makes sense, since buyers and sellers are normally not able to make a connection with each other for simple exchanges of goods or services without an intermediary. For example, due to different geographical locations buyers of goods are unaware of existing sellers that live in the same town. Catalini and Gans (2017) formulated additional cost the intermediaries can charge the users of their platform. These additional cost can be charged for having access to transaction data and being able to select which transactions to execute, respectively defined as privacy risk and censorship risk (Catalini & Gans, 2017). A more detailed overview about platform governance provides more understanding that is not relevant for further elaboration in this chapter (Appendix A).

2.2.6 Conclusions

This subsection concludes by addressing the second sub-question of this research. The main characteristics of multi-sided platforms need to be clarified to comprehend the relevance of blockchain technology for Peerby. Multi-sided platforms aggregate the supply and demand side of a market and facilitate direct interactions between individuals. This intermediary role solves problems in market exchanges, because individuals would not be able to find each other without the multi-sided platform. Both groups can take up different roles, being both supplier and demander of goods. Multi-sided platforms are characterized by multi-sided markets and network effects. Multi-markets revert back to the facilitation of interactions between two or more distinct groups of individuals. Network effects relate to the way multi-sided platforms grow.

One of the biggest challenges for multi-sided platforms is to acquire the two groups of individuals and keep them active. Network effects are a circumstance where the value of a product or service increases as more individuals use it. There are two types of network effects that can be positive or negative. The types of network effects relates to the direction. Network effects can exist for the same side users group or other user group. Multi-sided platforms are able to expand their network of users by strengthening positive network effects. Network effects can be strengthened in different ways. Multi-sided markets often have a platform monopolist. Multi-sided platforms have a strategic focus to expand the value network and remain competitive. The main goals of a multi-sided platform are to establish a large network of users and make sure that there is a high retention rate.

Section 2.3 describes the different typologies of multi-sided platforms in the sharing economy and reflects on similarities with Peerby. The literature review on platform typologies helps to determine the research scope.

2.3 Platform typologies within the sharing economy

This section aims to clarify the case of Peerby and describes the research scope. This section starts with a description of collaborative consumption and sharing economy to clarify the case of Peerby. This description will also help to understand criteria of multi-sided platforms to be included in the sharing economy (2.3.1). A description of different multi-sided platforms and platform industries within the sharing economy will be presented (2.3.2). Consequently, identifying a typology of peer-to-peer multi-sided platforms reveals the similarities of sharing platforms with Peerby (2.3.3). The review of literature on multi-sided platforms and sharing economy concludes by delineating the research scope (2.3.4).

2.3.1 Collaborative consumption and the sharing economy

The case of Peerby is a multi-sided platform within the sharing economy. A review of literature on the sharing economy is required to understand and define the research scope. The introduction of multi-sided platforms has given rise to collaborative consumption (Ellen MacArthur Foundation, 2015; Botsman & Rogers, 2010). Collaborative consumption is often confused with the sharing economy (Botsman, 2015). A definition of collaborative consumption and sharing economy clarifies the distinction between the two concepts. The following definitions of **collaborative consumption** and **sharing economy** are used in this research (Botsman, 2015, p. 25):

> *“Collaborative consumption is the reinvention of traditional market behaviours – renting, lending, swapping, sharing, bartering, gifting – through technology, taking place in ways and on a scale not possible before the Internet.”*

> *“The sharing economy is an economic ecosystem that facilitates the sharing of underused goods or services, either for free or for a fee, directly between individuals or organizations.”*

The sharing economy is part of collaborative consumption. Therefore, literature on collaborative consumption is used to determine when multi-sided platforms fit within the sharing economy. Multi-sided platforms within the sharing economy are referred to as sharing platforms. Sharing platforms are guided by the principles of the sharing economy. One implication of sharing platforms relates to transforming the mind-set of ownership to asset utilization (Peerby, 2017). Increased asset utilization means that goods must be used more frequently during their lifetime (Ellen MacArthur Foundation, 2015). Sharing platforms give individuals access to products or services via peer-to-peer interactions. The supply-side shares goods with the demand-side to create value for the network (Riemer, Gal, Hamann, Gilchriest, & Teixeira, 2015). Peerby facilitates sharing of underused goods between individuals. Suppliers are enabled to share goods when these are not being utilized (Van De Glind, 2013; Peerby, 2017). Individuals can lend goods for free or rent for a fee. The demand-side is enabled to access products without actually owning them. Users are no longer required to buy products (Ellen MacArthur Foundation, 2015). This research uses four criteria to determine whether a platform is included in the sharing economy (Botsman, 2015). The first criterion involves the core business idea. The business proposition aims to increase utilization of underused assets. This can be for both monetary and non-monetary purposes. The second criterion describes how a company should have a mission that is value-driven. These core values relate to transparency, authenticity and humanness (Petropoulos, 2016). The third criterion relates to the supply-side of the platform. The supply-side should be enabled by the platform business in reaching their individual goals. This implies that customers that enlist their goods on the platform should be valued most, because their product offering to the intermediating platform must be continuously and consistent to make the business model of the platform effective. The fourth criterion describes that the demand-side should be able to capture their needs. This means that users have the ability to access goods or services on the sharing platform. Therefore, sharing platforms should be built on networks that are decentralized or distributed marketplaces (Botsman, 2015; Petropoulos, 2016). This is an idealistic criterion that cannot be fully realized as long multi-sided platforms are centralized. The realization of distributed marketplaces and decentralized networks rests in the creation of collective accountability, mutual benefits through the building of communities and a sense of belonging within these communities (Botsman, 2015). Section 2.1 described the potential use of blockchain technology to enable pure peer-to-peer interactions via decentralization of processes, which could contribute to the fourth criterion of multi-sided platform in the sharing economy.

2.3.2 Peer-to-peer multi-sided platforms and platform industries

There are three main categories of multi-sided business models: business-to-customer (B2C), business-to-business (B2B) and customer-to-customer (C2C), referred to peer-to-peer (P2P). Multi-sided platforms within the sharing economy focus on known peer-to-peer markets, referred to as customer-to-customer (C2C) (Osterwalder & Pigneur, 2010). The value offering of the supply side is transferred to the demand side. The intermediary facilitates interactions between both sides. Literature on the sharing economy classifies different sharing platforms (Codagnone & Martens, 2016). Figure 10 on page 23 illustrates four categories in a two-dimensional matrix. The horizontal axis separates Not-For-Profit from For-Profit platforms. The vertical axis separates business-to-customer from peer-to-peer sharing platforms. The four quadrants classify different platform types in the collaborative economy. It is also possible to classify different industries in which these platforms operate (Codagnone & Martens, 2016). The first quadrant involves a P2P business model that has a revenue model that does not aim for raising profit. This is the true sharing platform. The founding of Peerby was based on this business model, where supply-side of the platform was allowed to interact with the demand-side to lend out their goods for free. The second quadrant involves the P2P business model that Peerby has evolved towards, where people are also allowed to rent out their goods in exchange for a fee. The demand-side of the platform would be charged with a commission for the facilitating services of the platform that allowed interactions between peers. Airbnb and Uber are also platforms that fall in the second quadrant. The third quadrant is described as an ‘empty set’, because B2C platforms are profit-oriented by definition. The fourth quadrant in this matrix refers to online activities that are involved with traditional platforms (Codagnone & Martens, 2016).

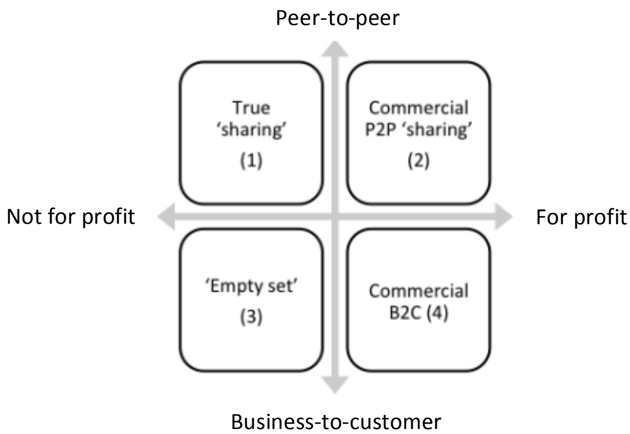

FIGURE 10 – CLASSIFICATION OF SHARING PLATFORMS (CODAGNONE & MARTENS, 2016)

In 2016, the European Parliament published an extensive economic review of the economy of collaborative consumption, which includes the sharing economy. Peer-to-peer multi-sided platforms operate in different industries. The most common platforms operate in the accommodation, transportation and finance industry or are digital marketplaces (Petropoulos, 2016). Platforms in the accommodation industry enable people to rent out residential space to people that seek short-term stay. Platforms in the transportation sector can relate to two types. Sharing platforms in the transportation industry facilitate the hiring of vehicles, like bicycles, motorbikes and cars and sharing platforms the rent out these vehicles including labour (Petropoulos, 2016). This latter refers to a platform like Uber. The finance industry connects funders of projects with entrepreneurs. The funders must be willing to invest financial capital into the companies. Such platform excludes the need for a commercial bank with stricter rules. Kickstarter is an example of a peer-to-peer multi-sided platform in the finance industry. The last industry comprises digital marketplaces. Digital marketplaces constitute a significant share of the sharing economy. Platforms in this industry position themselves as a facilitating intermediary in both peer-to-peer and business-to-customer activities (Petropoulos, 2016). Such platforms have a revenue model that is based on the sales of goods, making them part of either the second or the fourth quadrant (Codagnone & Martens, 2016; Petropoulos, 2016). The goods sharing industry of Peerby is not as far developed as these industries. Therefore, the scope of this research will focus on other industries than the goods sharing industry of Peerby. Subsection 2.3.3 identifies a typology of peer-to-peer multi-sided platforms that are similar to Peerby. This typologies will be used to determine what the industries have similar characteristics as the goods sharing industry.

2.3.3 Archetypes of peer-to-peer multi-sided platforms

In the domain of peer-to-peer multi-sided platforms there are multiple platform archetypes that can be identified. A study on peer-to-peer service sharing platforms defined four archetypes of peer-to-peer exchanges within the sharing economy: (1) file sharing, (2) trading, (3) goods sharing and (4) service sharing (Andersson, Hjalmarsson, & Avital, 2013). These exchanges between peers are referred to as interactions between individuals. The archetypes of peer-to-peer multi-sided platforms are given different definitions based on their characteristics (Table 2).

TABLE 2 – FOUR ARCHETYPES OF PEER-TO-PEER EXCHANGES (ANDERSSON, HJALMARSSON, & AVITAL, 2013)

	Peer-to-peer file sharing	Peer-to-peer goods trading	Peer-to-peer goods sharing	Peer-to-peer service sharing
Object of exchange	Digital material	Tangible material	Tangible material	Intangible encounter
Timing requirement	No	Not necessary	Not necessary	Yes
Meeting requirement	No	No	Not necessary	Yes
Example	Napster	eBay	Airbnb	Uber

A platform for file sharing facilitates the sharing of digital content, such as software, movies and music. An example is Napster for the sharing of digital music. The second archetype enables trading of physical assets. An example of such peer-to-peer trading platform is eBay. The third peer-to-peer archetype is the goods sharing platform. Goods sharing platforms involve no transfer of ownership between the interacting actors, which makes these fundamentally different from peer-to-peer goods trading (Andersson, Hjalmarsson, & Avital, 2013). The focus of goods sharing platforms aims to enable access to certain product and does not involve purchases and sales of goods. An example of the goods sharing archetype is Airbnb, where accommodations are being shared between peers. The fourth archetype relates to peer-to-peer service sharing platforms. Peer-to-peer service sharing platforms are divergent from the other types, because the services are used at the same time these are provided. The supplier of the service shares the good itself, for example a car, but includes the service of driving the consumer to the destination. The business model of peer-to-peer service sharing platforms is similar to peer-to-peer goods sharing platforms, but include an additional service. Peerby is considered a peer-to-peer goods sharing platform. The business model of Peerby will not necessarily change if users of Peerby would also offer an additional service. The peer-to-peer goods sharing and service sharing platforms are both included in the research scope.

2.3.4 Conclusions

This subsection concludes by addressing the third sub-question of this research. This research aims to determine on how Peerby can innovate its business model by analysing existing peer-to-peer multi-sided platforms that use blockchain technology. It is important that the research scope focuses on peer-to-peer multi-sided platforms that are similar to Peerby. The literature review on multi-sided platforms and the sharing economy is used to determine the research scope. The literature review revealed different types of multi-sided platforms within the sharing economy. Not all peer-to-peer multi-sided platforms are similar to Peerby. A total of four elements of multi-sided platforms were compared with Peerby to determine the research scope: (1) characteristics of multi-sided platforms, (2) criteria for multi-sided platforms to be included within the sharing economy, (3) archetypes of peer-to-peer exchanges and (4) sharing economy industries. A Venn diagram is made to illustrate this research scope (Figure 11). The research scope helps to select interviewees from peer-to-peer multi-sided platforms that are similar to Peerby.

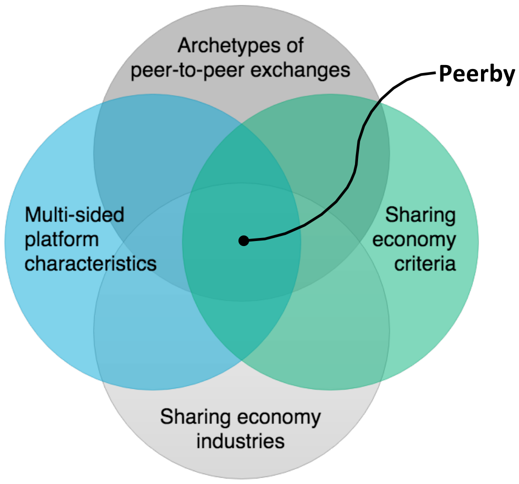

FIGURE 11 – VENN DIAGRAM OF RESEARCH SCOPE

Multi-sided platforms must have four criteria to be included in the sharing economy. First, multi-sided platforms must increase utilization of underused goods. Second, the company has a value-driven mission. Third, the supply side should be enabled to reach their individual goals. Fourth, the demand side should be able to capture their needs. These criteria all relate to Peerby. Peerby is a multi-sided platform that facilitates sharing of underused goods between individuals. The research scope was based on the case of Peerby. Therefore, this research focused on multi-sided platforms that facilitate sharing of underused goods between individuals, rather than organizations. Individuals request goods from their neighbours on Peerby's website.

Neighbours can share these goods with the requesting individuals. Peerby does not own the physical assets. Instead the users of the platform own the goods. Individuals are enabled to share their resources.

There are different types of multi-sided platforms in the sharing economy. These types are defined as peer-to-peer multi-sided platforms. The literature review distinguished four archetypes of peer-to-peer multi-sided platforms. There are two archetypes of peer-to-peer platforms that overlap with Peerby. These archetypes are peer-to-peer goods sharing and peer-to-peer service sharing. Peer-to-peer goods trading platforms are excluded from the research scope, because it involves a transfer of ownership between individuals. Peer-to-peer goods trading platforms are excluded from the scope, because this archetype allows that ownership of the good is transferred between individuals. A fundamental element of Peerby its business model is focused on sharing or physical objects, not trading. Peer-to-peer file sharing platforms are excluded from the research scope, because these facilitate the transfer of intangible material. Only peer-to-peer exchange archetypes that offer access to goods or services, without having ownership of the underlying assets, are within the delineation of this research.

The last categorization that is made to determine the research scope involves the different industries of the sharing economy. This helps to determine what companies are relevant to analyse. The results of this research must create insights that are valuable for companies like Peerby. The most prominent industries in the sharing economy are the accommodation, transportation, e-commerce and finance industries. There are no multi-sided platforms within the finance industry that involve the exchange of physical objects. The e-commerce industry falls within the same category as goods trading platforms, which is excluded from the research scope. The marketplaces within the e-commerce sector all relate to peer-to-peer goods trading platforms. Marketplaces are characterized by transferring ownership of the goods between peers. Therefore, these two industries do not relate to Peerby. There are peer-to-peer multi-sided platforms that in the accommodation and transportation sector that are similar to Peerby. The most prominent multi-sided in the accommodation and transportation sector are respectively Airbnb and Uber. Airbnb is a peer-to-peer goods sharing platform and Uber peer-to-peer service sharing platform.

The research scope can be summarized in an overview (Table 3). The research scope helps with the selection of interviewees to participate in the research. Multi-sided platforms that fit the research scope and use blockchain technology can be identified. These are the multi-sided platforms that posses knowledge about the business model of multi-sided platforms and blockchain technology.

TABLE 3 – RESEARCH SCOPE BASED ON ELEMENTS OF PEER-TO-PEER MULTI-SIDED PLATFORMS

	Research scope	Out of scope	Source
Multi-sided platform characteristics	▪ Facilitation transactions ▪ No ownership of goods ▪ No transfer of ownership	–	Van Alstyne, Parker & Choudary, 2016; Botsman & Rogers, 2010
Sharing economy criteria	▪ Utilize underused assets ▪ Value-driven mission ▪ Supply-side reaches individual goals ▪ Demand-side captures their needs	–	Petropoulos, 2016; Botsman & Rogers, 2010
Archetypes of P2P exchanges	▪ Goods sharing ▪ Service sharing	▪ File sharing ▪ Goods trading	Andersson, Hjalmarsson & Avital, 2013
Sharing economy industries	▪ Accommodation ▪ Transportation	▪ Marketplaces ▪ Finance	Codagnone & Martens, 2016

A deeper understanding of business model components helps to structure interviews. These interviews explore the impact of blockchain technology on multi-sided platforms. Section 2.4 describes business modelling approaches that help to understand the different business model components and structure the interview themes and questions. Moreover, literature on business model design and business model evaluation can be used to respectively determine the business model components and address the viability and feasibility of the business model.

2.4 Business modelling approaches

This section presents literature on business modelling that will be used to design and evaluate the business models of multi-sided platforms. A definition of a business model will be described, prior to presenting the business modelling approaches (2.4.1). The STOF business model will be applied to design a decentralized business model for Peerby (2.4.2). The robustness of the new business model will be determined with a business model stress test. The business model stress test describes the steps to undertake to determine viability and feasibility of business models (2.4.3).

2.4.1 Defining business models

The definition of a business model must be defined before being able to describe a business model and analyse the impact of blockchain technology on multi-sided platforms. The description of a business model is one of the first steps to undertake in entrepreneurial activities in order to communicate the offered value of a business (Solaimani, Bouwman, & Itälä, 2013). The business model of any company is the most prominent determinant of the performance, together with the competitive and macro environment (Afuah & Tucci, 2003). Researchers have referred to a business model by solely stating that it is the description of how a company plans to earn revenues (Afuah & Tucci, 2003). This description of a business model is not satisfactory for this study. The design of a business model also gives understanding about the value that businesses offer to end-users, including the architecture and governance of the business (Osterwalder & Pigneur, 2002). Additionally, a business model describes the external relationships with partners that are needed to generate profitable revenue streams (Osterwalder & Pigneur, 2002). A more elaborated definition states that a business model is a description of the rationale on the ways value is created, delivered and captured. Amit & Zott (2001) have similar approach by defining a business model as a depiction of contents, structure and governance of transactions that should generate value through business opportunities.

A limitation of the before mentioned definitions is that the service component of a business model is not explicitly mentioned. Bouwman et al. (2008) argue that the design aspects of business models are important in order to capture the intangible values of the customer. This research focuses on multi-sided platforms that are very service oriented businesses (Bouwman, Faber, Haaker, Kijl, & De Reuver, 2008). The business models of multi-sided platforms are user-centric, because users central to the production and exchanges of value. Therefore, this research uses the following definition of a business model (Bouwman, Faber, Haaker, Kijl, & De Reuver, 2008, p. 4):

> *"A business model is a blueprint for a service to be delivered, describing the service definition and the intended value for the target group, the sources of revenue, and providing an architecture for the service delivery, including a description of the resources required, and the organizational and financial arrangements between the involved business actors, including a description of their roles and the division of costs and revenues over the business actors."*

How the business model will generate value requires in-depth and broad understanding of the business model components (Solaimani, Bouwman, & Itälä, 2013). Section 2.4.2 presents the business model components of the STOF business model.

2.4.2 Business model design

The business model definition emphasizes the importance of the service element of a business model, which is central to multi-sided platforms. Literature describes multiple approaches to design a business model. One prominent approach for business model design is the Business Model Canvas (Osterwalder & Pigneur, 2010). A Business Model Canvas distinguishes nine business model components, or building blocks, that constitute the business model (Osterwalder & Pigneur, 2010). The business model components of the business model canvas have a focus on individual companies (Bouwman, et al., 2012). This focus is not suitable to analyse the business model of a multi-sided platform. A more suitable approach to analyse a multi-sided platform focuses more on the actors within the network. The STOF business model ontology is focused on the actors in a value network by design (Figure 12).

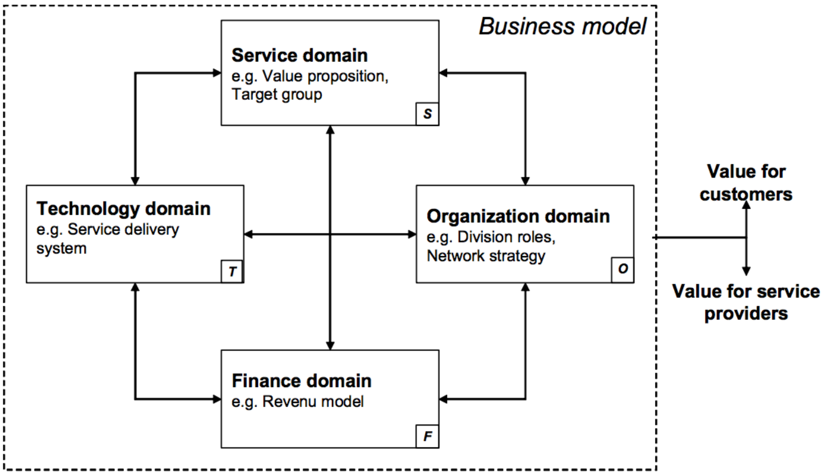

FIGURE 12 – STOF BUSINESS MODEL FRAMEWORK (BOUWMAN, FABER, HAAKER, KIJL, & DE REUVER, 2008)

The STOF business model approach starts the design by determining the required technical architecture as it focuses on ICT-enabled services. Furthermore, the STOF business model determines the required resources and capabilities (Haaker, Bouwman, & Faber, 2004; Bouwman, Faber, Haaker, Kijl, & De Reuver, 2008; Bouwman, et al., 2012). The STOF business model is also suitable to analyse the impact of a technology on a value network. Therefore, this research applies the STOF business model to analyse the impact of blockchain technology on multi-sided platforms. The impact of blockchain technology on each business model components will be analysed. The analysis will be used to design a decentralized business model for Peerby. This STOF business model uses a descriptive approach that distinguishes four domains of a business model that are central to the customer value.

The remainder of this subsection concludes by addressing the fourth sub-question of this research. This research will explore the impact of blockchain technology on multi-sided platforms according the STOF business model ontology. The service, technology, organization and finance domains will be discussed in more detail:

The **service domain** comprises the value proposition of a business and its targeted market segments. Multi-sided platforms always have two of more customer segments (Osterwalder & Pigneur, 2010). The value proposition describes how the business intends to generate value for its customers via its service (Haaker, Bouwman, & Faber, 2004). The value proposition describes who is offering what to whom and what is expected in return (Bouwman, Faber, Haaker, Kijl, & De Reuver, 2008). The core value proposition of a multi-sided platform is the creation of value by enabling direct exchanges between its customers and producers. Multi-sided platforms require different resources and capabilities in order to deliver this value proposition to its users. Therefore, multi-sided platforms need to include customer groups with relevant resources and capabilities (Hagiu & Wright, 2015). There is a difference between customers and end-users.

The customers pay for the service and the end-users are the ones that actually use the service (Haaker, De Reuver, & Bouwman, 2018). Customers and end-users can, however, be the same group of platform users.

The **technology domain** describes the technical functionalities of the platform. The technical functionality is the central concept in the technology domain and refers to the technical abilities that the components of the technical architecture collectively offer. In other words, the functionality determines what applications can do for its end users (Haaker, Bouwman, & Faber, 2004). The technical architecture of the platform is the other core concept of the technology domain. The technical architecture serves to actually deliver the intended value to the end-users (Haaker, Bouwman, & Faber, 2004). Multi-sided business models often include a platform do bring the actual value to its customers (Afuah & Tucci, 2003; Haaker, De Reuver, & Bouwman, 2018). The platform itself is a key resource that is needed to provide the intended value to the customers of a multi-sided business model (Osterwalder & Pigneur, 2010). A multi-sided platform, like any other business, needs to align its business model with its processes (Solaimani, Bouwman, & Itälä, 2013). The business processes are closely related to the technical architecture, since these enable the interaction of users with the technical infrastructure of the platform.

The **organization domain** describes the actors and their resources and capabilities that are needed to create and deliver the services. Therefore, the organization domain focuses on managing resources and capabilities that are needed within the value network. The resources and capabilities are relevant for all actors within the network and do not focus solely on actors within the platform network (Haaker, Bouwman, & Faber, 2004). A platform is focused on offering capabilities to its customers, instead of traditional products. Governance of the platform is of significant importance to the business, because interactions between actors are crucial to the growth of the value network (Gawer & Cusumano, 2013). The key activities of the business are to manage the platform, provide the actual service and promote the platform (Osterwalder & Pigneur, 2010). Traditionally, platforms needed central governance of the network of actors.

The **finance domain** refers to the financial arrangements of a business model, including revenue models, costs structures and investment decisions. A business model needs a description that clarifies how the platform owner aims to generate revenue (Tiwana, 2014). Each customer segment of a multi-sided platform has a distinct value proposition and corresponding revenue stream (Osterwalder & Pigneur, 2010).

The research uses the STOF business model ontology to identify the impact of blockchain technology on the described business model components. The STOF business model ontology will also be used to design a new business model for Peerby. Subsection 2.4.3 addresses the business model stress test that will be used to address the viability and feasibility of this business model.

2.4.3 Business model stress testing

This research applies the Business Model Stress Test method to analyse the robustness of the business model that will be proposed to Peerby. This method addresses viability and feasibility of a business model by confronting business model components with selected scenarios that can impact the different business model components (Bouwman, Heikkilä, Heikkilä, Leopold, & Haaker, 2017). A well functioning business model should be both viable and feasible. Viability refers to whether the business model can function effectively in the future. This relates to the financial implications of a business model. Feasibility refers to the reasonableness of business model to function properly in a given future environment (Bouwman, et al., 2012). The long-term viability and feasibility is used as the definition for a robust business model.

The remainder of this subsection concludes by addressing the fifth sub-question of this research. Business model stress testing was introduced as a method to evaluate a business model against with trends and uncertainties via a scenario analysis (Bouwman, et al., 2012). This method to evaluate a business model involves a six-step process. The formulation of these steps is based on the different studies on business model stress testing, which resulted in slight changes in the formulation of these steps (Bouwman, et al., 2012; Bouwman, Heikkilä, Heikkilä, Leopold, & Haaker, 2017; Haaker, De Reuver, & Bouwman, 2018):

1. Business model description
2. Identification and selection of stress factors
3. Mapping business model to stress factors
4. Heat map creation
5. Analysing results
6. Formulation of improvements

The first step is the description of the business model by means of a descriptive framework. All components of the business model must be made explicit. This step allows that the each business model component can later be tested against the trends and uncertainties (Haaker, De Reuver, & Bouwman, 2018). The second step involves the identification and selection of relevant scenarios, or stress factors, for the business model. The scenarios represent relevant trends and uncertainties in technology, market, society and regulation (Haaker, De Reuver, & Bouwman, 2018). These trends and uncertainties are defined as stress factors (Bouwman, et al., 2012; Bouwman, Heikkilä, Heikkilä, Leopold, & Haaker, 2017). The third step involves the initial mapping of causality between the selected scenarios and business model components. Only the trends and uncertainties that directly impact BM components are included in the actual stress test (Bouwman, Heikkilä, Heikkilä, Leopold, & Haaker, 2017). The fourth step assesses the impact that each mapped stress factor has on the business model components. The third and fourth step can be described as the confrontation between the business model and scenarios. The result is the creation of a heat map, which displays the impact level that stress factors have on each business model component. The fifth step involves analysis of the heat map. The heat map analysis offers the foundation for changes in the business models (Haaker, Bouwman, Janssen, & De Reuver, 2017). The heat map displays the weak parts of business model components (Bouwman, Heikkilä, Heikkilä, Leopold, & Haaker, 2017). This step involves a qualitative procedure as the argumentation for the colouring is described. Each stress factors that positively or negatively affects the business model. The analysis includes both a sub-view analysis and a pattern analysis. The sub-view analysis helps to understand why parts of the business models appear more robust than others by accumulating the impact of all stress factors on each business model component. The pattern analysis aims to reveal patterns of colourings that can identify (1) inconsistencies in outcomes, (2) favourable outcomes on stress factors, (3) unfeasible business model components, and (4) assess the robustness of the business model (Bouwman, Heikkilä, Heikkilä, Leopold, & Haaker, 2017). The sixth step focuses on the formulation of improvements of the business model, by improving weak parts of the business model and improving consistency between components (Bouwman, et al., 2012; Bouwman, Heikkilä, Heikkilä, Leopold, & Haaker, 2017). The formulation of improvements is outside the scope of this research, however, some suggestions will be made after interpretation of the results.

2.5 Conceptual model

The literature review on blockchain technology, multi-sided platforms and business modelling approaches are combined to validate and extent the initial conceptual model. The conceptual model gives understanding about the relationships between the core concepts (Figure 13). The literature review on multi-sided platforms and blockchain technology provided the necessary knowledge to understand the relation between the technical capabilities of blockchain and multi-sided platforms. The impact of blockchain technology on the business model will be addressed during this research. The business model components that compose a business model will be described according to the STOF business model ontology. The STOF business model distinguishes the service, technology, organization and finance domain. The impact of blockchain technology on multi-sided platforms is analysed following these four business model components. A new business model will be designed with the STOF business model. It is important to assess whether the new business model is future proof. Confronting the business model components with selected stress factors will determine the robustness of the business model. The stress factors relate to technology, market, society and regulation. A business model stress test identifies the strong and weak parts of the business model. The stress test will make sure whether it is viable and feasible to use blockchain technology as a driver for business model innovation of multi-sided platforms.

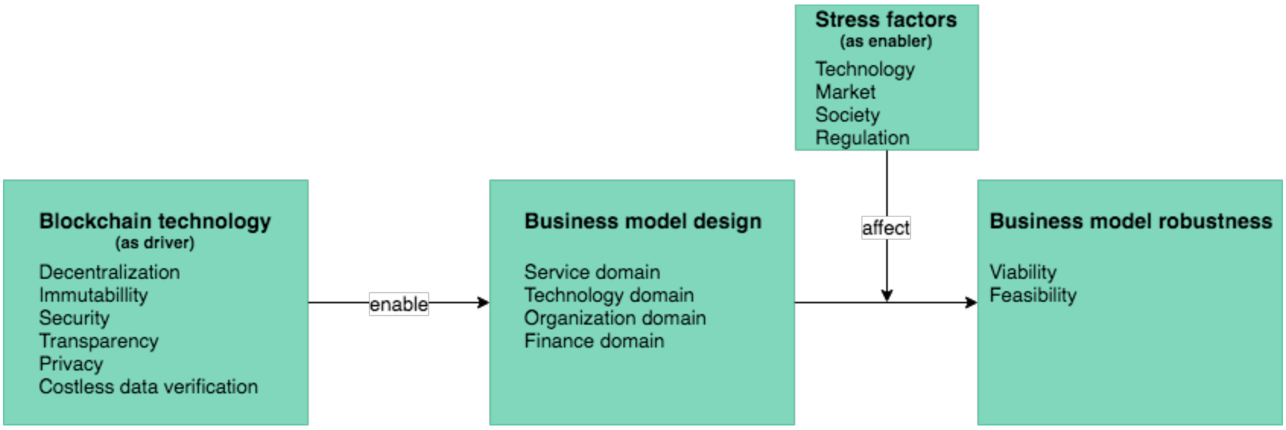

FIGURE 13 – CONCEPTUAL MODEL

3 Research methodology

This research followed a qualitative case study approach that used primary and secondary data. This chapter presents the core of the case study protocol, which is described conform literature on case study research (Cunningham, 1997; Saunders, Thornhill, & Lewis, 2007; Brereton, Kitchenham, Budgen, & Li, 2008; Yin, 2013; Sekaran & Bougie, 2016). The case study protocol categorizes the research design, data collection procedures and data analysis procedures. The research design describes the case study design and required data for the case study (3.1). The rest of this chapter describes the procedures that guided the process of data collection and analysis. The primary data is collected through semi-structured interviews (3.2) and the business model stress test workshop (3.3). Both qualitative data collection methods provide insights about the decentralized business model.

3.1 Research design

The research is approached in a qualitative way by a case study to provide in-depth knowledge. Qualitative case studies aim to ensure a high level of depth of understanding, which is the goal of this research (Cunningham, 1997). The case study is executed at Peerby. A decentralized business model was designed for Peerby. The business model of peer-to-peer multi-sided platforms is the unit of analysis of this research. The decentralized business model will be compared with the centralized peer-to-peer multi-sided platform. A schematic view of the case study design is presented in Table 4.

TABLE 4 – CASE STUDY DESIGN

	Peer-to-peer multi-sided platform
Centralized platform	Peerby (as-is)
Decentralized platform	Decentralized Peerby (to-be)

The qualitative data collection methods help to explore new concepts, identify themes and patterns within and between the cases (Saunders, Thornhill, & Lewis, 2007; Yin, 2013). There are multiple sources of information that provide evidence for case studies. Each sub-question is steered to require specific types of information. The required information determines the sources of evidence and corresponding data collection methods (Table 5) (Verschuren & Doorewaard, 2010; Yin, 2013).

TABLE 5 – REQUIRED SOURCES OF EVIDENCE PER SUB-QUESTION

Sub-question	**Type of information**	**Sources of evidence**	**Data collection method**
1	Data	Literature	Desk research
2	Data	Literature	Desk research
3	Data	Literature	Desk research
4	Data	Literature	Desk research
5	Data	Literature	Desk research
6	Knowledge	Individuals	Interviews
7	Knowledge	Individuals	Stress test workshop

The required sources of evidence relating to sub-question 1 to 5 are already collected during the desk research. Chapter 2 addressed these sub-questions and concluded with a conceptual model. This chapter addresses the data collection and data analysis procedures that relate to the interviews and business model stress test workshop. The interviews and business model stress test workshop respectively answer sub-question 6 and 7.

3.2 Interviews

This section describes how primary data is collected and analysed through interviews. Semi-structured are conducted to subtract knowledge from experts (3.2.1). The individuals that were interviewed were selected based on the research scope (3.2.2). The data analysis procedure describes how interviews are transcribed and coded before being able to draw conclusions from the data (3.2.3).

3.2.1 Data collection

The interview protocol describes the data collection procedures (Appendix B). The interview protocol guided the interviews through a list of themes and topics. The in-depth interviews are semi-structured allowing flexibility in responses and keeping control over the interview (Bryman, 1989). The semi-structured interviews were guided by the STOF business model ontology. The STOF business model was described by answering the questions in Appendix C (Haaker, De Reuver, & Bouwman, 2018). However, each question was related to blockchain technology. The questions were steered to understand whether business model components could and would change from using blockchain technology and to explore the effects of these changes. Potential trends and uncertainties, regarding blockchain technology and decentralized business models were identified.

Prior to the interviews, a list of themes and questions was prepared (Appendix C). Each interview started with an introduction of the research that included the purpose of the interview. The interviewees were asked to introduce themselves and their background. Blockchain technology was addressed as the first topic during each interview. After a discussion about blockchain technology, smart contracts and decentralized applications the STOF business model was introduced. The interviewer elaborated on the rest of the interview structure. After the impact of blockchain technology on all business model components was discussed, the interview concluded by a discussion on trends and uncertainties. At the end of each interview, interviewees were given the opportunity to elaborate on questions or ask for clarification. The interviews were conducted via Google Hangouts, a platform for videoconferencing. One interview involved a physical meeting to conduct the interview. It was important to obtain informed consent from the participants. Informed consent implies that participants have sufficient knowledge and be able to speak freely, based on the participation rights and intended use of data (Saunders, Thornhill, & Lewis, 2007).

3.2.2 Interviewee selection

This selection of interviewees is based on the criteria from the research scope from section 2.3.4. Companies that fit within the research scope have similar characteristics as Peerby. The companies that participated in this study were decentralized sharing platforms (Appendix D). Decentralized business models were analysed to learn about the impact of blockchain technology on a business model that is similar to Peerby. Five of the eight companies that were contacted agreed to participate. The companies benefited from participating in the study because the results are relevant for their business. Several founders and C-level executives of these companies were interviewed (Table 6). These individuals have expertise about the combination of multi-sided platforms and blockchain technology. Two experts were interviewed that do not work for a decentralized ride-sharing or home-sharing platform. One of these experts specialized in blockchain technology and smart contracts. Interviewees might have a biased perspective towards the capabilities of blockchain technology. There is the potential risk of reflexivity (Maimbo & Pervan, 2005). Reflexivity implies that the interviewee expresses what the interviewer want to hear (Bryman, 1989). This concern is mitigated by the interview protocol that describes how the interviews are conducted.

TABLE 6 – INTERVIEW PARTICIPANTS				
Interviewee	**Name**	**Role**	**Organization**	**Industry**
1	Not disclosed	Executive	Arcade City	Decentralized ride-sharing
2	Not disclosed	Executive	WeHome	Decentralized home sharing
3	Not disclosed	Executive	AXVECO	Management consulting
4	Not disclosed	Executive	Chasyr	Decentralized ride-sharing
5	Not disclosed	Executive	Populstay	Decentralized home sharing
6	Not disclosed	Advisor sharing economy	HireGo	Decentralized ride-sharing

3.2.3 Data analysis

For analysis purposes, the interviews were audio recorded and transcribed with consent of the interviewees. The interviewees were given the opportunity to comment or revise the transcripts. The construction of these transcripts was facilitated by automatic transcription software, named 'Otter'. The interviews are not transcribed verbatim, but summarised to make it more consistent (Appendix E). The structure and consistency of the transcripts were guided by a list of themes and questions that cluster main topics together. Transcripts of the audio records and memos were imported and coded in MAXQDA, which is software for qualitative data analysis. The data coding process involved different activities to systematically order the collected data (Saldaña, 2009). Text fragments from the transcripts are being labelled with codes. Themes and concepts are developed from a set of categories that emerge from codes during the coding process (Figure 14). MAXQDA is used to develop a code system based on the transcripts. The code system presents the amount of codes per interview transcripts per interviewee that are attached to separate categories. The literature review on the STOF business model ontology helped to the coding process. The different categories and sub-categories are described following the STOF business model ontology. The interview results reveal how business model components could be revised from using blockchain technology. Ultimately, data interpretation is needed in order to derive conclusions and address the research questions.

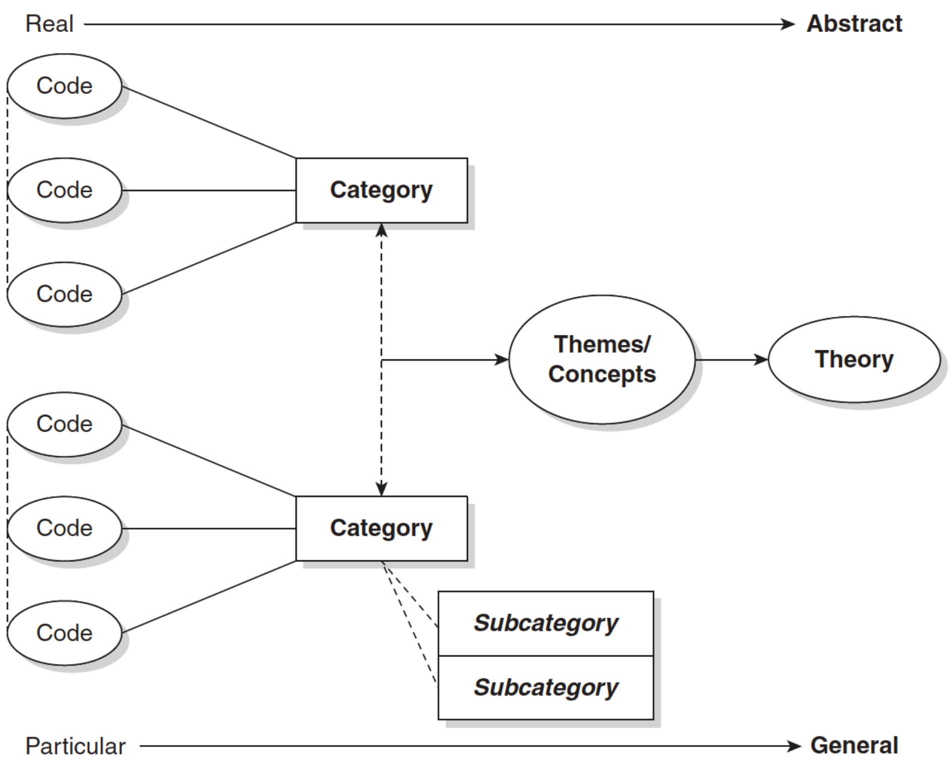

FIGURE 14 – A STREAMLINED CODES-TO-THEORY MODEL FOR QUALITATIVE INQUIRY (SALDAÑA, 2009)

The current business model (as-is) was compared with the interview results that revealed the business model components of the decentralized business model (to-be). The interview results were interpreted to determine the relevance of blockchain technology for Peerby. Only relevant changes were made to the current business model to design a decentralized business model for Peerby. This decentralized business model is input for the business model stress test. Moreover, the results from the interviews were used to identify stress factors. A selection of stress factors was also input for the business model stress test. The business model stress test workshop is discussed in section 3.3.

3.3 Business model stress test workshop

This section describes the process of evaluating the decentralized business model, as was introduced in section 2.4.3. The necessary steps to determine the viability and feasibility of the decentralized business model are based on the business model stress test method (3.3.1). The participants of business model stress test workshop provided different perspectives to the discussion. An overview of the participants and their roles during the workshop clarifies how the business stress test workshop was executed (3.3.2).

3.3.1 Business model stress test approach

Several steps were executed prior to the business model stress test workshop. The findings from the interviews were used to design a decentralized business model for Peerby. The interview results are compared with the business model of Peerby to determine what business model components should be changed. Some parts of the business model that were enabled by blockchain technology are excluded from the decentralized business model design, because these do not relate to Peerby. The decentralized business model describes the service, technology, organization and finance domains. To keep the workshop organized a selection of business model components had to be made. The STOF business model consists of the four domains, but it constitutes a total of sixteen elements. It is not possible to confront sixteen business model components with stress factors, due to time constraints. Therefore, a selection of the most relevant business model components was made to design a decentralized business model for Peerby. These business model components are both impacted by blockchain technology and are relevant for Peerby. During the interviews multiple stress factors were identified, relating to technology, market, society and regulation. A selection of three stress factors was made. To bring contrast in the findings, each two outcomes per stress are included in the business model stress test workshop. The stress factor outcomes involve the extreme ends of scenarios. This means that each business model component is confronted with a total of six stress factor outcomes.

In preparation of the business model stress test workshop a time schedule is made (Appendix F). The time schedule describes the remaining steps that had to be executed to determine the robustness of the decentralized business model. The business model components were mapped to the different stress factor outcomes during the stress test workshop. The core activity of the business model stress test workshop involved the creation of a heat map (Haaker, Bouwman, Janssen, & De Reuver, 2017). The decentralized business model for Peerby and the selected stress factors were used to create a template for the heat map. The heat map is presented in a matrix that includes the business model components and selected stress factors that are, respectively, vertically and horizontally positioned. The stress test outcomes were labelled with codes based on the respective (1) business model component, (2) stress factor and (3) stress factor outcome. The heat map uses a colouring structure to show the impact of the stress factor outcomes on the business model components (Table 7). In preparation for the workshop multiple posters of the heat map template and the colour legend were printed.

Table 7 – Heat map colour descriptions		
Colour		**Description**
Red		The stress factor outcome makes the business model component no longer feasible. This stress factor becomes an obstacle that needs to be resolved before the business model can be implemented and deployed in practice.
Orange		The stress factor outcome makes the business model component no longer viable. This stress factor becomes an obstacle in the long-term, therefore requires revisions of the business model components.
Green		The stress factor outcome affects the business model component without negative implications.
Grey		The stress factor outcome has no impact on the business model component, as there exist no causal relationship between them.

The heat map analysis involves a qualitative procedure that describes the argumentation for the heat map. The researcher made memos during the discussion in preparation for this qualitative procedure. The discussion was audio recorded with consent of the participants to support the processing of memos. Some revisions are made in the assigned colours, based on either repetitiveness or inconsistencies between the assigned colours and argumentation.

3.3.2 Participant selection

The participants of the business model stress test workshop were individuals with different perspectives and knowledge *(*Table 8*)*. This subsection describes the participants and their roles during the workshop. The CEO (participant 1) and UX designer (participant 2) of Peerby participated in the business model stress test. Both participants know the business model of Peerby very well. The quality and effectiveness of the business model stress test workshop improved by inviting external participants with knowledge about the business model of Peerby. Prior knowledge of Peerby was necessary to have an in-depth discussion about the decentralized business model. Two external sharing economy experts were invited to include multiple perspectives. The participation of external experts made the discussion more dynamic. Participant 3 is an entrepreneur and researcher at Utrecht University. He is an acknowledged international expert on scalable platforms in the sharing economy. Participant 4 is the co-founder of shareNL and has expertise in the field of platforms and the sharing economy. A business model stress test needs a facilitator that guides the group through the process and acts as chair (Haaker, De Reuver, & Bouwman, 2018). The decision was made to invite the co-author of the business model stress test to act as the facilitator. This person has the knowledge and experience to guide the group through the process, moderate the discussion and stimulate interactions between participants. Moreover, the role of the facilitator involved the creation of the heat map. Consequently, the researcher was not able to interfere in this process, which could have resulted in more subjective argumentation of the stress factor outcomes. The business model stress test workshop was prepared together with the facilitator. The decision was made to select business model components and stress factors to make the workshop manageable within the scheduled time.

Table 8 – Business model stress test participants			
Participant	**Name**	**Role**	**Organization**
1	Daan Weddepohl	Founder & CEO	Peerby
2	Rick Pijnenburg	UX Designer	Peerby
3	Martijn Arets	Researcher on platform economy & Founder of 'Deeleconomie in Nederland'	Utrecht University
4	Pieter van de Glind	Co-founder shareNL	shareNL
5	Timber Haaker (facilitator)	Professor Business Models (Co-author of stress test method)	TU Delft, Saxion
6	Frank Ribbens	Student	TU Delft

The results of the business model stress test are used to address the viability and feasibility of the decentralized business model. This decentralized business model (to-be) is based on interviews and relates to Peerby. The current business model (as-is) is not included in the business model stress test. The stress test output will be evaluated to make suggestions to improve the decentralized business model that uses blockchain technology.

4 Results

This chapter provides an analysis of the case study findings. The interview results describe the impact of blockchain technology on the business model components of peer-to-peer multi-sided platforms (4.1). The results of the interviews are used to design a decentralized business model for Peerby. The business model design was the first step of the business model stress test. The interviews also revealed stress factors that could affect business models of decentralized peer-to-peer multi-sided platforms (4.2). The identification and selection of stress factors was the second step of the business model stress test. The business model stress test results address the viability and feasibility of the decentralized business model (4.3).

4.1 Blockchain impact on multi-sided platforms

This section presents the interview results that addressed the impact of blockchain technology on the business model of multi-sided platforms. The interviews provide insights in the impact of blockchain technology on business model components of peer-to-peer multi-sided platforms. The results from data analysis are described according to the code system (Figure 15). Figure 15 shows the frequency of categories that are discussed by each interviewee. This code system was used to analyse the interview results. The code system distinguishes the service (4.1.1), technology (4.1.2), organization (4.1.3) and finance domain (4.1.4). The interpretations of the results are used to derive conclusions (4.1.5). The conclusions of the interviews make the causal relations between codes explicit where possible.

Code System	No. 1 ...	No. 2 ...	No. 3 ...	No. 4 ...	No. 5 ...	No. 6 ...	SUM
Service domain	8	9	4	17	12	13	63
Technology domain	53	41	47	40	31	24	236
Organization domain	38	25	5	14	15	16	113
Finance domain	8	13	4	5	11	4	45
Σ SUM	118	95	79	88	78	63	521

FIGURE 15 – INTERVIEW RESULTS FROM DATA ANALYSIS

4.1.1 Service domain

This subsection describes how applications of blockchain technology impact the users and value proposition of peer-to-peer multi-sided platforms (Figure 16). The coding results show the sub-categories that were discussed by each interviewee. Figure 16 shows whether or not a sub-category was discussed. The sum shows the number of interviewees that provided insights per sub-category.

Code System	No. 1 ...	No. 2 ...	No. 3 ...	No. 4 ...	No. 5 ...	No. 6 ...	SUM
Service domain							0
Customers and end-users		■		■	■	■	4
Value proposition							0
Better value proposition than c	■	■	■		■	■	5
Lower transaction fees		■	■	■	■		4
Free cross-border payments				■	■	■	3
Value distribution across users	■	■	■	■	■	■	6
Additional services	■	■		■	■	■	5

FIGURE 16 – SERVICE DOMAIN CODING RESULTS

Customers and end-users

Decentralized sharing platforms reach the same end-users as centralized platforms (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). A decentralized sharing platform its main objective is to aggregate supply and demand. The demand side has to pay for the services (Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). Blockchain technology has no impact on the users of a platform. The market determines the users of a platform, rather than a new technology (Interviewee 2, 2018; Interviewee 6, 2018). The perceived value, however, does change from blockchain technology.

Value proposition

The value proposition of a centralized peer-to-peer multi-sided platform has multiple aspects that differ from decentralized platforms. Blockchain technology improves the value proposition of peer-to-peer multi-sided platforms (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). The value proposition can change as a result from blockchain technology. The following changes are discussed in more detail:

1. Free cross-border payments
2. Value distribution across users
3. Additional services

Ad 1 Free cross-border payments

Decentralized sharing platforms aggregate supply and demand. There are platform industries that involve cross-border payments based on currency conversion. A unique characteristic of the value proposition of decentralized sharing platforms is the elimination of cross-border conversion fees. Token systems can be used across borders without exchange fees that would otherwise be paid to a middleman (Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018):

> *"The token system, as an application of blockchain technology, is important for a decentralized platform. Token systems can be used across borders without exchange fees that are paid to a middleman. The disintermediation of the whole process, similar to Bitcoin, involves no middleman or anything like that. Users can go purchase tokens directly without a middleman or central authority and use this token as well without intermediation." – Interviewee 4, executive at Chasyr*

The token system allows platforms to equalize fees globally (Interviewee 4, 2018). There are no exchange rates for cryptocurrencies, because all users can pay with the same cryptocurrency (Interviewee 5, 2018). This value proposition is relevant for decentralized sharing platforms that operate in global network where cross-border payments exist. Free cross-border payments are not relevant for Peerby, because Peerby allows individuals to share goods with their neighbours. Transactions between neighbours involve no currency conversion. Neither the current business model nor the future business model will involve currency conversion fees.

Ad 2 Value distribution across users

The value proposition of decentralized sharing platforms allows a proportionate distribution of value across the users (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). The business model creates value for the platform users and the service providers. Additional value that is created by the use of blockchain technology is mostly directed to the platform users (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). Three interviewees explained that centralized platforms focus on satisfying shareholders, rather than its customers (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 4, 2018).

Current platform monopolists like Airbnb and Uber have the *"intention to maximize profits for their stakeholders"* (Interviewee 1, 2018). As the company grows, centralized platforms shift their focus from users to shareholders, leaving the users dissatisfied. Increasing market share maximizes shareholders' profits. One interviewee explained that shift in focus with the following statement: *"One main characteristic of decentralized sharing platforms is that they can be focused on the supply side of the market, whom actually create value for the platform, rather then being focused on the demand side and concentrate on market share"* (Interviewee 4, 2018). Decentralized sharing platforms aim to reward the users that create most value for the platform (Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018). The current business model of Peerby focuses on adopting users, rather than stimulating the supplying users by means of rewards. The future business model needs to allow that the value flows from demand side to supply side. This means that Peerby cannot charge high transaction fees.

Ad 3 Additional services

Decentralized sharing platforms will deliver value-added services *"offer additional services to their customers by allowing complementary services on their platform"* (Interviewee 6, 2018). This strategy was explained as horizontal differentiation in section 2.2.3. Users of platforms get presented with a number of options regarding the service they would like to use. The additional services could be valuable for the different demands of platform users. Opt-in services allow users to choose what services they want to use, which is described as a *"significant factor in the future success of decentralized platforms"* (Interviewee 2, 2018). The interviewees that work directly with a decentralized sharing platform argued that these decentralized business models must include value-added services (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). The current business model of Peerby offers no additional services. The future state business model, however, needs to look for additional services that are valuable for the end-users. These additional services allow Peerby to have new revenue streams. Blockchain technology is not required to offer additional services.

4.1.2 Technology domain

This subsection describes how applications of blockchain technology impact the technical architecture of peer-to-peer multi-sided platforms by describing its technical functionalities, token systems and business functions (Figure 17).

Code System	No. 1 ...	No. 2 ...	No. 3 ...	No. 4 ...	No. 5 ...	No. 6 ...	SUM
Technology domain							0
Technical functionality	■	■	■	■	■	■	6
Technical architecture	■	■	■				3
Token system	■	■	■	■	■	■	6
Business functions							0
Process automation	■	■	■	■	■	■	6
Conditional transactions			■	■	■		3
Automated identity verification	■	■	■	■	■	■	6
Automated reputation system	■	■		■	■		4
Automated arbitration system	■	■	■	■	■		5

FIGURE 17 – TECHNOLOGY DOMAIN CODING RESULTS

Technical functionality

Blockchain technology impacts the functionalities of the technical architecture of platforms. The applications of blockchain that are used by decentralized sharing platforms bring built-in trust and transparency for its users. This is something centralized platforms are not able to offer (Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018).

The technical capability of blockchain technology allows that decentralized platforms offer the same guarantees to their users as normal platforms (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). The trust in the centralized platforms is being placed in the technology as a result of decentralization. Multiple interviewees argued that blockchain technology does not make platforms trustless, as there is always the need for trust with peer-to-peer interactions (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). Users place their trust in *“a technological system instead of a third party”*. Blockchain technology enables that middlemen are no longer required (Interviewee 1, 2018; Interviewee 2, 2018). By means of decentralization, blockchain technology offers three capabilities that are valuable for decentralized platforms (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 5, 2018):

> *“The blockchain technology provides three main capabilities: transaction of value, immutable storage of data and storage of logic. The storage of logic is the smart contract application. Blockchain technology can be used for these three capabilities without the need for an intermediary.” – Interviewee 3, executive at AXVECO*

Multiple interviewees stated that the user experience does not change from decentralization, because blockchain technology applies to the backend on the process layer (Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018). The use of a token system brings transparency to the platform (Interviewee 4, 2018). The distributed database allows storage of *“transaction data or listing information on a public blockchain that is completely transparent to everybody”* (Interviewee 5, 2018).

Transaction of value is realized by, or value exchange, is facilitated by a token system or cryptocurrency (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018). Smart contracts can *“enable a platform infrastructure that ensures safe use of platforms for value exchange, or storage of agreement between users without the need for a central authority that arbitrates”* (Interviewee 3, 2018). One interviewee did explicitly mention that a centralized sharing platform in does not require blockchain at all. Blockchain technology is only applicable to sharing platforms that are decentralized (Interviewee 3, 2018).

Token system

A token system is an application of blockchain technology and is used by decentralized sharing platforms. The token system allows direct interaction between the two market sides by facilitating direct transactions (Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018). A token system can be used to reward users for activities that expand the value network. The token system is used to align incentives of users with the goal to realize positive network effects (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018). This is realized by building economic incentives in the token system.

> *“Economic incentives of the token system can be used to reward users that contribute to the platform.” – Interviewee 2, executive at WeHome*

Users become motivated to do something that is valuable for other users, because they are rewarded with tokens that have a utility and also a monetary value (Interviewee 5, 2018). It is important that the token is continuously being used to get access to the service of the platform (Interviewee 5, 2018). One interviewee stated that the token utility *“resides in the characteristic that is gives owners access to the service”* (Interviewee 2, 2018). Users can be rewarded with tokens for activities that stimulate network effects, for example the rating other users (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 4, 2018). Token systems open up new user groups, because it does not involve traditional financial institutions that facilitate transactions. People without a back account, in theory, could also make use of decentralized sharing platforms (Interviewee 4, 2018; Interviewee 5, 2018). These users only need a digital wallet for the utility tokens, so-called savings wallets. The savings wallets can be made either on the platform or users can integrate their own wallet on the platform (Interviewee 5, 2018). The current business model of Peerby involves no rewarding of users for contributing to the platform. The future business model that uses blockchain technology needs to have a token system with built-in rewards for contributing users.

Business functions

Smart contracts are used to offer services of decentralized sharing platforms. The smart contracts can be programmed to automate business processes (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). Business processes that are automated via smart contracts no longer require an intermediary and result in a cost reduction for the platform:

> *"Smart contracts allow processes to be automated by following the logic of rules that have been built in the contract. Processes can be automated without a blockchain by centralized platforms, but the value resides in the use for decentralized platforms. Automating these processes that no longer need an intermediary, so peer-to-peer, results in much lower costs for the platform." – Interviewee 3, executive at AXVECO*

Decentralized sharing platforms offer different business functions via automated business processes. A total of four business functions were explicitly discussed during the interviews that will be discussed in more detail:

1. Conditional transactions
2. Automated identity verification
3. Reputation systems
4. Automated dispute settlement

Ad 1 Conditional transactions

Smart contracts can include the conditions of an agreement between users. Sub-paragraph 0 described the use of token systems as an application of blockchain technology that enables peer-to-peer transactions. This payment system involves direct transactions that are secured by blockchain technology and the transaction data is stored on a blockchain (Interviewee 2, 2018). Smart contracts can be used to *"offer guarantees on value exchanges"* to facilitate conditional transactions between users (Interviewee 3, 2018). This works similar as direct transactions, but a condition is built in the smart contract that must be met before the value is transferred to the other party (Interviewee 3, 2018; Interviewee 4, 2018). This application of blockchain technology is valuable for peer-to-peer platforms and is referred to as multi-signature escrows. Multi-signature escrows require multiple parties to verify the occurrence of an event. In other words, the users must both agree that the condition has been met. This application is explained with a practical example from an interviewee from a decentralized ride sharing platform:

> *"If users accept the ride, the money then goes into a smart contract that gets held in escrow until the journey is complete. This multi-signature escrow is an important application of blockchain technology that can be used by sharing platforms" – Interviewee 4, executive at Chasyr*

Automatic order cancellation can be also programmed on smart contracts (Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018). This is comparable with the scenario above if one of the parties does not meet with the condition of the contract. The money is than automatically returned to the paying user (Interviewee 2, 2018) (Interviewee 5, 2018). Peerby allows that individuals can engage in conditional transactions with their current business model. Conditional transactions are critical to their business model. The future business model that uses blockchain technology does no longer need Peerby as an intermediary to facilitate conditional transactions. The future business model uses smart contracts to ensure trust between interacting individuals.

Ad 2 Automated identity verification

Peer-to-peer multi-sided platforms are responsible for the verification of the identity of its users (Interviewee 1, 2018; Interviewee 4, 2018). Four interviewees describes that the authentication process of user identities requires that interacting peers trust each other (Interviewee 1, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 6, 2018). Normally, an intermediary is responsible for the authentication process. However, smart contracts can include the digital identities of users that is stored on a blockchain and controlled by the users. The users of the platforms will be in control of their own information and the platform no longer has authority of the user's data (Interviewee 3, 2018; Interviewee 4, 2018).

> *"With this application [Self Sovereign Identities] people are in control of the data of their identity that they want to share with companies, platforms and governments. Customers often share too much information with companies. The identity of every person would be stored on a smart contract that they control." – Interviewee 3, executive at AXVECO*

With Self Sovereign Identities the platform users can determine *"when to give access to personal data and when to block this access"* (Interviewee 3, 2018). The digital identity of platform users is stored on a blockchain (Interviewee 1, 2018; Interviewee 3, 2018; Interviewee 4, 2018). The identity of users can be linked to the individual instead of a specific company (Interviewee 6, 2018). The current business model of Peerby requires verification of identities before users can engage in transactions with each other. The future business model does no longer need Peerby for identity verification, as individuals control their own identity via a smart contract.

Ad 3 Reputation systems

Decentralized sharing platforms should include a reputation system as a business function that establishes trust between peers. A reputation system helps individuals to decide whether to engage in interactions with other individuals. The reputations of users can be stored on a blockchain (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). Centralized platforms have the ability to modify or delete reputation data. When the reputation data is stored on a blockchain platforms no longer have these abilities and the level of trust increase (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 4, 2018).

> *"Another way that blockchain technology will impact platforms is the way customers interact with each other. The reputation systems that these companies use are very important for all users, as it will enhance trust within the community." – Interviewee 6, sharing economy advisor at HireGo*

The personal reputation of users is the rating that other users assign to interactions. The reputation increases with better ratings (Interviewee 5, 2018). Reputation systems are no part of Peerby's current business model. The future business model can have an automated reputation system that uses smart contracts. The reputation system is relevant for individuals to decide whether or not to engage with another user, based on their reputation. Blockchain technology is not required to build a reputation system, but when it is built with smart contracts it adopts the technical capabilities of blockchain technology. A reputation system with the technical capabilities of blockchain technology can be argued to be more effective than a centralized reputation system that is owned and controlled by Peerby.

Ad 4 Arbitration systems

Smart contracts can be used to automate an arbitration system that settles disputes between users. An arbitration system uses the reputation of users or local communities to settle disputes in a decentralized way (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018). Users with a good reputation can take a leading role in settling disputes. One interviewee explains that they allow *"local community members"* to have a governing role within the community. These community members are rewarded with tokens to resolve disputes between users (Interviewee 5, 2018). The level of power of community members also depends on their reputation (Interviewee 2, 2018).

> *"Smart contracts allow processes to be automated by following the logic of rules that have been built in the contract. Processes can be automated without a blockchain by centralized platforms, but the value resides in the use for decentralized platforms. Automating these processes that no longer need for an intermediary, so peer-to-peer, result in much lower costs for the platform." – Interviewee 3, executive at AXVECO*

The current business model has no automated arbitration system. Peerby is the central party that is responsible to settle disputes between users. The future business model that uses a blockchain technology can have an automated arbitration system. An arbitration system is important for a multi-sided platform, because disputes can always occur.

4.1.3 Organization domain

This subsection describes the interview results that explore how applications of blockchain technology impact the value network of peer-to-peer multi-sided platforms (Figure 18). The organization domain describes the value network of the platform that is required to deliver the intended service offering.

Code System	No. 1 ...	No. 2 ...	No. 3 ...	No. 4 ...	No. 5 ...	No. 6 ...	SUM
▼ Organization domain							0
▶ Actors		■	■	■	■	■	5
▼ Business roles							0
▶ Token owners		■			■	■	3
▶ Decentralized authority	■	■		■	■	■	5
▶ Community ownership	■	■		■	■	■	5
▼ Collaboration							0
▶ Third party integration	■	■		■	■	■	5
▶ Platform collaboration	■	■	■	■	■	■	6

FIGURE 18 – ORGANIZATION DOMAIN CODING RESULTS

Value activities

The value networks of peer-to-peer multi-sided platforms are built by the value activities of the stakeholders. The end-users of decentralized sharing platforms are also the actors that contribute to the expansion of the network (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). Based on the business functions, described in sub-paragraph 0, different value activities are needed to create positive network effects (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018). Actors in the value network of decentralized sharing platforms are able to engage in transactions, rate other users and settle disputes. Users are rewarded for their activity on the platform. When users engage in peer-to-peer interactions on the platform they are indirectly rewarded. The token utility is increased it is being used to make transactions (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018). Users can be rewarded with tokens for rating other users and settling disputes (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018).

> *"So these functionalities [value-added services] allow more choice and the motivation to be an active member of the community. We've got to have incentives for both sides to join the network. For example, rewarding users for creating value for the platform and lowering fees for users of the services." – Interviewee 4, executive at Chasyr*

The value activities ensure that the platform can expand and realize positive network effects. The current business model requires users to engage in similar value activities than the future business model. However, the future business model requires that users become more active. Users of the platform become responsible for the business functions. Users of the future business model need to rate other users and settle disputes in addition to make transactions. Individuals must use the token to expand the value network of the platform. This token system has economic incentives for users to engage in value activities. The current business model does not include rewards for contributing users.

Business roles

The roles of users can change when peer-to-peer multi-sided platforms are using blockchain technology. The actors in the value network become responsible to engage in value activities, such as dispute settlement and rating other users (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018). This empowers users with a good reputation. Based on their reputation, *"community managers can take a leading position within the community"* (Interviewee 4, 2018). The token system can be programmed with economic incentives that reward users with tokens.

> *"The platform will be owned by its users. When a platform is decentralized its authority is distributed among the community, focused on community ownership." – Interviewee 2, executive at WeHome*

Decentralization of platforms has multiple implications for the authority of peer-to-peer multi-sided platforms. The hierarchy of platforms change along with the empowerment of local communities (Interviewee 4, 2018). Users could also get penalties for non-activity, rather than only being rewarded for contributing to the platform (Interviewee 1, 2018).

Collaboration

Collaboration with external parties is a strategy to increase the value offering to platform users. Decentralized sharing platforms can choose to integrate third party services into the platform (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018).

> *"Opt-in services can be offered to platform users, but also third party services can be integrated in the platform. These third parties do not necessary need to use blockchain technology." – Interviewee 2, executive at WeHome*

The isolation of third parties from the platform could have a negative impact on the profitability of the business model (Interviewee 5, 2018). This is backed by one interviewee who stated that *"decentralized platforms need to have integration possibilities"* for complementary services of third parties (Interviewee 4, 2018). The current business model does not require blockchain technology to collaborate with third parties. However, the future business model could benefit from increasing the value offering to platform users. Therefore, integration of complementary services will be part of the decentralized business model.

The future of the sharing economy is user-centric with the individual in control (Interviewee 3, 2018). Blockchain technology allows a personal identity to be used across different sharing platforms, instead of platforms owning your personal data (Interviewee 3, 2018; Interviewee 4, 2018). It remains uncertain whether this will actually be the case, because it *"fully depends on the technological development of blockchain technology"* (Interviewee 3, 2018).

4.1.4 Finance domain

This subsection describes how applications of blockchain technology impact the finance domain of peer-to-peer multi-sided platforms by describing changes in cost structure and revenues (Figure 19).

Code System	No. 1 ...	No. 2 ...	No. 3 ...	No. 4 ...	No. 5 ...	No. 6 ...	SUM
▼ Finance domain							0
▼ Costs							0
▶ Data verification costs	■	■	■	■	■		5
▶ Acquisition costs	■	■			■		3
▶ Arbitration costs			■				1
▼ Revenue model							0
▶ Payments for transactions		■	■		■	■	4
▶ Payments for value added servi	■			■	■		3
▶ Payments for third party commi		■					1
▶ Currency conversion fees		■		■	■	■	4
▶ Advertising						■	1
▶ Initial Coin Offering	■	■				■	3

FIGURE 19 – FINANCE DOMAIN CODING RESULTS

Costs

Blockchain technology impacts the cost structure of peer-to-peer multi-sided platforms. Blockchain technology affects data verification costs, acquisition costs and arbitration costs (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018). All peer-to-peer multi-sided platforms incur these costs.

> *"Blockchain technology can be used to costless facilitate the exchange of value between platform users." – Interviewee 2, executive at WeHome*

All business operations that are decentralized via smart contracts will almost completely eliminate the corresponding data verification costs, as described in paragraph 0 (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018). One interviewee argued that the cost structure of decentralized sharing platforms is *"most affected by the operations and marketing"* (Interviewee 2, 2018). The main implications from decentralization are captured in the following excerpt:

> *"The decentralized business models can overcome the dominance of established platform monopolists. This is possible by the improved value proposition, reduced transaction costs and the empowering the users, as they own the platform. This new business model will be able to acquire users from the established platforms." – Interviewee 2, executive at WeHome*

According to three interviewees the acquisition costs of new users is much lower than centralized sharing platforms (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 5, 2018). According to one interviewee, their platform does need *"to achieve some scale in order to be successful"* (Interviewee 1, 2018). The main argument is that the cost reduction and improved value proposition makes the decentralized platform directly rewarding for new users. The costs that platforms incur to settle disputes require a minimum form of revenues. This is argued by the possibility to decentralize arbitration and give ownership of the platform to the users, as described in paragraph 0. This application of blockchain technology lowers the costs for arbitration (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018).

Revenues

This sub-paragraph describes the revenues of decentralized sharing platforms that apply blockchain technology. Multiple respondents gave insight how new revenues are directly enabled by blockchain technology (Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). A total of six revenue models were discussed during the interviews:

1. Payments for transactions
2. Payments for value added services (B2C)
3. Payments for third party commissions (B2B)
4. Advertising
5. Currency conversion fees
6. Initial Coin Offerings

Ad 1 Payments for transactions

The value proposition of decentralized business models describes that blockchain technology allows lowering the transaction fees for its users. Two interviewees argued that it would not be a sustainable revenue model for decentralized sharing platforms to charge any fees for transactions (Interviewee 2, 2018; Interviewee 5, 2018).

> *"Decentralized platforms allow that no fees are charged for transactions. The service is free for users. Charging commissions to value providing platform users will no longer be a sustainable revenue model for decentralized platforms." – Interviewee 2, executive at WeHome*

According to one interviewee, sharing platforms should become not for profit businesses, from an idealistic point of view (Interviewee 3, 2018). This type of business model aligns with the classification of true-sharing platforms as displayed in Figure 10. There must always be some form of revenues to cover the costs (Interviewee 3, 2018). The other interviewees argued similarly that decentralized platforms could still be profitable, despite the lowering or elimination of transaction fees. Five interviewees elaborated on different ways for decentralized platforms to earn revenues (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). Three of the interviewees described that decentralized platform should still be able to charge transaction fees. These fees should be lowered proportionately as blockchain technology lowers the data verification costs (Interviewee 1, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 6, 2018).

Ad 2 Payments for value added services

The offering of opt-in services enables decentralized sharing platforms to earn revenues from end-users (Interviewee 1, 2018; Interviewee 4, 2018; Interviewee 5, 2018). Users that would like to use additional features on the platform it are required to pay fees for these premium services.

> *"These opt-in services allow the multi-sided platform to become profitable, rather than charging transaction fees." – Interviewee 5, executive at Populstay*

Value added services depend on the market offered service by the platform. According to three interviewees users often want the option to insure their goods (Interviewee 2, 2018; Interviewee 5, 2018; Interviewee 6, 2018). According to another interviewee, opt-in services can also provide access to the reputation of other users (Interviewee 1, 2018). The current business model of Peerby earns no revenue that is based on value added services. Blockchain technology is not required to offer value added services. The future business model will include revenues based on value added services.

Ad 3 Payments for third party commissions (B2B)

The opt-in services that are offered to platform users can resources of third parties that are integrated in the platform. According to one interviewee, these third parties can be charged with commissions in order to offer reach customers through the intermediating platform (Interviewee 2, 2018). This is a business-to-business revenue model. These third parties do not necessary need to use blockchain technology (Interviewee 2, 2018). The current business model of Peerby earns no revenue from third party commissions. If the future business model offers value added services from third parties, such third party commissions could be charged per transaction that involves these third party services.

Ad 4 Currency conversion fees

Blockchain technology enables a new revenue model that is based on the exchanges of currencies (Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). The value proposition of decentralized sharing platforms eliminates cross-border conversion fees when converting fiat currencies. Cross-border exchange rates do not longer exists, because the token system gives free access to the platform (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018). Multi-sided platforms were not able to use before the token system existed. Users could be allowed by the platform to transact with different currencies. A decentralized platform can charge exchange fees when users want to pay with fiat currency or with a token that gives access to a different service (Interviewee 2, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018).

> *“Decentralized platforms could allow users to pay with fiat currency or other cryptocurrencies. The decentralized platform charges an exchange fee when users don’t use their token. This gives the users an incentive to buy the token, because it means that they can access the service for free.” – Interviewee 5, executive at Populstay*

The current business model of Peerby involves no conversion of currencies. The future business model, however, is expected to have many currency conversions as users pay with euros that need to be converted to the token in order to have the transaction registered on the blockchain. The future business model could earn revenues from currency conversion fees, but only to cover these costs. Furthermore, this fee can be work as an incentive for users to purchase tokens and use these to transact on the platform, rather than pay with fiat currency.

Ad 5 Advertising

There was one interviewee that described advertising as a revenue model for decentralized platforms (Interviewee 6, 2018). Earning revenues via advertising is no new revenue model and is not enabled by blockchain technology. The interviewee gave advertising as an example, because decentralized platforms *“need to look for new ways to earn revenues”* (Interviewee 6, 2018). Both the current and future business model could include advertising as part of the revenue model. However, blockchain technology is not applicable for advertising purposes on the platform.

Ad 6 Initial Coin Offerings

The distribution of tokens is done through a so-called Initial Coin Offering (ICO). An ICO is a novel fundraising approach that decentralized businesses use to publicly sell their tokens (Interviewee 1, 2018; Interviewee 2, 2018; Interviewee 6, 2018). An ICO is similar to selling of shares of a business via a stock exchange, through an Initial Public Offering (IPO). When a business sells shares to investors, the power of the business owner is distributed among the shareholders (Interviewee 2, 2018; Interviewee 6, 2018). The sale of tokens has two similar effects as IPOs. First, the central power of a peer-to-peer multi-sided platform is distributed among the token owners. Second, the business collects funds that are often required to continue the development of the platform. This funding is used to develop the token system and logic of smart contracts (Interviewee 1, 2018). The current business model is not able to distribute tokens through an ICO. This is only possible for a decentralized business model with a token system.

4.1.5 Interpretations

All four domains of the STOF business model ontology are impacted when peer-to-peer multi-sided platforms use blockchain technology to decentralize their business model. In particular, the distribution of tokens and the use of smart contracts impact the business model components. The centralized business model of Peerby (as-is) is compared with a decentralized business model (to-be). An overview of the business model components is presented in Table 9 on page 51.

Service domain

The user-centric business models of peer-to-peer multi-sided platforms are impacted by blockchain technology. Every interviewee explained that the value proposition of decentralized sharing platforms brings more value to its users than centralized peer-to-peer multi-sided platforms. The core of the value proposition of decentralized sharing platforms is similar to the value proposition of peer-to-peer multi-sided platforms. The value proposition of the business model aims to aggregate supply and demand and allows individuals to interact directly via the intermediating service. However, blockchain technology changes how users access the services of peer-to-peer multi-sided platforms. It is important to understand that blockchain technology is only valuable when used for decentralization purposes, which is why blockchain technology is not suitable for centralized peer-to-peer multi-sided platforms. All interviewees expressed the importance of a token system for decentralized sharing platforms. A token must have utility for its users, which can be compared with network effects. Token utility is created by continuous usage of the platform that will make the services of the platform more valuable. Tokens must be distributed among users as these tokens facilitate direct transactions between individuals. In other words, tokens can be used to access the services of decentralized sharing platforms. When a decentralized sharing platforms aims to scale it requires a functioning token system with economic incentives for the users. This aligns with the perspective of three interviewees who expressed the importance of Initial Coin Offerings. As described earlier, once tokens are distributed it has two effects on the value proposition of decentralized sharing platforms: (1) the power of the platform is distributed among token holders and (2) funds are raised that can be used to develop the platform. In the long-term, after the sale of shares, centralized platforms become inclined to increase market share to satisfy the demands of shareholders. Token holders of a decentralized platform represent the shareholders of centralized platforms. Therefore, decentralized sharing platforms no longer need to focus on maximizing profits for external shareholders that leaves users dissatisfied. Decentralized sharing platforms reward users for creating value for the network. Focus on platform users, rather than capturing market share for the shareholders. When decentralized sharing platforms remain focused on the value of users, rather than capturing market share for the shareholders, it could mitigate repercussions that users would incur from shareholder pressure. The value proposition of decentralized sharing platforms can still be improved by horizontal differentiation. According to five interviewees, horizontal differentiation remains important when peer-to-peer multi-sided platforms use blockchain technology. Decentralized sharing platforms should be able to offer complementary services via the integrating of third parties. The integrating of third parties requires no blockchain technology, however, the decentralized sharing platform needs to seek ways to improve the value proposition. Adding complementary services could be beneficial for users and contribute to collaboration with third parties. In return, collaboration with third parties can be helpful to increase the adoption rate of users. According one interviewee, a token system also allows decentralized sharing platforms to equalize fees globally, because there are no currency exchange rates. In addition to the distribution of value and power, can be concluded that blockchain technology improves the value proposition of peer-to-peer multi-sided platforms.

Technology domain

The technology domain of the decentralized business model is mostly impacted by the use of a token system and smart contracts. The token system has direct impact on the value proposition. Smart contracts have more impact on the technological architecture and the platform governance. Decentralized sharing platforms use smart contracts to automate business processes. A smart contract is an application of blockchain technology that is significant for the decentralization of peer-to-peer multi-sided platforms. Four business functions were made explicit during the interviews: (1) conditional transactions, (2) automated identity verification, (3) reputation systems and (4) arbitration systems. All interviewees expressed the importance of conditional transactions for peer-to-peer multi-sided platforms. The transactions between individuals in the sharing economy involve access to a good or service in exchange for money. Interacting individuals always required a trusted third party that intermediates in the exchanges of value. The intermediating services of peer-to-peer multi-sided platforms are no longer required when smart contracts are used to facilitate conditional transactions between individuals. The current state of development of blockchain technology allows peer-to-peer multi-sided platforms to use smart contracts for conditional transactions. Conditional transactions are straightforward to be programmed into a smart contract. The other business functions that decentralized sharing platforms more difficult, because the processes are more complex. Automating the user ratings can be valuable for the platform users. Currently, peer-to-peer multi-sided platforms are in control of the reputation systems and are able to change data according to their interests. Decentralizing the reputation system involves the storage of reputation data on a blockchain. This could contribute to establishing trusts between peers. However, the effects of decentralized reputation systems on the value network of decentralized sharing platforms are not clear. Blockchain technology eliminates the need for a trusted third party that intermediated between interacting users. However, and disputes between individuals will always occur. For example, when a product gets damaged and both parties claim to be not responsible. Smart contracts can be used to automate dispute settlement via an arbitration system, which is now done by the intermediating party. Automated arbitration systems can be very valuable for peer-to-peer multi-sided platforms, because dispute settlement is labour-intensive. The interview results suggest that users of decentralized sharing platforms could be allowed to take a leading role if they have a good reputation. The responsible individuals are rewarded with tokens if they contribute to resolve disputes. This arbitration system could be interpreted as fair and objective arbitration. However, it is difficult to predict whether these individuals are effective in dispute settlement.

Organization domain

The users can be seen as the main assets of a peer-to-peer multi-sided platform and they become more valuable when business functions are decentralized. Platform users need to engage in value activities to expand the value network of the platform. These value activities relate to the business functions of decentralized sharing platforms. The interviews identified three value activities: (1) transactions, (2) rating users and (3) dispute settlement. It is of significant importance that users engage in these activities to realize network effects. Positive network effects are a prerequisite for platforms to scale. According to four interviewees, there is a direct link between economic incentives and positive network effects. Users do not benefit from rating other users or settling disputes. Engaging in these activities is in misalignment with their individual interests. Therefore, the token system must be programmed to offer economic incentives. The token system can be programmed in a way that contributing users are rewarded with tokens. Yet, no examples of decentralized sharing platforms exist at this moment that realized positive network effects. This has nothing to do with failure of the decentralized sharing platforms, but rather with the novelty of decentralized business models. Therefore, it is difficult to understand the effectiveness of economic incentives. In addition, there is no knowledge about the optimal trade-off between economic incentives and effectiveness. The interview results also revealed a causal relation between horizontal differentiation and positive network effects. Five interviewees expressed that integration of complementary services is significant for the competitive position of decentralized sharing platforms. Decentralized sharing platforms need to differentiate their service offering by collaborating with third parties. Horizontal differentiation gives users the option to pay for additional services. Additional services contribute to the users' perception. Users could get more value from the service. The relation between horizontal differentiation and increased perceived value could be interpreted as enhancing for positive network effects. This makes collaboration with third parties an important aspect of decentralized sharing platforms.

Finance domain

Peer-to-peer multi-sided platforms have a revenue model that is based on transaction fees. Decentralizing business processes results in the elimination of transaction costs. Four interviewees explained that this cost reduction should be used to decrease of the transaction fees that users pay in order to use the service. There is some inconsistency in whether decentralized sharing platforms should completely eliminate transaction fees as a result of the cost reduction. Two interviewees argued that decentralized sharing platforms would not able to charge any commissions on transactions. Another interviewee stated that the complete elimination of transaction fees would make the business model not viable, because it would negatively impact the revenue model. All interviewees agreed that the transaction fees of decentralized sharing platforms should at least be lower than the transaction fees of centralized sharing platforms. Established platform monopolies, like Airbnb and Uber, charge high fees for transactions. Uber drivers have to pay 30 to 40% of their earnings to the intermediating platform. Blockchain technology could hamper the revenue model of peer-to-peer multi-sided platforms. Decentralized sharing platforms should explore different ways to earn revenue. Collaboration with third parties is allows for new revenue models. Users could pay for opt-in services and third parties are could be charged with commissions to reach new customers for their services. This revenue model is only possible if complementary services of third parties are allowed on the platform. Four interviewees suggested that decentralized sharing platforms could earn revenues from currency conversion fees. Users would pay additional fees if they pay with another currency than the token. This is probably not a viable revenue model for decentralized sharing platforms. However, it could be an extra incentive for users to use tokens, which increases the token utility. Three interviewees discussed the relevance of Initial Coin Offerings for decentralized sharing platforms. The distribution of tokens though an ICO could be useful to collect funds to develop the decentralized sharing platforms. Overall, blockchain technology could eliminate transaction cost, which can be used to decrease the transaction fees to benefit users. However, decentralized sharing platforms should look for new revenue models if the transaction fees are completely eliminated.

<table>
<tr><th colspan="2">TABLE 9 – OVERVIEW OF BUSINESS MODEL COMPONENTS (AS-IS & TO-BE)</th></tr>
<tr><th colspan="2">Service domain</th></tr>
<tr><td>Customers and end-users (as-is)
Individuals that own goods (supply) can share these with neighbours (demand) and individuals that want to access goods from neighbours (demand)</td><td>Customers and end-users (to-be)
Individuals that own goods (supply) can share these with neighbours (demand) and individuals that want to access goods from neighbours (demand)</td></tr>
<tr><td>Value proposition (as-is)
▪ Facilitating the sharing of underused goods between neighbours
▪ Supply side is enabled to share goods, either for free or for a fee
▪ Demand side is enabled to access goods via the platform</td><td>Value proposition (to-be)
The value proposition of the centralized business model improves from using blockchain technology.
▪ Free cross-border payments
▪ Value distribution across users
▪ Additional services</td></tr>
<tr><th colspan="2">Technology domain</th></tr>
<tr><td>Technical functionality (as-is)
Data is stored in a centralized database without technical capabilities of blockchain technology.</td><td>Technical functionality (to-be)
Technical capabilities of blockchain technology are adopted in the technical architecture to decentralize the business model (e.g. immutable, secure, transparent)</td></tr>
<tr><td>Token system (as-is)
The renting of goods is paid with fiat currency (€).</td><td>Token system (to-be)
Token system to facilitate transactions between individuals and offer economic incentives to individuals to engage in value activities</td></tr>
<tr><td>Business functions (as-is)
Business processes are not automated.
▪ Conditional transactions facilitated via Peerby's platform
▪ Identity verification by Peerby
▪ Arbitration by Peerby</td><td>Business functions (to-be)
Business processes are automated and decentralized with smart contracts.
▪ Conditional transactions
▪ Automated identity verification
▪ Reputation systems
▪ Arbitration systems</td></tr>
<tr><th colspan="2">Organization domain</th></tr>
<tr><td>Value activities (as-is)
Users need to interact to create network effects. The platform does not provide economic incentives</td><td>Value activities (to-be)
Users need to interact to create network effects. Users that that engage in value activities are rewarded with tokens</td></tr>
<tr><td>Business roles (as-is)
Peerby is responsible for all activities</td><td>Business roles (to-be)
The ownership of the platform is distributed across the users via tokens. Token rewards for users that engage in value activities</td></tr>
<tr><td>Collaboration (as-is)
No third party collaborations</td><td>Collaboration (to-be)
Third party collaborations to integrate additional services</td></tr>
<tr><th colspan="2">Finance domain</th></tr>
<tr><td>Costs (as-is)
Data verification costs to facilitate interactions between individuals.</td><td>Costs (to-be)
Elimination of data verification costs by using a token system and smart contracts to facilitate interactions between individuals.</td></tr>
<tr><td>Revenues (as-is)
▪ Payments for transactions</td><td>Revenues (to-be)
▪ Payments for transactions
▪ Payments for value-added services
▪ Payments for third party activities
▪ Advertising
▪ Currency conversion fees
▪ Initial Coin Offerings</td></tr>
</table>

4.1.6 Decentralized business model design

The interview results are interpreted to determine the relevance for Peerby to use blockchain technology. The comparison between the current business model (as-is) and the future business model (to-be) shows that some components of the decentralized business model do not require blockchain technology. This comparison also shows that not all uses of blockchain technology are relevant for Peerby. This subsection discusses the decentralized business model that is designed for Peerby based on the interviews. Table 10 on page 53 presents the decentralized business model for Peerby. This decentralized business model is input for the business model stress test.

The service domain of the decentralized business model includes the value proposition. The facilitation of interactions between individuals is enabled by blockchain technology. The value proposition is based on the technical capabilities of blockchain technology. The decentralized business model distributes the power among the users. Furthermore, the transaction fees that users have to pay are lowered as a result of the cost reduction. The lower transaction fees contribute to the value proposition, which lowers the revenue model. Therefore, Peerby needs to offer additional services through the platform that can be used to generate income. Two examples of additional services that could be relevant for Peerby are insurance of goods and logistic services that deliver goods.

The technology domain of the decentralized business model includes business functions that are enabled by a token system and smart contracts. The business functions that are facilitated by the platform involve the facilitation of interactions between individuals. Smart contracts are used to decentralize different business processes. Peerby is no longer involved in the authentication process of user identities. The digital identities of users are stored on a blockchain and controlled by users via a smart contract. Moreover, smart contracts are used to develop an automated reputation system and arbitration system. The reputation system helps users to decided whether to lend or rent a good from or to another individual. A good reputation allows users to help with the settlement of disputes between other users.

The organization domain of the decentralized business model includes the value activities and collaboration with third parties. The value activities need to be executed by the users of Peerby. Users need engage in transactions, rate other users and settle disputes that may arise. These activities contribute to the value network and increase token utility. Users are rewarded with tokens if they rate other users or settle disputes. The demand side pays for the services. A large percentage will be transferred to the supply side that provides value to the network. Individuals are incentivised with tokens to contribute to the community in order to stimulate positive network effects. Collaboration with third parties is also required to increase the value network. Complementary services of third parties need to be integrated to offer additional services to the users.

The finance domain of the decentralized business model includes the revenues. The revenue model comprises multiple streams of income. First, every transaction involves a transaction fee, which is the same percentage for every payment. Second, users can choose to pay for additional services that are offered by the platform. For example, users could decide to have a product delivered at home. Third, a commission is paid when individuals are using additional services from third parties. Fourth, users that want to pay with fiat currency, and not use the token, have to pay a small fee for every transaction. This currency conversion fees aim to stimulate the usage of tokens. Finally, the tokens are distributed among the users through an ICO. The funds that would be raised need to be invested in development of the platform.

TABLE 10 – DECENTRALIZED BUSINESS MODEL FOR PEERBY (TO-BE)	
Service domain	**Technology domain**
Value proposition ▪ Free cross-border payments ▪ Value distribution across users ▪ Low transaction fees ▪ Additional services	**Business functions** ▪ Conditional transactions ▪ Identity verification ▪ Reputation system ▪ Arbitration system
Finance domain	**Organization domain**
Revenues ▪ Payments for transactions ▪ Payments for value added services (B2C) ▪ Payments for third party commissions (B2B) ▪ Currency conversion fees ▪ Initial Coin Offering	**Value activities** ▪ Transactions ▪ User rating ▪ Dispute settlement **Collaborations** ▪ Integration of third party services

4.2 Stress factor identification and selection

The second step in the business model stress test involves the identification and selection of stress factors. The interviews revealed different stress factors relating to blockchain technology (4.2.1). The identified stress factors are interpreted to understand the relevance of each stress factor. Three stress factors were selected to confront with the decentralized business model design (4.2.2). The selected stress factors are used as input for the business model stress test that evaluated the viability and feasibility of the decentralized business model.

4.2.1 Identified stress factors

This subsection describes the trends and uncertainties that are identified during the interviews, relating to technology, market, society and regulation (Figure 20). The identification of stress factors is part of the preparation of the business model stress test.

Code System	No. 1 ...	No. 2 ...	No. 3 ...	No. 4 ...	No. 5 ...	No. 6 ...	SUM
Uncertainties							0
Technology	■		■	■	■	■	5
Market							0
Speculation on currency values		■	■	■	■		4
Revenue model viability			■				1
Centralized platform threat	■	■	■	■			4
Society							0
Blockchain understanding	■	■		■	■	■	5
Societal trust	■	■	■	■	■	■	6
Regulation		■		■	■	■	4

FIGURE 20 – CODING RESULTS FOR STRESS FACTORS

Technology

Three interviewees mentioned the early technological development of blockchain technology as a weakness of decentralized business models (Interviewee 1, 2018; Interviewee 4, 2018; Interviewee 5, 2018). The transactional throughput of blockchain technology is explained as the time delay before transactions are stored on a blockchain (Interviewee 1, 2018; Interviewee 3, 2018). The payment process from fiat currency to cryptocurrency needs improvement before it can be integrated properly by decentralized sharing platforms (Interviewee 1, 2018).

“Decentralized sharing platforms need to have a good method of exchange set up. This exchange allows users to convert cryptocurrency into fiat currency and vice versa.” – Interviewee 4, executive at Chasyr

Market

Three interviewees discussed the volatility in token value as a market trend that affects the sustainability of decentralized business models (Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018). Some countries do not allow that fiat currency is converted to cryptocurrencies. One interviewee argued that the current solution to this restriction involves over-the-counter transactions, where tokens are traded as assets. This needs to be resolved before decentralized platforms can scale massively and have positive network effects (Interviewee 5, 2018). Three interviewees described the same causal link between market speculation and the sustainability of decentralized business models (Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 5, 2018).

“At this moment, many decentralized applications make money from speculating on growth of currency values. One of the biggest challenges for decentralized sharing platforms will be to build a sustainable business model.” – Interviewee 3, executive at AXVECO

Decentralized sharing platforms need to guarantee a stable value of a currency to build a sustainable business model (Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018). At this early stage of decentralized business models there is *“much speculated with cryptocurrencies as an asset rather than a utility token”* (Interviewee 5, 2018). The intended use of a token is not realized as a result of speculation.

“If the token is not used properly, the price is going down, every token owner want wants to sell and the platform will not work. That's not the purpose because it's not working. If everyone is just holding the token, it is not being used to gain the actual access to service.” – Interviewee 4, executive at Populstay

Society

Five interviewees identified lacking societal trust in blockchain technology as an uncertainty for decentralized sharing platforms (Interviewee 2, 2018; Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). Acceptance of blockchain technology *“needs time as society and governments learn about it”* (Interviewee 5, 2018). Multiple interviewees identified similar causal relation that explains the lack of societal trust in blockchain technology (Interviewee 3, 2018; Interviewee 4, 2018; Interviewee 5, 2018; Interviewee 6, 2018). The following three excerpts from the interview transcripts show that educating users about blockchain technology is an important method to resolve a weak societal trust in the technology and decentralized sharing platforms:

“The key strategy to overcome social uncertainty with regard to cryptocurrency and blockchain technology is to educate the users of the platform. We hold cryptocurrency educational meet-ups in order to raise awareness.” – Interviewee 4, executive at Chasyr

“There is no trust about blockchain from society. The users must be educated about blockchain technology” – Interviewee 5, executive at Populstay

“People really don't trust blockchain technology. This is part of the process of innovations and it can only be resolved by informing people.” – Interviewee 6, sharing economy advisor at HireGo

Regulation

Three interviewees elaborated on the regulatory environment as an uncertainty for decentralized sharing platforms (Interviewee 2, 2018; Interviewee 5, 2018; Interviewee 6, 2018). The regulatory environment regarding blockchain technology is rapidly changing, which is an uncertain development for decentralized business models (Interviewee 2, 2018; Interviewee 5, 2018). Governments will try to understand blockchain technology and its use by learning from existing applications (Interviewee 2, 2018). There are already governments that understand the technology and see its contribution to economic purposes (Interviewee 5, 2018). However, most governments have difficulties to develop proper regulation regarding new technologies. The complexity of blockchain technology makes it even harder for governments to determine what applications of blockchain technology should be allowed or regulated. Educating governments about the technical capabilities and applications of blockchain technology could be important for multi-sided platforms with a decentralized business model. Three interviewees argued that there is a causal link between the *"insecure regulatory environment"* and understanding about blockchain capabilities (Interviewee 2, 2018; Interviewee 5, 2018; Interviewee 6, 2018). In the past years, there were multiple fraudulent cases with ICOs. Businesses created a token system without any utility that was sold to potential users or investors during an ICO. Currently, regulations are being developed that limit or even prohibit ICOs. Therefore, decentralized sharing platform could be limited in the distribution of tokens and collecting funds. Moreover, new applications of blockchain technology are being developed. Policymakers are unable to keep up with these technological developments. More understanding about tokens systems is realized through the global attention for Bitcoin. However, different applications of smart contract, for example the facilitation of conditional transactions or automation of other business processes, are still novel to high-tech businesses. Overall, the regulatory environment regarding blockchain technology is an uncertainty for decentralized business models.

4.2.2 Selected stress factors

Multiple stress factors are identified that could restrict the viability and feasibility of decentralized sharing platforms. The four stress factors that were identified relate directly to blockchain technology. The first stress factor relates to the technological development of blockchain technology. Blockchain technology is still highly inefficient in data verification when it is compared to a centralized database. There exist a time delay for each transaction that takes place. The interviewees mostly referred to tokens that facilitate direct transactions between individuals. The exchange process between fiat currency and cryptocurrency needs to be improved before decentralized sharing platforms can become effective. The outcome of this trend is very important for the implementation of token systems and decentralized applications. However, the novelty of blockchain technology explains the current inefficiencies. It is common for innovations to increasingly become more efficient in its use as the technology continues to be developed.

The second stress factor involves the market speculation on growth of token value. In general, tokens can be exchanged to other currencies, either fiat currency or another cryptocurrency. This explains how every token has a monetary value. In theory, this monetary value should represent the utility of the token. However, since the development of Bitcoin in 2008, many other token systems are developed. The monetary value of these tokens currently depends on the value of Bitcoin. This means that a decentralized sharing platform could develop a token system that is valuable for its users, but the monetary value is not based on the token utility. The viability and feasibility of a decentralized business model is affected by volatility of token value. For example, the economic incentive could not be effective to stimulate network effects. Users would not be incentivised to engage in value activities if they receive no reward, because the token has no value.

The third stress factor is the societal trust in blockchain technology. Individuals are not familiar with blockchain technology and its uses. It is difficult to predict to what extent society will become start to adopt applications of blockchain technology. Blockchain technology is mainly associated with Bitcoin. The complexity of blockchain technology and volatile token value contribute to lacking societal trust in the technology. Trust needs to be established before decentralized business models will disrupt centralized business models.

The fourth stress factor relates to establishing regulation on blockchain technology that is developed by policymakers. The changing regulatory environment is an uncertainty for the viability and feasibility decentralized business models. Many countries are currently establishing regulation that concerns blockchain technology, however, policymakers are not able to keep up with the quick development of blockchain technology. The regulatory environment is currently different for the United States, Japan, Europe and United Kingdom. It can be argued that lacking knowledge about blockchain technology contributes to a restrictive regulatory environment.

The validity of stress tests depends on the selected stress factors (Bouwman, Heikkilä, Heikkilä, Leopold, & Haaker, 2017). Blockchain technology is novel and inefficient. The technological development of blockchain technology is a very relevant trend with an uncertain outcome. For that reason it would be a good stress factor to include in the business model stress test. However, this stress factor is not included in the business model stress test because the impact on viability and feasibility is very predictable. Decentralized sharing platforms will not be future-proof if the increasing efficiency of blockchain technology hampers. On the other hand, continuous development of blockchain technology is beneficial for decentralized business models. Consequently, there is little relevance to include the development of blockchain technology in the stress test. The other stress factors that were identified during the interviews are more relevant. A total of three stress factors are included in the stress test: (1) societal trust in blockchain technology, (2) speculation on token value growth and (3) changing regulatory environment (Table 11).

TABLE 11 – STRESS FACTOR SELECTION AND OUTCOMES

Perspective	Stress factor	Outcome 1	Outcome 2
Society	Trust in blockchain technology	Weak trust	Strong trust
Market	Speculation on token value growth	Instable token value	Stable token value
Regulation	Changing regulatory environment	Restrictive regulation	Supportive regulation

The selection of these stress factors involves the extreme ends of scenarios in order to bring contrast in the findings. The outcomes of the first stress factor are weak societal trust and strong societal trust in blockchain technology. The outcomes of the second stress factor are instable token value and stable token value. The outcomes of the third stress factor are restrictive and supportive regulatory environment. The selected stress factors are confronted with the decentralized business model (to-be). The stress factors relate to blockchain technology and the current business model does not use blockchain technology. Therefore, the viability and feasibility of the current business model will not be addressed during the business model stress test.

4.3 Business model stress test

This section describes the heat mapping results that was created during the business model stress test workshop (Figure 21). This heat map is analysed to address the viability and feasibility of the decentralized business model. The sub-view analysis helps to understand why parts of the decentralized business models appear more robust than others by accumulating the impact of all stress factors on each business model component (4.3.2). The pattern analysis aims to reveal patterns of colourings in the heat map (4.3.3). This section concludes with a reflection on the business model stress test results of the decentralized business model (4.3.4). An overview of the decentralized business model was presented in Table 10 on page 53.

4.3.1 Heat map results

The business model stress test addresses the viability and feasibility of the decentralized business model. The core activity of the business model stress test workshop was the creation of the heat map. The results of the business model stress test (Appendix G) were processed in Excel to allow a more comprehensive analysis of the heat map. The heat map of the business model stress test workshop is presented in Figure 21. The stress test outcomes are labelled with codes. These codes are based on the respective business model component (1), stress factor (2) and the stress factor outcome (3). The colours of the notes that were used during the business model stress test workshop differ from the colours in Table 7 on page 35. The pink and yellow notes respectively represent the red and orange stress test outcomes. The memos and audio recordings were used to describe the corresponding argumentation for the heat map. Appendix H presents the qualitative argumentation that resulted in the creation of the heat map.

A heat map was created during the business model stress test workshop. The heat map results include the selected business model components and stress factors, respectively vertically and horizontally positioned in the matrix. Before the creation of a heat map, the business model was mapped to the stress factors. This step determined whether the stress factors affect the business model component. If there exist no causal relation between a business model component and stress factors there is no need to discuss these during the creation of the heat map. The heat map results show that there were multiple business model components that were not affected by certain stress factors. The business functions was not affected by the stress factors that involved societal trust in blockchain technology and market speculation with tokens. A supporting regulatory environment only affects the value proposition. The supportive regulatory environment does not affect the technology, organization and finance domains.

		Selected stress factors					
		Societal trust in blockchain (S)		Market speculation with tokens (M)		Changing regulatory environment (R)	
		Weak trust (W)	Strong trust (S)	Instable token value (I)	Stable token value (S)	Restrictive regulation (R)	Supportive regulation (S)
Business model components	Value proposition (V)	VSW-1 VSW-2 VSW-3 VSW-4	VSS-1 VSS-2	VMI-1	VMS-1	VRR-1 VRR-2 VRR-3	VRS-1
	Business function (B)					BRR-1	
	Value activities (A)	ASW-1 ASW-2 ASW-3	ASS-1	AMI-1 AMI-2	AMS-1	ARR-1	
	Collaborations (C)	CSW-1	CSS-1	CMI-1	CMS-1	CRR-1 CRR-2	
	Revenues (R)	RSW-1 RSW-2	RSS-1 RSS-2	RMI-1 RMI-2 RMI-3	RMS-1	RRR-1	

FIGURE 21 – HEAT MAP RESULTS

4.3.2 Sub-view analysis

The value proposition of the decentralized business model appears to be neither feasible nor viable in different future scenarios. When society has no trust in blockchain technology it will not be possible to deploy the value proposition in practice. The intended transparency is not realized and value distribution across users is hampered. A restrictive regulatory environment makes the value proposition not viable. However, regulation does contribute to trust and clarity about blockchain technology, which can actually make the value proposition both viable and feasible. All positive stress factor outcomes have positive implications for the delivery of value proposition.

The technological architecture and business functions of the decentralized business model appears to be very robust. The business functions that Peerby would offer by decentralizing the platform are not impacted by trust in blockchain technology or speculation on growth of the token value. A restrictive regulatory environment could make some business functions unviable. Regulation does not impact the crucial business functions that are required to facilitate interactions.

The activities that contribute to expansion of the value network are affected by the selected stress factors. Instability of the token value makes this business model component unfeasible. Weak trust and restrictive regulatory environment result in unviability of the value activities. The accumulated stress factor results show that this business model component is the least viable. All negative stress factor outcomes make collaboration with third parties not viable. Weak societal trust in blockchain technology, instable token value and restrictive regulation cause barriers to collaborate with Peerby. Positive stress factor outcomes can contribute to the establishment of collaborations. It is attractive to collaborate with Peerby when there is strong trust in blockchain technology and the token value is not volatile.

The heat map reveals that the revenue model of the decentralized sharing platform is the least robust. All three selected stress factors can make the revenue model not feasible. Value activities and collaborations impact the revenue model directly, respectively the payments for value added services and third party commissions. When these are not viable. The revenue model is most susceptible to the negative implications of the selected uncertainties.

4.3.3 Pattern analysis

The colouring patterns can identify (1) inconsistencies in outcomes, (2) favourable outcomes on stress factors, (3) unfeasible business model components, and (4) assess the robustness of the business model (Bouwman, Heikkilä, Heikkilä, Leopold, & Haaker, 2017). The heat map reveals that the robustness of decentralized platforms is highly dependent on the developments of societal, market and regulatory uncertainties. The heat map shows no chequered colour patterns in within the columns. Each separate stress factor outcome has a similar impact on the viability and feasibility of the business model. There is a clear distinction between positive and negative stress factor outcomes. Positive outcomes of the stress factors – trust, stable token value and supportive regulation – are causally related to the business model components, but have no negative implications. Negative stress factor outcomes show weaknesses in the business model. Multiple business model components become unfeasible when confronted with negative stress factor outcomes.

The value proposition is not feasible when there is no trust and the token value is instable. The established reputation of Peerby has a strong impact on the impact of distrust in blockchain technology. The reputation of Peerby and trust in the platform is important for the acceptance of blockchain technology by its users. The establishment of regulation has positive effects on the trust and understanding about blockchain technology. The heat map illustrates the importance of trust in blockchain technology for the implementation of the decentralized business model. Strong societal trust in blockchain technology has favourable implications for the tested business model components. Value activities and collaborations with third parties are both affected negatively by the stress factors. Positive stress factor outcome have positive implications for value activities and collaborations. The colour pattern across the heat map displays a relation between the organization domain and the finance domain. The stress factors can make the revenue model unfeasible in all negative scenarios. Instable token value can also contribute to an Initial Coin Offering that allows the development of the decentralized platform. The revenue model becomes either not viable or not feasible when the platform has restrictions in its value activities or collaborations. The argumentation of the stress factor outcomes verifies this causality. Strong trust and stable token value both have positive implications for the revenue model.

The heat map shows that the decentralized business model is not robust. Trends and uncertainties determine how well the business model components will function in practice. If the selected stress factors will have negative outcomes it will not feasible to realize the intended value proposition, value activities and revenues. Collaborations and part of the business functions will not be viable. Alternatively, if the stress factors have a positive outcome this business model can bring more economic and societal value to platforms, communities and collaborations.

4.3.4 Interpretations

Reflecting on the heat map results helps to address the strong and weak parts of the business model in order to make suggestions to improve the decentralized business model. The selected stress factors are all closely related to each other, because all stress factors concern blockchain technology. The heat map analysis shows that a strong trust in blockchain technology and a stable token value is very important for an optimal implementation of the decentralized business model. The value proposition becomes not feasible if the trends in society and market have a negative outcome. As long as there is no trust in blockchain technology, users will believe it is risky to use the services of Peerby. Volatility in the token value has also a negative impact on the value proposition. The value that users get from economic incentives would fluctuate. Therefore, the rewards that users receive their contribution to the value network will be inconsistent, making users less inclined to engage in value activities. It is important to address the relation between the value proposition and the revenue model. The revenue model is based on the value proposition that is delivered to the users. Peerby would not be able to receive income when the value proposition is not feasible. The arbitration system is not viable when users have no trust in blockchain technology. Conditional transactions and the reward system will be unaffected by this stress factor. Other stress factor outcomes do not impact the use of smart contracts for conditional transactions or rating of users. These two stress factors do not affect the business functions that are enabled by the use of a token system and smart contracts. The business functions seem very robust. The heat maps shows that restrictive regulation can hamper the use of some applications of blockchain technology. Policymakers develop regulation that is based on existing use cases or successful businesses. Blockchain technology has already been used for fraudulent activities in the past. The complexity of blockchain technology makes it difficult for regulators to understand the up and downsides of the technology. Therefore, the regulatory environment remains uncertain for decentralized businesses. The business model stress test workshop revealed that regulation could restrict decentralized business models in different ways. Arbitration systems could be prohibited for example, as policymakers would decide that users are not able to settle disputes. Another examples relates to the prohibition of ICOs. The decentralized business model has no feasible revenues when ICOs are restricted. The volatile token value is the only stress factor outcome that makes the value proposition and value activities not feasible. As the token value depends on the speculation on growth of value, users will not use tokens to transact. Users would have more financial benefits if they would pay with fiat currency. The result is that users purchase tokens at a low price and sell these for a premium. Such activities would only stimulate the volatility of the token value.

It is very likely that the decentralized business model of Peerby will not be viable if the regulatory environment becomes restrictive. Establishing regulation, however, contributes to the understanding of blockchain technology. Therefore, it is possible that restrictive regulation could have positive implications for the business model. Regulators in the United States have a very strict policy on ICOs. This makes it difficult to distribute tokens among users, which is essential for the token system to work. It is impossible to create positive network effects if the token has no utility. A regulatory environment that restricts ICOs would make decentralized business models not feasible to implement. A supportive regulatory environment only affects the value proposition, thus indirectly affecting the revenue model. However, supportive regulation has no negative implications for the decentralized business model.

The decentralized business model appears to be problematic under the selected trends and uncertainties in society, market and regulation. The stress factors determine whether the business model can be implemented and how viable it will be in the long-term. Negative outcomes of the stress factors make all business model components not viable in the long term. Moreover, the value proposition, value activities and revenue model will not feasible if the stress factor outcomes are negative. Positive stress factor outcomes do not negatively affect any business model component. The business model stress test reveals that the decentralized business model is neither viable nor feasible if any stress factor outcome is negative. It can be concluded that decentralizing the business model of Peerby is not robust.

The business model stress test has some implications for Peerby. From a managerial perspective, there are multiple revisions that can be made to the decentralized business model to make it more robust. Users need to be educated on blockchain technology in order to make the value proposition less affected by stress factors. This could lead to acceptance of the technology. Moreover, multi-sided platforms that aim to decentralize their business model need to ensure stable rewards to users. The economics of the token system must be effective to realize network effects and give utility to the token. One suggestion to improve the robustness of the business model involves token rewards with a consistent monetary value. A fluctuating decreasing or increasing token value would require that contributing users are rewarded with, respectively, more or less tokens. This would help to incentivize users to adopt the platform according to the business model stress test results. Third party collaborations are affected by all stress factors. Inclusion of third party services is important for the viability of the platform. The reputation of Peerby could be a benefit for third parties to collaborate with the decentralized sharing platform. Otherwise, potential partners need to be informed about the advantages of decentralization with blockchain technology. The revenue model remains viable if other business model components are not restricted. Current regulation makes it difficult to distribute tokens through an Initial Coin Offering in the United States. It is not possible for Peerby to prevent restrictive regulation on Initial Coin Offerings.

5 Conclusions and discussion

This chapter discusses the research outcomes, reflects on the academic contribution and implications of the research, and discusses limitations and future research. The research outcomes are discussed in relation to the research objective by answering the main research question (5.1). The academic contribution and implications of this research are discussed after the reflection on the research outcomes (5.2). The potential limitations of the research (5.3) are used to make suggestions for future research (5.4).

5.1 Conclusions

The objective of this research was to explore the impact of blockchain technology on peer-to-peer multi-sided platforms by designing a decentralized business model that allows individuals to share goods with each other and to evaluate the viability and feasibility of this decentralized business model. The research objective was used to derive the following main research question:

> *How can blockchain technology enable business model innovation of peer-to-peer multi-sided platforms and can decentralized business models be viable and feasible?*

The findings of this case study are based on a literature review, semi-structured interviews and a business model stress test workshop. The research outcomes are used to answer the main research question and realize the research objective. The main research question was divided in seven sub-questions in section 1.5.

Blockchain impact on service domain

It is important to highlight that blockchain technology is only valuable for decentralized sharing platforms, which is why blockchain technology is not suitable for centralized peer-to-peer multi-sided platforms. Blockchain technology can be used to change the value proposition of peer-to-peer multi-sided platforms, by decentralizing the business model. The value proposition of a decentralized business model brings more value to users than centralized business models. The core of the value proposition remains the same, as peer-to-peer multi-sided platforms create value by enabling direct exchanges between two or more groups of individuals. However, blockchain technology changes how users access these services. Decentralized sharing platforms use a token system, or cryptocurrency, to facilitate transactions between individuals without an intermediary. The token must have utility for the users. Token utility is increased when individuals use it. The tokens can be used to access the service, which requires that users purchase these tokens. Initial Coin Offerings (ICOs) are important for decentralized sharing platforms, because this helps to distribute tokens across users. Individuals are allowed to purchase tokens during an ICO. The distribution of tokens has two effects: (1) the power of the company is distributed among token holders and (2) the company raises funds to continue the development of the platform. Token holders of a decentralized sharing platform are similar to the shareholders of a centralized multi-sided company. Decentralized sharing platforms reward users for creating value for the network in order to stimulate network effects. Multi-sided platforms that use blockchain technology can still improve the value proposition by offering complementary services. Decentralized sharing platforms could offer complementary services via the integration of third parties. Overall, can be concluded that the value proposition of peer-to-peer multi-sided platforms can be improved by blockchain technology.

Blockchain impact on technology domain

Blockchain technology can be used to change the technical architecture and business functions of peer-to-peer multi-sided platforms, by means of a token system and smart contracts. Smart contracts allow automation of business processed via programmable logic that is stored on a blockchain. It is possible to automate processes without using blockchain technology, however, this does not offer the technical capabilities of blockchain technology. The multi-sided platform is no longer needed for data verification when business processes are automated with smart contracts, an application of blockchain technology. Decentralized sharing platforms use smart contracts to offer multiple business functions. Smart contracts can be used to offer guarantees of value exchanges. Multi-sided platforms facilitate interactions between individuals that want to exchange something of value on a certain condition. This reverts back to the criteria for a multi-sided platform to be included within the sharing economy. These criteria state that both supply and demand should, respectively, be enabled to reach their individual goals and capture their needs. Smart contracts allow that these criteria are ensured via conditional transactions. A conditional transaction works as follows. Individual A wants to rent a good from individual B in exchange for a certain amount of money. This agreement is stored on a blockchain via a smart contract that holds the money. Once the product is delivered to individual A, both parties have to verify that this actually happened. The smart contract automatically transfers the money to individual B after verification. Normally, the multi-sided platform offers such guarantees to the user groups, but a decentralized sharing platform uses blockchain technology for such processes. Conditional transactions are relatively easy to program in a smart contract. The other three business functions are more complex and require multiple smart contracts. New decentralized applications are being developed. One of these applications are so-called Self Sovereign Identities that are stored on a blockchain that give individuals control over their digital identity. The implication of Self Sovereign Identifies for peer-to-peer multi-sided platforms could be that there is no longer a third party involved in the authentication process of user identities. Another decentralized application involves the reputation of users. Automating reputation systems can be valuable for platform users, because multi-sided platforms are currently in control of the reputation systems. This allows them to change reputation data according to their interests that might not be aligned with the interests of platform users. Using smart contracts to automate reputation system increases transparency in the network, as user reputations can be stored on a blockchain. Another decentralized application is an automated arbitration system, which is also enabled by multiple smart contracts. An arbitration system is important for multi-sided platforms, because interacting users can always have a dispute on a value exchange. Dispute settlement is labour-intensive. Therefore, it is valuable for multi-sided platforms that these processes can be decentralized. A suggestion would be to choose users with a good reputation to play a role in settling disputes. A blockchain-enabled arbitration system could be more objective if disputes are not settled by the multi-sided platform. It remains difficult to predict how well this decentralized application will work in practice.

Blockchain impact on organization domain

Users need to engage in value activities that contribute to the expansion of the value network. These activities are related to the business functions. Users offer the main resources and capabilities that a decentralized platform needs. Three value activities are identified that are impacted by blockchain technology. Users must engage in value activities in order to create positive network effects. Therefore, multi-sided platforms focus on managing the resources and capabilities of users. The research outcomes identified a causal relation between economic incentives and positive network effects. Users need to be stimulated, with tokens, to engage in value activities. Users do not benefit from rating other users of settling disputes. Therefore, decentralized sharing platforms need to provide economic incentives to individuals that contribute to the value network. The token system could be programmed to rewards these individuals. It is difficult to quantify the effectiveness of economic incentives, as decentralized business models are novel. The core value activity involves normal transactions between individuals. Furthermore, decentralized sharing platforms need to be open for external relationships. Collaborating with third parties is important for the offering of complementary services. This is known as horizontal differentiation, which is strategy that is relevant for both centralized and decentralized sharing platforms. Additional services could increase the value that users get from using the platform. Users become more inclined to use the services if these become more valuable. Therefore, collaboration with third parties is an important aspect of decentralized sharing platforms. Moreover, part of the income will be based on third party commissions.

Blockchain impact on finance domain

Decentralizing business processes of multi-sided platforms result in the elimination of transaction costs. The transaction costs are eliminated, because there is no longer a third party that is involved in the process. This cost reduction could be used to decrease the transaction fees that users pay to use the service. The revenue model for peer-to-peer multi-sided platforms is usually based on such transaction fees. There is some inconsistency whether transaction fees should be completely eliminated, because then the core revenues of the business model disappear. In this scenario, the decentralized business model should find new ways to earn income. From the research outcomes can be concluded that the transaction fees of decentralized sharing platforms are lower then centralized sharing platforms. However, the revenue model needs to ensure the viability of the business model. One suggestion to generate other income streams focuses on the offering of complementary services. This gives users the option to pay extra for complementary services, known as opt-in services. The opt-in services could be offering via third party integration. If decentralized sharing platform collaborate with third parties, these third parties could be charged with a commission. These two alternatives to generative income make the elimination of transaction fees for users a viable possibility. Moreover, the user retention could be higher when there are no transaction costs. This would help to create network effects more quickly. The tokens must be used in order for the business model to work. Therefore, payments with fiat currency need to be converted by the decentralized sharing platform to the tokens. This new intermediary role involves costs that need to be covered by charging currency conversion fees. In addition, this could be an extra incentive for users to purchase tokens, increasing the token utility. It is important to note that currency conversion fees are not profitable. Finally, decentralized sharing platforms need to distribute the tokens through an ICO. The distribution of tokens is a useful method to collect funds that are needed to continue developing the decentralized sharing platforms. Overall, the finance domain is affected by blockchain technology. The cost reductions could be used to improve the value proposition and new revenue models can be realized via opt-in services and third party commissions.

Decentralized business model design (to-be)

Table 10, presented on page 53, shows the decentralized business model that was designed for Peerby. The interview results distinguish the value proposition, business functions, value activities, collaborations and revenues to describe the decentralized business model for Peerby.

TABLE 9 – DECENTRALIZED BUSINESS MODEL FOR PEERBY	
Service domain	**Technology domain**
Value proposition ▪ Free cross-border payments ▪ Value distribution across users ▪ Low transaction fees ▪ Additional services	**Business functions** ▪ Conditional transactions ▪ Identity verification ▪ Reputation system ▪ Arbitration system
Finance domain	**Organization domain**
Revenues ▪ Payments for transactions ▪ Payments for value added services (B2C) ▪ Payments for third party commissions (B2B) ▪ Currency conversion fees ▪ Initial Coin Offering	**Value activities** ▪ Transactions ▪ User rating ▪ Dispute settlement **Collaborations** ▪ Integration of third party services

Stress factor identification and selection

During the interviews multiple stress factors were identified, relating to technology, market, society and regulation. Interviews results revealed that all four trends and uncertainties relate directly to blockchain technology. Three stress factors were selected to keep the business model stress test workshop organized. The selected stress factors relate to trends and development in market, society and regulation. To bring contrast in the findings, each two outcomes per stress are included in the business model stress test workshop. The stress factors and stress factor outcomes were presented in an overview in Table 11 on page 56. The first stress factor relates to the societal trust in blockchain technology. The two outcomes were described as weak trust in blockchain technology and strong trust in blockchain. The second stress factor relates to the market speculation on token value growth. The two outcomes were described as instable token value and stable token value. The third stress factor relates to the regulatory environment. The two outcomes were described as restrictive regulation and supportive regulation. The stress factor that was not in the business model stress test is still relevant for decentralized business model. The interview results revealed that the technological development of blockchain technology is uncertain. Blockchain technology is still highly inefficient in the verification of data, compared to a centralized database. It is predictable what the impact of technological development will be on decentralized business models. If the efficiency of blockchain technology does not increase, it will be difficult to decentralized business processes of multi-sided platforms.

Business model stress test

The business model stress test workshop resulted in the creation of a heat map. Appendix G presents the heat map that was made during the business model stress test workshop. After processing of memos and audio recordings, the heat map was processed in Excel. Figure 21, presented on page 57, presents an overview of the heat map results.

		Selected stress factors					
		Societal trust in blockchain (S)		Market speculation with tokens (M)		Changing regulatory environment (R)	
		Weak trust (W)	Strong trust (S)	Instable token value (I)	Stable token value (S)	Restrictive regulation (R)	Supportive regulation (S)
Business model components	Value proposition (V)	VSW-1 VSW-2 VSW-3 VSW-4	VSS-1 VSS-2	VMI-1	VMS-1	VRR-1 VRR-2 VRR-3	VRS-1
	Business function (B)					BRR-1	
	Value activities (A)	ASW-1 ASW-2 ASW-3	ASS-1	AMI-1 AMI-2	AMS-1	ARR-1	
	Collaborations (C)	CSW-1	CSS-1	CMI-1	CMS-1	CRR-1 CRR-2	
	Revenues (R)	RSW-1 RSW-2	RSS-1 RSS-2	RMI-1 RMI-2 RMI-3	RMS-1	RRR-1	

FIGURE 21 – HEAT MAP RESULTS

The **service domain** cannot be feasible with two stress factors outcomes. The heat map revealed that the value proposition is neither feasible nor viable with negative stress factor outcomes. All positive stress factor outcomes affect the value proposition, but have no negative implications on this business model component domain. When society has no trust in blockchain technology it will not be possible to deploy the value proposition in practice. The transparency is not realized and value distribution across users is hampered, because using the platform is perceived as risky and the benefits for users are inconsistent. A restrictive regulatory environment makes the value proposition not viable, but it could contribute to the understanding of blockchain technology. Therefore, regulation could enhance trust blockchain technology, which can actually make the value proposition both viable and feasible. Users will perceive the services of Peerby as risky as long as society has no trust in blockchain technology. The reputation of Peerby could mitigate the impact of a weak trust in blockchain technology and contribute to the acceptance of blockchain technology.

The **technology domain** of the decentralized business model appeared to be very robust. The business functions of the decentralized business model are not affected by trust in blockchain technology or speculation on growth of the token value. The automated arbitration system, built with smart contracts, could not be viable if users have no trust in blockchain technology. However, conditional transactions and the reward system will be unaffected by the level of trust in blockchain technology. The other stress factor outcomes do not impact the use of smart contracts to decentralize business processes. The heat map does show that restrictive regulation could hamper the use of decentralized business functions. For example, regulation could restrict the settlement of disputes by users.

The **organization domain** comprises the value activities of users and collaborations with third parties. The negative stress factors outcomes have a negative impact on the value activities. Weak trust in blockchain technology, volatility of the token value and restrictive regulation all make the value activities not viable. Instability of the token value could even make this business model component unfeasible, because users will not use tokens. When users received fluctuating rewards, they will also be less inclined to engage in value activities. Token will be hold by users, because they would also speculate on the growth of the token value. The accumulated stress factor results showed that value activities are the least viable. Moreover, the negative stress factor outcomes would make collaboration with third parties not viable. Weak societal trust in blockchain technology and instable token value cause barriers for third parties to collaborate with Peerby. Third parties would be more inclined to collaborate with Peerby when there is strong trust in blockchain technology and the token value is not volatile.

The **finance domain** is not feasible as a result of all stress factors. The revenue model appeared to be the least feasible. The colour pattern across the heat map revealed a relation between the service domain and finance domain. The relation between the service domain and finance domain is important to address. The revenue model is based on the value that is delivered to the users of the decentralized sharing platform. Peerby will have no sustainable possibility for Peerby to receive income, if the value proposition is not feasible. The revenue model is most susceptible to the negative outcomes of the selected uncertainties. All three selected stress factors could result in a revenue model that is not feasible. Weak trust in blockchain technology and restrictive regulation limits the possibility of an ICO. Tokens must be distributed through an ICO in order to be used by users. Tokens must be used to make these valuable for users. It is not possible to create positive network effects if the token has no utility. Therefore, the business model will be not feasible when there is no possibility to do an ICO. Furthermore, the revenue model is impacted by value activities of users and collaborations with third parties. Respectively, the payments for value added services and third party commissions would not be feasible and generate no income for Peerby.

Overall, the business model is very dependent on the trends and uncertainties in society, market and regulation. The viability and feasibility of the decentralized business model is determined by the outcome of each the stress factor. The positive stress factor outcomes can have favourable implications for the business model. The stress factors could contribute to an optimal implementation of the decentralized business model. The results of the business model stress test workshop reveal that strong trust in blockchain technology and stability of token value is very important to make the business model viable and feasible. Both stress factor outcomes contribute to the revenue model, as users receive more value from the service and perceive less risk. The value activities and collaborations can also be positively impacted by the stress factors. However, negative stress factor outcomes will make the intended value proposition, value activities and revenue model not feasible. Moreover, the other business model components would not viable. The business model stress test results revealed that the decentralized business model is not very robust. Using blockchain technology to innovate peer-to-peer multi-sided platforms hampers the viability and feasibility of the business model. It can be concluded that the decentralization of peer-to-peer multi-sided platforms is not future-proof.

5.2 Research implications

The identified knowledge gaps are used to discuss the academic contributions of this research (5.2.1). This research also has managerial implications for multi-sided platforms, which are discussed and used to formulate recommendations for Peerby (5.2.2). Next, societal relevance of the research is discussed by addressing implications of this research on consumption behaviour (5.2.3).

5.2.1 Academic contribution

Exploring how blockchain technology could be used as an enabler for business model innovation is a new approach to blockchain research. Many use cases of blockchain technology are being discovered. Token systems and smart contracts are state-of-the-art technological developments. No literature describes the relevance of blockchain technology for multi-sided platforms. This research presented the main implications of using blockchain technology to innovate peer-to-peer multi-sided platforms. Moreover, the viability and feasibility of the revised business model when affected by trends and uncertainties are explored. The technical capabilities of blockchain technology were compared with the characteristics of multi-sided platforms. The research outcomes revealed how the technical capabilities of blockchain technology could enable business model innovation. The main scientific contributions of this research are made to the combined fields of blockchain technology and multi-sided platforms. The need-driven approach structured this research to analyse how blockchain technology could be used by multi-sided platforms that benefit users. Literature on multi-sided platforms extensively shows the importance of the technical architecture and the platform governance. Prior research focused on platforms that were centrally organized. This research explored the technical architecture and platform governance of a decentralized sharing platform. The decentralization of business processes with smart contracts impact the platform governance. The interactions between users will no longer be managed by the intermediary, but by the logic on the smart contract. When a platform seeks to decentralize its business model it needs to create smart contracts that will manage interactions between users. These insights contribute to existing literature on multi-sided platforms as this research explores a new governance structure. The smart contracts can have implications for the different dimensions of governance that were described in section 2.2.5.

The knowledge was created through semi-structured interviews with experts and a business model stress test workshop. The semi-structured interviews contribute to both fields of research. Theoretical knowledge on blockchain technology was combined with business model innovation research to develop a list of themes and questions. During the interviews novel applications of blockchain technology were discussed that are in a very early stage of development. The relevance of blockchain technology for multi-sided platforms is made explicit during the interviews. Furthermore, the experts represent international perspectives on this research topic. The in-depth knowledge that is created contributes to the future of multi-sided platforms that aim to increase the utilization of underused assets and understanding of decentralized sharing platforms.

This research offers a new perspective on business model innovation by designing a decentralized business model. This decentralized business model does not build upon the work of other researchers, because there are no published scientific articles on the decentralization of multi-sided platforms. Therefore, it can be argued that this research takes a novel approach to business modelling research by exploring how blockchain technology could enable new business models for the sharing economy. This research field is introduced as business model decentralization. Research on business model decentralization compliments literature on business model innovation. Furthermore, this research contributes to literature on business model tooling, by applying the STOF business model ontology to design this business model (Bouwman, Faber, Haaker, Kijl, & De Reuver, 2008). A research agenda on business model tooling describes how the STOF business model ontology was progressing in different directions (Bouwman, et al., 2012). Moreover, the business model stress test method was used to structure the process that helped to determine viability and feasibility of this business model (Haaker, Bouwman, Janssen, & De Reuver, 2017). The business model stress test workshop turned out to be a practical method to evaluate the business model robustness. Moreover, the practicality of the STOF business model ontology was made clear during the interviews. The interviews used the STOF business model ontology to guide the discussions. The descriptive STOF business model framework proved to be a useful tool to analyse and design a business model.

The limited number of interviews hampers the generalizability of this research, as well as the case study design that is characterized by a low external validity. However, based on the literature research and the research outcomes some generalizations can be made. During the literature review on multi-sided platforms, a research scope was determined that focuses on multi-sided platforms within the sharing economy. Therefore, the data was collected from individuals with expertise on two types of peer-to-peer multi-sided platforms. These peer-to-peer multi-sided platforms facilitated the sharing of goods and services. These peer-to-peer multi-sided platforms do not facilitate the transfer of ownership of goods. A transfer of ownership through buying and selling of goods, rather then lending and renting goods, characterize peer-to-peer goods trading platforms. This difference is significant for the type of users, but the business model is vastly similar. Therefore, a generalization of the results could be made to peer-to-peer goods trading platforms. Moreover, these research outcomes can be translated to different industries including digital marketplaces. Although, this research focused on Airbnb and Uber, a generalization could be made to peer-to-peer goods trading platforms like eBay. The ways that individuals interact is similar. The same applies to business-to-customer multi-sided platforms, like Amazon. The intermediary facilitates transactions between companies and customers. Digital marketplaces like eBay and Amazon incur the same data verification costs from their intermediary role. The automation of business processes through the use of smart contracts could be equally beneficial for digital marketplaces that facilitate trading of goods. The research outcomes that would be applicable to such digital marketplaces relate to the conditional transactions, automated identity verification, reputation systems and dispute settlement. However, arbitration between individuals is less complicated for such multi-sided platforms, because goods do not need to be returned to their previous owner. Consequently, there is no need for a complementary service like goods insurance. Moreover, the elimination of cross-border payments could be valuable for any multi-sided platform that facilitates interactions between individuals from different countries. The revenue model of a decentralized sharing platform needs to be revised, as payments for transactions will no longer be a sustainable revenue model.

This research provides a fundament for decentralized business model for future research to build upon. This fundament contributes to a novel field of research on blockchain technology and multi-sided platform within the sharing economy, which can be referred to as 'business model decentralization'. The exploration of business model decentralization concludes the main scientific contribution of this research.

5.2.2 Managerial implications

The research outcomes contribute to the future of the sharing economy. The sharing economy drives from multi-sided platforms that increase asset utilization. Network effects could be realized s the value proposition of multi-sided platforms improves with blockchain technology. This research has shown that decentralized sharing platforms offer benefits to its users. The Chicken-and-Egg problem of multi-sided platforms could become less difficult to overcome when multi-sided platforms use blockchain technology. The improved value proposition makes it more attractive for users to transact via the platform. This could contribute to the realization of positive network effects, which is required for a multi-sided platform to scale.

The problem owner of this research is the peer-to-peer multi-sided platform Peerby. This research aimed to describe how blockchain technology could be used to revise the current business model of Peerby. The research outcomes help Peerby with its long-term digital transformation. The results of this research help Peerby to develop a whitepaper. The interview results and the decentralized business model are fundamental for a whitepaper that describes how Peerby intends to use blockchain technology. The value proposition of Peerby can be improved by decentralizing business processes. This would help Peerby in the acquisition of users. The elimination of data verification costs allows that Peerby decreases the transaction fees, which will increase the rate of retention. Peerby and other peer-to-peer multi-sided platforms can use this report to develop a blockchain strategy. Using blockchain technology to facilitate transactions between individuals requires a token system. Network effects can be realized as long as individuals use the token. Decentralized sharing platforms distribute tokens through an Initial Coin Offering, by selling the tokens to users. It is important that the tokens are distributed and an ICO helps the multi-sided platform to collect funds. These funds are required to continue development of the platform. Overall, the interview results revealed that blockchain technology could be very valuable for a peer-to-peer multi-sided platform like Peerby.

Multi-sided platforms can exploit this knowledge for business model innovation and realize competitive advantages. However, the decentralized business model also appeared to be not viable of feasible when confronted with negative stress test outcomes. The evaluation of the decentralized business model gave insights that suggest that blockchain technology is not ready to be used to innovate business models. The business model stress test results revealed that three stress factor outcomes make the business model not feasible. This means that one of more business model components need to be changed before it can be implemented in practice. The literature review on multi-sided platforms described how multi-sided platforms are able to grow and realize positive network effects. Trends and uncertainties in market, society and regulation hamper positive network effects. It can be concluded that it is too soon to use blockchain technology to decentralize business models. There are implications of using blockchain technology, or another information system, as a driver for business model innovation. One of these implications relates to the approach to the business model innovation research. A need-driven approach is important when the potential impact of new technologies on business models is explored. This ensures that the technology is only used for practical reasons that benefit the users. Using a technology to innovate business models starts with a real problem that requires a solution. This research showed how blockchain technology could be used to provide a solution for data verification costs that multi-sided platforms incur. Peerby incurs approximately fifty to seventy percent of one euro for each transaction. The decentralization of the business processes, and thereby decentralizing parts of the business model, eliminates data verification costs. The impact of this solution depends on the size of the multi-sided platform. The data verification cost decrease with increasing interactions between users. The implication for Peerby regarding this practical problem is marginal, because Peerby is a relatively small multi-sided platform. Large multi-sided platforms like Airbnb, Uber, eBay and Amazon would have much larger financial benefits from blockchain technology.

This research did not reflect on the actual digital transformation from the “as-is” business model to the “to-be” business model. There are different challenges that Peerby needs to overcome before implementing blockchain technology to automate different business processes. The two main challenges relate to raising funds to continue the development of the platform and realizing network effects from acquiring enough users that frequently engage in value activities. This digital transformation should start with a roadmap that shows users and investors how Peerby intends to decentralize its business model. The roadmap includes different milestones. Important milestones are the whitepaper publication, sale of tokens through an ICO and moment that users can use the services of the decentralized platform. The content of the whitepaper can be derived from this research, by describing how Peerby intends to use blockchain technology to benefit its users. It might be difficult for Peerby to innovate through a digital transformation. One of the companies that participated was in a similar position as Peerby and decided to establish a new company that was decentralized from the start. The migration of users happened through collaboration between the "as-if" and "to-be" companies. This example illustrated that this decision might be more cost-effective. It can be argued that Peerby should not pursue business model innovation by means of blockchain technology anytime soon. Peerby is a start-up that is currently not profitable, as the platform is still under development. Using blockchain technology as a driver for a digital transformation requires financial resources that Peerby does not posses. The development of a whitepaper is the first step in the digital transformation of Peerby if they decide to decentralize their business model. Peerby could decide to distribution of tokens through a private sale with selected investors in case policymakers decide to prohibit ICOs.

5.2.3 Societal relevance

This research could have positive implications for the sharing economy. Giaglis & Kipriotaki (2014) stated that the entire economic system could be affected by blockchain technology. The technical capabilities of blockchain technology have positive implications for multi-sided platforms. Research shows the advantages of a sharing economy that is characterized by sharing of underutilized goods (Ellen MacArthur Foundation, 2015). Multi-sided platforms empower users to engage in more sustainable consumption behaviour. If more multi-sided platforms within the sharing economy understand the relevance of blockchain technology, they could decide to decentralize their business model. Consumers receive value from utilizing goods, rather then owning them (Chase, 2015). Blockchain technology could be used to improve multiple business model components, including the value proposition, cost structure and revenues. Therefore, users of decentralized sharing platforms could become more inclined to adopt the platform, which increases utilization of underused goods. Therefore, decentralized business models could stimulate sharing of underutilized goods. It can be argued that this would contribute to consumption behaviour of individuals. Other implications would relate to the environmental impact of consumption and productions of goods, as people buy fewer goods.

5.3 Research limitations

Concerns of case study research include low generalizability, lack of rigor, inability to replicate and subjectivity of the researcher (Cunningham, 1997; Yin, 2013; Sekaran & Bougie, 2016). The case study results from the semi-structured interviews and business model stress test completely depend on the insights from interviewees. This makes the research difficult to replicate. It is possible that the research outcomes are very different if individuals from a different background participate in the same study. The interviewees were selected based on the research scope. The research outcomes are based on peer-to-peer multi-sided platforms within the accommodation or transportation industry. Most interviewees were C-level executives or advisors for a decentralized sharing platform. Only one individual was interviewed that played no role at a decentralized sharing platform. This interview results were based on interviewees with similar perspectives. The fact that interviewees had similar perspectives decreases the reliability of the results. Scheduling interviews with C-level executives proved to be time intensive, due the busy roles of these individuals and the different time zones. Only six interviews were conducted, due to the limited amount of experts and existing decentralized sharing platforms that were reachable. The novelty of blockchain technology also made it difficult to find suitable interviewees. Furthermore, the qualitative data analysis of the interview and business model stress test workshop can be influenced by subjectivity of the researcher. In addition to subjectivity, the researcher has incomplete recollection of the discussions. Audio recordings were used to mitigate these two limitations. A more specific limitation relates to the complexity of blockchain technology. It was difficult to identify dependencies between the components in the technical architecture without an educational background in software development. The technical architectures of multi-sided platforms are very complex. Therefore, the description of the blockchain architecture is limited.

The results from the business model stress test workshop restricted, due to time constraints. A selection of business model components and stress factors had to be made to keep the workshop organized. The results would have been more complete if a compete business model was confronted with more stress factors. The preparation of the business model stress test was very time intensive. This is partially due to the design of a decentralized business model that needed to be clarified to all participants of the business model stress test workshop. The impact of the stress factor outcomes was only addressed in a qualitative procedure, which made it hard to assess the exact implications for viability and feasibility of the business model components.

5.4 Suggestions for future research

The discussed limitations are used to make suggestions for future research. There are multiple aspects that should be done differently when this research is repeated in the future:

First, more data needs to be collected that incorporates multiple perspectives on this research topic. More interviews need to be conducted to increase the reliability. It has proved to be difficult to find individuals with proper knowledge. The experts should have knowledge about multi-sided platforms, blockchain technology and the sharing economy.

Second, research outcomes should be based on multiple data sources, not solely on semi-structured interviews. This list of themes and questions can be used as a foundation that can be expanded by in-depth questions about the technical architecture of a blockchain.

Third, the impact of decentralizing business processes should be quantified. This research has only qualitatively assessed the impact of blockchain technology on multi-sided platforms. A quantitative analysis could contribute to the understanding about the impact of blockchain technology on multi-sided platforms.

Fourth, the research can be translated to a broader context by including the marketplaces and financial industry in the research scope. The research explores how applications of blockchain technology can be used to innovate peer-to-peer multi-sided platforms in the accommodation and transportation sector, respectively representing goods sharing and service sharing platforms. It could be relevant to seek for patterns across different case studies with a different scope. Future studies could focus on other peer-to-peer or business-to-customer multi-sided platforms.

Fifth, a new business model stress test workshop could be organized with multiple groups. The results of different workshops could be compared to find derive new conclusions. The business model stress test workshop should include a broader perspective of trends and uncertainties that can be confronted with decentralized business model. Moreover, the complete business model should be stress tested, rather than a selection of business model components. This business model stress test workshop could give new insights regarding the viability and feasibility of decentralized business models.

The outcomes of this research helped to identify knowledge gaps that need to be explored in the future. A total of five suggestions for future research are derived from the research outcomes:

First, new platform strategies need to be explored as a result of business model innovation that is enabled by blockchain technology. Several studies argue that the strategy of multi-sided platforms is not fully guided by Porter's Five Forces model (Evans, 2003; Van Alstyne, Parker, & Choudary, 2016). The literature review showed that strategy of multi-sided platforms could be change from business model innovation. This research revealed that decentralized business models could create positive network effects by means of a utility token. Further research should be conducted to quantify the causal relation between a token system and network effects.

Second, a feasibility study could be conducted to explore when blockchain technology can actually be implemented by multi-sided platforms. This research explored the impact of blockchain technology on multi-sided platforms. A follow-up research could investigate the implementation costs of and the optimal extent of decentralization. This could be used to develop a framework that determines the extent of decentralization of multi-sided platforms that balances viability and societal contribution of the business model.

Third, different types of blockchain technology and consensus mechanisms exist. It would be valuable to address the impact of different blockchain types and consensus mechanisms on multi-sided platforms. The literature review revealed that blockchain types impact the level of decentralization, scalability and safety of the blockchain. Different blockchain types could have different implications on decentralized business models.

Fourth, other researchers could study the effects of decentralization on the governance structure of multi-sided platforms. This research revealed that decentralization or business processes has implications on the ways that users interact. The automation and decentralization of an arbitration system with smart contracts eliminates the multi-sided platform from this process. This means that users are responsible to settle disputes themselves and that the multi-sided platform has no direct control over the arbitration process.

Fifth, further research could analyse how the decentralized business model of Peerby can be improved to make it more robust. This research addressed the viability and feasibility of the business model. Following the analysed was concluded that the business model was not future-proof, but no insights were given on how to improve the business model.

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Appendix A – Platform governance overview

Dimen-sions	Mechanisms	Description	Source
Governance structure	• Governance structure • Decision rights • Ownership status	Centralized or diffused governance. Platform governance then entails how the authority and responsibility for each class of decisions is divided between the platform owner and module developers. Ownership declares whether a platform itself is proprietary to a single firm or is shared by multiple owners.	(Nambisan 2013; Tiwana et al. 2010)
Resources & documentation	• Platform transparency • Platform boundary resources	Documentation ensures easy understanding and usability of the platform. Transparency of the platform. Governance decisions concerning the platform's marketplace are easy to follow and understand. Application programming interfaces (APIs) for cultivating platform ecosystems through third-party development.	(Benlian et al. 2015; Ghazawneh and Henfridsson 2013)
Accessibility & control	• Output control & monitoring	The platform governance pre-specifies the principles by which outputs are evaluated, penalized, or rewarded.	(Tiwana et al. 2010)
	• Input control • Securing	Controlling which products or services are allowed. Assess quality of services or products as a gatekeeping mechanism.	(Tiwana et al. 2010; Ghazawneh and Henfridsson 2013)
	• Platform accessibility • Process control • Platform openness	Who has access to the platform and are there any restrictions on participation? Who controls the process and is in charge for setting up regulations? Is the platform open or closed? Constraints: Technical performance cost of required equipment, and cost of selling.	(Benlian et al. 2015; Eisenmann et al. 2006; Tiwana et al. 2010; Tilson et al. 2010; Boudreau 2010)
Trust & perceived risk	• Strengthen trust • Reduce perceived risk	Platform enhances trust. Perceived risk of platform participants is minimized.	(Nambisan 2013)
Pricing	• Pricing	Pricing is depended on who is setting the price, who decides on participation, who is paying and who values.	(Bakos and Katsamakas 2008; Tan et al. 2015; Caillaud and Jullien 2003; Armstrong 2006)
External Relationships	• External relationship management	Management of inter-firm dependencies. Architecture of participation. Firm's ability to manage the relationships between its IT function and external stakeholders. The platform allows technical interoperability between other systems.	(Benlian et al. 2015; Tan et al. 2015; Selander et al. 2013)

Source: Hein, Schreieck, Wiesche & Krcmar, 2016

Appendix B – Interview protocol

Pre interview

- After the interview has been confirmed, send an informative e-mail about the research.
- The thesis report includes citations from the interviews. Permission is asked and given by the interviewees.
- The study is explorative in nature, which means that novel concepts are explored. This means that there are right or wrong answers.
- The interviewees were informed to receive a transcript of the interview. This gives participants the opportunity to make corrections by completing, deleting or changing information.
- Introduce the research topics and questions that will guide the interviewee in his/her preparation.

Conducting interviews

Introduction

- Give clear introduction that is the same way for all interviews.
- State the purpose of the interview, estimated time of the interview and relevance for both interviewer and interviewee.
- Sum up the topics that will be discussed
- Briefly mention confidentiality issues that might be experiences by the interviewee (e.g. name, information etc.) and tell that the information will be verified before it will be used in the report.
- Ask permission to use an audio recorder to tape the interview

Question sequence

- Begin with easy, low stakes questions to develop comfort
- Cluster questions to themes, where a general question is followed by increasingly specific questions.
- The interviewer must prevent to go lock step through the questions by being responsive to the statements of the respondents.

Interviewer responses

- Ask for clarification about something that has been said earlier in order to elicit greater detail from responses.
- Repeat answers of the interviewee to confirm correct interpretation.

Closing

- Before closing, a check is done whether all core questions are answered.
- The main findings are recapped and linked back to the purpose of the study.
- Interviewees are thanked for investing their time by participating. The interviewees are informed about the next steps.
- Permission is asked to contact the interviewee if other questions arise later, either per telephone of e-mail.

Post interview

- Send a mail to the interviewee, thanking him/her again for contributing to the study.
- Provide a transcript of the interview. Ask the interviewee to review the report and make corrections or comments if he/she wishes that changes were made.

Appendix C – List of themes and questions

Q1. Background interviewee

What is the background of the interviewee, company he/she is working for, and his/her role and responsibilities?

Q2. Blockchain technology

Underlying principles of blockchain

What technical capabilities of blockchain technology do you consider important for sharing platforms?

Decentralized applications

What is the use of smart contracts for decentralized applications?

What are decentralized application and how these differ from traditional web applications?

Q3. Business model components

3.1 Service domain

Customers and end-users

Who is the customer? Who will pay for the service?

Who is the end-user? Who will be using the service?

Value propositions and service offering

In what specific situation(s) would people want to use the service?

What does the service do for the customer of end-user?

3.2 Technology domain

Technical functionality

What (business) functions does the service require?

What is the global architecture of the service offering?

Applications

What user applications should be running on the technological system (e.g. communication, interaction, content distribution, transactions)?

How are customer profiles and privacy managed?

How is secure access to, and use of, services arranged?

3.3 Organization domain

Actors

Which business roles are required to create and deliver the service?

Actors' resources & capabilities

What are capabilities and resources that these actors can or should provide?

Which resources and capabilities are critical? Hence which actors are preferable?

Which actors can and want to cooperate and take up the business roles?

3.4 Finance domain

Cost

What is the cost structure of the service (e.g. investment costs, fixed costs and variable costs)?

Revenues

What is the revenue model behind the service?

Financial arrangements

How are investments, costs and revenues divided over the actors?

Q.4 Disrupting centralized platforms

Enabling ecosystem for sharing

What are the different uses of blockchain technology to enable a sharing ecosystem?

Coexistence of centralized and decentralized platforms

Can they coexist?

Competition with established platform monopolists

Possible? Effective? How?

Q5. Trends and uncertainties

What are the most relevant developments that may impact centralized and decentralized platforms (e.g. technology, market, society and regulation)?

Appendix D – Description of participating companies

- **Populstay** is a decentralized booking platform for home-sharing and vacation rental, based in Tokyo. The platform is a start-up that was found in 2017. In Q3 2018 the company plans to release its whitepaper that elaborates how it uses blockchain technology to offer better value to its users. The second half of this year the company plans to start a public ICO that raises money for the next two years to develop the business (Populstay, 2018). Its market entry strategy is focused on Tokyo and plans to expand its geographical orientation to Shanghai, New York, London and Paris by 2020.

- **WeHome** is a decentralized home sharing platform, based in Seoul, South Korea. The platform is a decentralized variant of its founding company, Kozaza. Kozaza has six years experience as market leader in Korea and started WeHome and released a whitepaper on blockchain technology for decentralized home sharing in May 2018 (WeHome, 2018). In Q2 2018 the company did a private ICO to raise capital for development of the platform. The market entry strategy is focused on both Korea and Japan and plans to launch the platform in ten countries by the end of this year. WeHome published a roadmap on the development of the start-up. This roadmap shows the plans relating to the development of the platform and how the company will expand to other geographical markets. In 2022, WeHome aims to be a viable home sharing platform globally (Jo, Kim, Cho, Han, & Kang, 2018).

- **Arcade City** is a decentralized peer-to-peer ride-sharing platform, based in Austin, Texas. The platform is a start-up, founded late 2015, that applies blockchain technology to differentiate its business model from established centralized platform Uber (David & Nayer, 2018; Arcade City, 2018). The entry strategy of the company focuses on the state of Texas, since Uber had to withdrew from this state as a result of US regulation (David & Nayer, 2018). Arcade City has a network of over 70,000 users and launched a proof of concept of its app that allows payments with cryptocurrencies. In Q3 2018 it plans to start a public ICO to raise funding that will be used to continue development of the platform and integrate third party services.

- **Chasyr** is a decentralized peer-to-peer ride-sharing platform, based in Fresno, California. The platform is a start-up that is founded in 2017 by a former Uber driver (Chasyr, 2018). The company has an entry strategy that is focused on the ride-sharing market in California and London. Chasyr plans to launch a public ICO later this year, however, they have not scheduled a date for the sale of their token. They are working on their whitepaper that explains the use of blockchain technology for their platform. There is no clear roadmap published by Chasyr that elaborates on their platform expansion plans.

- **HireGo** is a decentralized peer-to-peer car rental platform, based in the United Kingdom. The platform is a start-up that was founded in 2017. HireGo release a whitepaper the same year and currently works on development of the platform and mobile app (HireGo, 2018). The platform has done a public ICO between May 1st and June 30th 2018. The collected funds will be used to deliver a beta of the mobile app by the end of 2018 (Hussain & Bashir, 2018). The company has no clear market entry strategy to penetrate the market that is dominated by Uber. Although, it has a very deep understanding of its business model and how blockchain technology will be used to design a decentralized ride-sharing application.

Appendix E – Interview transcripts

Appendix E1 – Transcript interviewee 1

Background interviewee

I play essentially three roles at arcade city, I'm responsible for supporting all aspects of operations, which is how arcade city is going to do whatever it is claiming it's doing, so that's why I have the title of Chief Operating Officer. What that is about is finding funding, finding the right marketing, person finding, getting involved in all aspects of operations. My I also have a different role, which is I've traditionally done work which is in the innovation stream, half of the company. And these are things like product development, marketing, business development, process development, strategy, and that's my overwhelming bias. I'm responsible for scope that includes what I would call delivery rather than innovation. I separate the company to delivery and in innovation and delivery has things like supply management, manufacturing, or production, customer service, selling, selling my view as delivery versus marketing, which is fine markets and partners and messages, but I think it was innovation. So I'm the Chief Strategy Officer in that regard. I'm working as an advisor and the entity is interestingly decentralized. It was at least four or five levels of decentralization, I consider myself to be part of the core team, which is nine key full time people and it goes out to about production, if you exclude some part time people. The next level is about, people who were doing software development and other things like that, and then it goes out to about and stakeholders. If you look at community managers and other pieces were but those people are largely funded by the activities within their piece of the decentralized organization.

So Arcade City is a combination of three different things. First, platform cooperativism, which is valuable to understand. It has it a convoluted name. You could think of it as co ops or cooperation, but it's cooperativism because it's named after something specific. That is using a piece of technology to get a group of individuals usually spread out in some physical way to participate together in some joint activity. It can be a marketplace. It can be a company, or project, and it involves a means of socially organizing, politically, organizing, though the arcade city platform serves as a platform cooperativism mechanism for ride share, ensuring a economy participants to organize around each other. And that does not require a blockchain that could be done with a centralized app.

Blockchain technology

There are definitely pieces of using blockchain that are useful for Arcade City. They're particularly useful for some of the ways the cooperation happens in the blockchain. They're useful for engaging in involving other members of the sharing economy. They're ways to establish trust and reputation that are I think superior to some of the other means. That's not to say that the sharing economy couldn't involve trust without blockchain. Airbnb is a very simple third party means of verifying trust and reliability. The difference with the blockchain is that it doesn't require a third party, it can be genuinely peer-to-peer. It can genuinely be impossible for a state actor to step into the middle of and then interfere with it. There are nine characteristics of the blockchain. We are interested in most of them but are currently limited by the ability to implement a large platform in a blockchain.

For example, drivers, one of the programs we are looking at but is not currently implemented is that drivers paying a fee for operating software, this fee is converted into tokens. So they're essentially buying tokens and buying the space in participating in the community. He can include risk if their behaviour like consensus within the community. Proven by blockchain and smart contracts them forfeit their rights to operate within the community. So if their ratings or their characteristics are the consensus is that they're not part of the community. They're dropped out of participating and their stake is sold for the benefit of the community. So they put something at risk. That means they're data verification speeds available for the community, because there was cash involved in that, that there's also reward for loyalty and reputation and then in the measures of trust ability. There's at least four dimensions to that there's only been part of it, the size of your stake and the reputation that you've had in the interactions, you've had with people and then the kinds of behaviours and activities, you're actually engaged in whether those involved risk or not or they will you know what role do you want to take on. Those are all traceable and what I described to you or things that some are implemented some or not.

Arcade City is a peer-to-peer ride sharing platform that also involves other elements of the sharing economy. It is focused on empowering the drivers and riders and municipalities that they operate in to cooperate with each other, locally. The driver controls their decisions about who and where and what they do they do they drive the writer also controls who and what and where they go. Those are done by permission and consensus between those parties and because there is no central ownership of that exchange. We believe that it facilitates cooperation with the municipalities as well to solve transportation issues that are key to the locality like solving parking solving congested grows the solving peak usage issues. Our general orientation is be more cooperative with cities, rather than Uber who comes in and having disputes with them.

We are happy to see a truly peer-to-peer blockchain implementation. When using blockchain to decentralize platforms communities are no longer subject to people in the foundation making choices. That could cause somebody or some entity earning million dollars. So there are central players who have extreme authority and while the block chains are being rolled out even the Bitcoin blockchain, which is considered more decentralized, it doesn't have a foundation that has magical powers. It still has issues around truly empowering decentralization, but I find it to be much more decentralized. Arcade City has a lot of characteristics in it, which are centralized we are we are building the app and the server, the piece of the app is quite centralized of the transactional throughput, the technology needs. Many of the decisions are decentralized. Like who you decide you want to get in your car or not, and what price you want to pay left as a decentralized decision. And that's the way you have to think about it. There are other pieces, which are we not going to decide about. For example, how you operate your car and whether you're a compliance laws. We want you to be in compliance with the local laws, yes, we are not going to participate in your commerce unless you can demonstrate to us that you're meeting the local laws because we don't want to break the local laws. If you can demonstrate your operating within the local laws, then we'll turn on other aspects of software, which may or may not engage us in activities, which need to be properly licensed locally. And I believe that's a pretty unique feature as well for our city.

Value proposition

I think there are a couple of things about us that are quite different. How we make money is another example. And I'm happy to talk about that as well. Companies must be consciousness about what's centralized and what's being centralized. The group that is here in Austin is running their own community. We participate and have access to their Facebook page, but we don't tell them what to do. They reach to us because we have experience in organizing their community, but they that community organization is left up to them. If they do not need basic fairness principles that we said, we will not turn on characteristics of our software for them, they will operate and if they go so far as to do things which are truly break our principles, we will not permit them to use our brand. This is something that we can do so will determine their brand ability that they'll still operate as they want to operate. They don't necessarily have access to all our software, but they could set up a Facebook group and connect with each other, you know, that that's completely independent of us, it is truly decentralized. We are a centralized provider of the software of the platform, and that will evolve. There will be key pieces of the software that are open source and available for people to plunge in and out by design and API systems so that people can plug in and out and join our community.

Reputation system
There is by design the intention to have the reputation and the key participant pieces of who's safe and is not safe in the community to be part of the blockchain. This is again not connected to our authority and how you behave in terms of representing yourself and caring for your own activities and being responsible for them. We want to be transparent and part of the watching not part of us deciding, you're good or bad, right, we're not to sit in judgment of you. We're going to let your own behaviour determine your reputation. There are services that we sell. For example, there are third parties that verify your identity. And there's third parties at verify that you have a commercial driving license. Those are services that we provide into the network, but they provide verification and we know who the third party verifier is.

So every, every participant in the community that is engaged with another person has the opportunity to rate that experience. The experience is rated, not the person. For example, you and I are having a discussion. Now I can rate the discussion. I don't know that I can rate who you are, I can rate them how I received the discussion, exactly. The platform allows users to look in the history of everybody's interaction. You rate every transaction that you've had, and compare your rating of those transactions to other people who've also rated the same people in similar transactions. So if you've rated five drivers, it's a rider and everybody else is also rated those five drivers, I have the community's ratings, and I have your ratings, and I can see you if you have a distinct bias or not. You may be what I call the grumpy judge. Everybody rate everyone else versus your peers. That is a characteristic of your rating, which I didn't measure and try to present as part of you. I invite you into my cab. I can know that historically, you under review rate people. I did also know that that may or may not penalizing, but if the encouragement is for you to be aware of your biases and know the effects of them. I can also measure whether you know female drivers scare you, whether you don't like to go to certain neighbourhoods, or all of those places to be measured by your behaviour. The degree to which we allow those biases to be visible and not is still an interesting game problem.

We are building our own reputation system. There are third parties. They look very interesting. Enhancing third parties is probably the way to go in the short term. We may do something else. The particular reputation system we think is very important to build trust and safety insurance. You know, as if I'm rating you as a driver, I might I care about whether you showed up on time, it's probably the most important thing tradition. I care whether I feel safe in your car, I care whether the, the price we negotiated was fair or not. That's between you and the driver. So that is a characteristic we want to measure.

The non-reviewing characteristic will be shown as part of who you are. There is an opportunity to see proof-of-location and proof-of-interaction. Using Internet of things for some of those is interesting, but it would be done by third parties. We looked at people who are interested in that there are services in the vehicle which are interesting drivers have wanted to have additional fix.

You can think of Arcade City as a software provider, yes, it's also an analysis engine. We're also doing training. So we're helping the participants in the ecosystem learn. We also provide community development and best practice sharing. Those are just different roles. So this can you think of us as having four or five different goals that can change over time.

Blockchain role

The reason why you want to do some things in the blockchain is you take that central state power away from certain pieces. You want to decide carefully what you want to do that with not because we would like to be in a safe world of necessarily one black economy and Silk Road happened. If driver is in dispute then we may use power to change or fix things, you need stabilization in the economy. And with sufficient rating level when we think it may be valuable to have those decentralized operators, right. If you can get a full by on your side to say this was just an unusual circumstance, I have a flat tire. And it's not that I'm a terrible driver. Yes, it's useful to be able to have them edit reputation and do things like that, yes, that's perceived to be their role.

There are different municipality and legal entities that exist within the driver populations. There are entities that exist within the driver populations, which are guilds. There are individual drivers who have different reputations. There are writers who have different reputations in roles. So not only can you write me notes in the white paper and see them show up, you can actually find me on that there's a there's a level of transparency there and you'll see me as a person. That has nothing to do reputation and has nothing to do with what whether I legal or not legal. An additional service can be the option to let people chat with each other and I can arrange a ride to the airport Saturday. The next the premium service as well I'm going to allow you to check my reputation on allow you to process your credit card through the app right those services that are involved in commerce, we need to make sure that they're it's your property legal and we're going to sell that as a premium service as opt-in premium services. These are third parties. The organization that verifies that your ideas correct in that you don't have a legal convicted felony history those services we can sell their third party verification to you. There's an API, where they can engage and you can you can get a certification through even prove your certification as a scuba diver instructor and you can include that in your driver profiled when you have all those services available. The third party that verifies that sells that service and we provide them access to sell that service the driver benefits from seeing it.

Enabling ecosystem for sharing

We've had a couple of other sharing a ton of people reach out to us and say you have people miss reputation in the raw material common why not be involved in sharing the stuff. We provide there's a handshake of API's. This participation allows the platform to scale and reduces costs. So there are definitely programs assets government we could offer to collectively build things. We collectively can engage getting a better credit card processor and its original take some of the statements. Yes, and we're constantly looking for that as we gain scale.

Revenues

Then we've had just opt in fees, where people are drivers have asked us to build something and they're willing to pay for it at the world. So we're separating fundraising and investment in development in the community, which is the private sale of tokens. From the purchasing of tokens as a sort of liquidity asset is the token as a utility token. It does have value. So, it is something that could be bought and sold. That's secondary characteristics. So you don't pay for rides with tokens. Although you can you pay for rides with any means that makes sense for paying for it. So we're completely indifferent how you want to pay for the right.

Token system

The token is valuable for stake, holding, voting, reputation and other characteristics. This reputation scoring is part of it. The staking is part of this. We believe that riders also need some staking. We're not clear about how it will work. And now it doesn't boil down to that decision. We think, first, to some extent, municipality to need stake in the platform. We want to support the progress and if we by consensus of the stakeholders involved in the microbus program. If these stakeholders are not acting, the smart contract will take the tokens away. Of course we're all going to play a stakeholders and voting system and that's one thing that we haven't talked about yet. There is no municipality yet that wanted to participate in that.

You're being as a fee for community and if you may have a place to digitally messy, they'll charge you an extra fee. They hold your credit card and you've agreed to End User License that allows them to charge you money. They're using a centralized power fiat system for causing you to behave well. Decentralized platforms can do this by a consensus-voting algorithm to arbitrate a conflict. Or we could use local communities who are not involved in it, like the guild. And one of the reasons we require drivers to belong to guilt because we want to local community, the arbitrary issues for the drivers. We don't want Arcade City to have responsibility for the people want to feel that responsibility for the so to this people there bill because that is a manageable problem. Yes, okay. Right. And we want it to be more than one person because groups are, the more effective. We don't know until marketplace is going to whether those kinds of decisions are stable. That's why it's very hard to completely finish the token economics piece of it.

In that regard, you can even hypothesize the token system could act as a form of capturing different values and you want it to be transparent, traceable, immutable and permissioned, based on exploitative and measured true merit and reward through merits.

Trends and uncertainties

There are three or four interesting trends. Uber has a billion of investment and they haven't made any money and they've been very aggressive about capturing market share and about transforming and making their ride sharing economy. In many ways centralized platforms have been clumsy about it and they've been inspiring. You have to see both things. Then there are things that they do, which I think are absolutely terrible and that's part of a values problem. There are a couple of characteristics. They've been pulling out markets and I think you can measure which markets they pull out a very easily because they function as a profit making entity that's trying to make money for themselves and they're very self focus for me as their own. When there are plenty of riders and drivers around, the platform will drive the prices down in order to try to capture market share.

We really need the blockchain capabilities to come along in terms of transactional throughput, just a time delay basically, and some of the other features. We need two to four million dollars more investment in the software. We need three to six months for the blockchain software to continue to develop and all the players that are available in that do you integrate our platform with their platform. We need to continue developing these social human sides of these decentralized organizations, which is to build coops and support the communities locally operating the pieces. And we believe that quite straightforward and we know how to do that. Yes. And, and there are some legal pieces that need to get worked out. Also, right. They're relatively straightforward. And in terms of market uncertainties, Arcade City plans to disrupt both the economic and social equilibrium of markets. By coming up with a model that genuinely rewards merit it will disrupt centralized platforms, which don't necessarily follow merit.

Coexistence of decentralized platforms

Decentralized sharing platforms can coexists in the future. There are different first movers in the world of decentralized platforms. Arcade City has an advantage if it is smart about being open and adaptable, and using the innovation and willpower of other people in a respectful way.. And I think the player is low cost and flexible and cooperative. The intention is not to monopolize if the intention is to empower all the other innovation as soon in. I see that as a distinctly different mission from Uber, which is a commercial company or intention is to maximize profits for our stakeholders. We taken on a lot of large investors who are very forcefully going to drive that model as opposed to, and we take it on think of hundreds of thousands of stakeholders, stakeholders supporting it's a pretty different concentration of ownership.

Cost

First of all it is important to know that blockchain is the most complex, clumsy way and running a database. Centralized apps and some of the other centralized in our more smarter ways to do certain things, and we will do them that way, rather than watching us watching for things which is useful. There are definitely frictions in the payment process. We look at the payment to be at least an 8 per cent cost. For a million transactions, you have to figure out a way to clump them, there's a lot of computing power in the, in the, in the instruments that people are carrying around, okay, and you can, this is, this is a classic problem that's already been solved at least four times in a major way through the history of computing that I've lived through. Succeed block in, which is a decentralized piece, which runs through this sort of terrible centralized mining process. There's a quality of mining, which is terribly centralized and have everybody competitively compete in the mining which I don't think is necessarily. Our token is fully mined, we're trying not to burn resources to do it, but there is a recording of it that you want to do efficiently and you do that by having block sizes of the right size and by having proof of stake and things which are less bad for the ecology. Some of the things can be done in centralized software. Some of it can be done in a private block chain and other things need to be transparent and what we've done in public blockchains and those may simply be keys of private information. So there are efficiencies there. If you have a million transactions, you can cluster them.

Competition with established platform monopolists

Obviously we we've talked a lot about all the economic incentives, including reward systems. I don’t even know that these advantages will disrupt established centralized platforms. We do not need, like other two-sided marketplaces, to achieve some scale in order to be successful. Arcade City is unique in that we don't need to do that at all. Our cost of customer acquisition is extremely low. Uber and the other players have already acquired million drivers out there. We only need to convert them one at a time, because they make more money on our app than they do on the other apps driving with mobile apps. So there’s absolutely no reason why they wouldn't add a more valuable app to their current portfolio and simply add us. The supplying side, drivers, brings the demand side, riders, to the platforms. Referrals are used to convert riders. More honest referrals are rewarded with more money from us.

For arcade city a unique driver wants to operate his or her own business and is prepared and trained to do that as an entrepreneur. That is not the average driver for Uber who wants to push a button work for a few hours and make some money. They're basically employees of the platform, until self-driving cars eliminate them. Arcade city drivers are entrepreneurs who are running a sharing economy business. It is likely to be a smaller fraction of drivers. So we're likely to be a niche player in some form or another. Will we ever get above referrals? That would be really interesting to see. And I think if we do it would be by economies scope. That's fine service offering. That's my read of that if you're asking it a strategist. Their intention is to simply survive long enough to go to autonomous vehicles.

Appendix E2 – Transcript interviewee 2

Background interviewee

We are planning to provide a service to global sharing with WeHome, because the platform will be owned by its users. It's based on platform cooperativism. When a platform is decentralized its authority is distributed among the community, focused on community ownership. I am the founder and chairman of the Sharing Economy Association of Korea (SEAK). This is an NGO that protects the user rights within the sharing economy. I received a PhD in computer science.

Blockchain technology

Platform monopolists dominate the sharing economy. Blockchain technology changes the rules of the game regarding competition with established centralized platforms. Blockchain has three layers that offer the capabilities: The first layer is the blockchain technology itself. The second layer is the token system and its token economics. The third layer is the governance. Blockchain technology can be an engine for the sharing economy, philosophically in terms of social values and economically. We approach the ways to disrupt established platform monopolies based on the philosophy of platform cooperativism. The sharing economy is by the people, of the people and for the people. The platform users create the value of a multi-sided platform. Therefore, the value should be evenly distributed to them not to the central platform.

Revenues

We tried to depend on the model of the centralized platform. They charge a high commission fee. Users get a lot of value from the community. A decentralized cannot charge any commission, because these platforms are open source that is imitable by competitors. A fixed commission fee is not a sustainable revenue model. A decentralized platform can charge exchange fees. For example, 4% for when paying with fiat currency like the US dollar, and 1% if you're paying with another cryptocurrency and it's free if you pay with the token of the platform. This is part of the revenue model of decentralized platforms.

Decentralized applications

Smart contracts can be used for different applications. One example is the cancellation of an order on a platform can be executed by a smart contract. In theory, every aspect of operations can be automated via a smart contract that is connected to a blockchain. All existing intermediaries, third parties, getting large amount of the money that represents the value comes from platform users. This is not good for the society itself.

Customers and end-users

Reaching a large amount of users is important for a platform. The network effects will only work if there are enough users. Decentralized sharing platforms have an advantage if they have market experience and a customer base from a centralized platform that already exist. The customers are the same as the end-users. These users are the same for centralized and decentralized platforms, because it only depends on the market not the business model. Decentralized platforms also need a proof-of-concept. Inviting the users with a credible reputation can help to test the new business model. There will be new actors involved that can benefit from the platform. These are the buyers of the token. The owners of cryptocurrencies do not need to be the end-user, if they don't want to use the service.

Value propositions

Decentralized platform allow that no fees are charged for transactions, legal support for users, transparent for local regulation, and supporting community ownership. Opt-in services are a significant factor in the future success of both centralized and decentralized platforms. Based on a reputation system, decentralized platforms will have community leaders that arbitrate disputes between users. The service is free for users. Charging commission to value providing platform users will no longer be a sustainable revenue model for decentralized platforms. Opt-in services can be offered to platform users, but also third party services can be integrated in the platform. The third parties can be charged with commissions, this is a business-to-business revenue model. These third parties do not necessary need to use blockchain technology.

Technical functionality

Trust is fundamental for a decentralized sharing platform. Blockchain technology can be used to costless facilitate the exchange of value between platform users. Therefore, blockchain technology is the driver of the sharing economy. The sharing economy is built around trust between peers and blockchain technology is means to realize this trust.

An identity and reputation system is effective as a result of policy and trust. Blockchain technology helps in these domains. The reputation of platform users can be stored on a blockchain. However, blockchain technology can provide most value to a platform by the application of smart contracts to decentralized the authority of the platform to local communities and use a token system. This token economics must be designed properly so the value of the token is stable. This prevents that people speculate with the token and rather use the token for its utility that is allows access to the service.

Smart contracts can be used to automate a decentralized arbitration system to settle disputes between users. Another application of smart contract can be used to automate the cancellation of orders without need for a central platform. If all the operations of a platform are decentralized and automated via smart contracts these platforms become decentralized autonomous organizations. The current payment system is replaced by the token system. The tokeneconomics are most important to make this system work.

Applications

Credential information of users will be stored on a blockchain. Other users could manage the user profiles and reputations. Payments are secured by blockchain, by using the token. The transaction data is stored on a blockchain. Blockchain is very important but the existence of decentralized communities with ownership of the platform is needed to make decentralized platforms work. This is critical for decentralized platforms to work over time. It needs to be managed locally, which will make the platform work autonomous, which relates to the platform cooperativism.

Collaboration between platforms

In the future there will be only platform in a market, because of the community. So multiple platforms in the same sector cannot exist. Network effects make it invaluable for platform users to multi-home. The users create and exchange value. Therefore, it is most effective is everyone uses the same platform where the network effects are the greatest. A blockchain protocol can enable a platform for the total sharing economy that connects different forms of sharing. Not specific for ride sharing or home sharing.

Competition with established platform monopolists

The decentralized business models can overcome the dominance of established platform monopolists. This is possible by the improved value proposition, reduced transaction costs and the empowering the users as they own the platform. This new business model will be able to acquire users from the established platforms.

Decentralized platforms can capture intangible values, like social values, with a token system. Economic incentives of the token system can be used to reward users that contribute to the platform. Users are rewarded with tokens for contributing. Making listing, for example, can be rewarded by the platform as it contributes to the total value of the ecosystem.

So it does not only capture monetary value, but other value as well. A token system is able to provide more than just monetary value, which is one of its essential characteristics. Intrinsic value of the token is important, because it has utility. For example, the utility resided in the characteristic that is gives owners access to the service.

Another characteristics, of a token system, aims to have incentives that ensures that the value of the cares remains stable. Users that purchase the token will be able to use the token without deflation of its value as a result of market speculation. The total tokens that are created by a decentralized platform should not be all distributed among users, because this will make the value dependent on the speculation within the market. Only some portion of the tokens will be exchangeable within the market.

Cost

The cost structure is most affected by the operations and marketing. By means of an ICO, selling the tokens, the platform can collect funds. This distributes the tokens among users and allows the platform to continue its development.

Trends and uncertainties

The regulatory environment changes rapidly. It is unclear how this will be in the future. Governments will try to understand blockchain technology and its use by learning from existing examples. The acceptance of blockchain technology needs time as society and governments learn about it. If decentralized platforms become decentralized autonomous organizations, the governance of these platforms is fully decentralized to the communities. These new ecosystems will have no problems with regulation as the users are in control.

Appendix E3 – Transcript interviewee 3

Background interviewee

AXVECO is a consultancy firm that focuses on sustainable innovation. Sustainable business models relates to the market position of a company after some years. This is a way of innovating that is strategically sound. Within AXVECO I am the Director Blockchain and Smart Contracts. Furthermore, I am a keynote speaker on these topics in the Netherlands and abroad. I have passion for exploring new ways to make things more efficient, cheap, fair. I believe in the philosophy of the sharing economy that focuses on pay per use, instead of owning something. For my educational background, I have Master of Science in systems engineering and BSc in aerospace engineering. After I started my professional career I got my MBA.

Blockchain technology

In the foundation of a sharing platform blockchain technology is not required. A decentralized sharing platform, however, does need blockchain technology. The blockchain technology provides three main capabilities: transaction of value, immutable storage of data and storage of logic. The storage of logic is the smart contract application. Blockchain technology can be used for these three capabilities without the need for an intermediary. This can enable a technological infrastructure of a platform that ensures safe use of platforms for things like value exchange or storage of agreements between users without the need for a central authority that arbitrates. The transfer of value, or value exchange, is facilitated by a token system, or cryptocurrency. This token system stores the pre-set rules of a certain agreement. For example, you rent something from me and we agree that you will pay a certain amount of value for that. The moment that we agree, automatically a smart contracts is created that holds the amount of money that we agreed upon. After the good or service is delivered, both parties have to verify whether this event happened or not. And after verification, the smart contract will automatically transfer the value to me.

Blockchain technology can be used to offer guarantees on value exchanges. Smart contracts allow processes to be automated by following the logic of rules that have been built in the contract. The contents of the smart contract are communicated to the users via the application interface by the frontend of the platform. The smart contract itself is stored on the blockchain-based backend. Processes can be automated without a blockchain by centralized platforms, but the value resides in the use for decentralized platforms. Automating these processes that no longer need for an intermediary, so peer-to-peer, result in much lower costs for the platform.

Decentralized applications

The end-user of a decentralized platform incurs no changes in how the platform is used. The backend of the application is the only thing the changes, in combination with other components of a business model like the cost that is just mentioned. Also the way data is verified is quicker and more secure through the consensus mechanisms. Both blockchain and the sharing economy are derived from an idealistic view. The early adopted are these idealists that see a better world where less is consumed and people collaborate. The mass of our society does not think this way. Traditionally, customers of a platform care about value strategy that focuses on product leadership, customer intimacy or operational excellence.

Value proposition

Decentralized business models allow that the initial end-user becomes a supplier of value too. The users can take up both roles. This already happens within the sharing economy, or peer-to-peer business models. Other industries where this did not make sense in the past this will become possible, such as the financial sector. For example, peer-to-peer loaning can be made possible by decentralization. This example requires trust among peers without them having to know each other. Decentralized business models can offer the same guarantees, as a traditional intermediary would bring. For a large proportion, the capital that builds large institutions comes from the people themselves. This begs the question: why would be run this capital through the intermediary that takes a large percentage of that capital in exchange for trust? From a technological perspective, the current system makes really good sense, because in the past there were no alternatives for this trust. We trust in a technological system instead of a third party, which is an intermediating company. The features that blockchain technology offers are often interpreted as becoming trustless. Trustless is an incorrect description for blockchain technology, because trust is still required for peers to interact. The trust is relocated into a different system.

Trends and uncertainties

Society has no trust in the technology. There are two factors that are the foundation of the trust uncertainties of blockchain technology. Every technology has a life cycle and also blockchain technology has to be discovered. This is something that we cannot change and have go through. There will definitely be more setbacks for the technological development, but over time blockchain becomes more efficient. The trajectory of blockchain can be compared to the beginning of the Internet. When Internet was new there was no one that wanted to leave their personal data on a website. Society had the impression that everything would be hacked immediately. This is the same world that we life in now when we look at blockchain. The second factor that does not contribute at all to the development of more trust is that blockchain is only associated with cryptocurrencies like Bitcoin and Ethereum. This contributes to the scepticism towards blockchain. This is scepticism regarding cryptocurrencies is not incorrect, because of the extremely volatile markets. When the technology is improved that it can guarantee a stable value of a currency.

One uncertainty in the domain of blockchain relates to the design of sustainable business models that have a viable revenue model. At this moment, many decentralized applications make money from speculating on growth of currency values. One of the biggest challenges for decentralized sharing platforms will be to build a sustainable business model.

Technical functionality

Blockchain technology enables peer-to-peer transactions. Two different types of transactions must be distinguished. For the sharing economy, conditional transactions are much more interesting than direct transactions. A direct transaction is where something is exchanged between two peers. A conditional transaction is the example that I gave earlier. It is the same as a direct transaction, but it has a condition built in. You transfer money to me, under the condition that I provide you with this service. If the condition is met, the money is released to me. This is what all the sharing economy platform do that use blockchain technology. These are indeed the decentralized sharing platforms. This application is valuable because platforms no longer need financial institutions. If 'multi' is defined as more than one, this description of a blockchain application is a called a multi-signature escrow.

The impact of blockchain technology on applications that platforms offer completely depends on future technological developments. One of the developments of blockchain is the creation of 'Self Sovereign Identity'. With this application people are in control of the data of their identity that they want to share with companies and platforms and governments. At this moment customers often share too much information with companies that don't have access to this information. The most striking example is why does a hotel require a copy of your passport. A passport contains much more information than the hotel needs. They only need to verify that you are the individual that you claim to be. Currently this 'Self Sovereign Identity' is being developed via blockchain solutions. This allows you to say when to give you access to personal data and when to block this access. The identity of every person would be stored on a smart contract that they control. The smart contract could have different categories that class the level of your data. For example a light, medium and heavy profile that serve different uses. If you interact with the government it could require access to your heavy profile. If you check-in at a hotel it could only require identification via the light profile.

Collaboration between platforms

We want to go to a situation where all different platforms collaborate. Not in way where all sharing economy platforms build a shared administration system, but in a way with the individual in control. This is one example of how blockchain technology could contribute to the future of the sharing economy. I have no idea whether this will work, but I think it is very good that the possibilities are being discovered. Identity is a very interesting concept. Only fifteen years ago individuals where not obliged to identify themselves. Everyone get a personal identity, under the condition that it is administered at the local government when you are born. If this did not happen, you officially have no identity. There are blockchain companies that work on this. Tykn is a company that looks into creating identities for refugees. People that come from a location that did not gave them an identity are enabled via blockchain to get a digital identity. This can include place of birth, but also your credentials like educational background.

Revenues

A platform must have, how thin it is, a revenue model. To keep the platform alive there must be some form of revenues. There must be revenues for maintenance of the platform, but especially for setting disputes between users. It is an illusion that if information is stored in a smart contract eliminates the need for arbitration. We can get a dispute because we disagree on the delivery of a good. No matter how much will be automated, disputes can always occur. If a dispute arises, something must be done to settle this. Arbitration, and establishing and continue the development of this, cost a lot of money. Where all sharing economy platforms should aim for, if they really do this for an idealistic point of view, these platforms should become not for profit businesses. This means that decentralized platforms should have a revenue model that is at least sufficient to cover the operating costs. It is also an illusion to think that in twenty years time everything that exists today is still good enough for customers. For example, people always want a new feature for an app. A problem of centralized platforms is that its supplying users are not allowed to make their own prices for the end-user. This is determined by the authority of the platform and makes the supplying users not users, but more like a semi-employee. From a capitalistic perspective, these decentralized sharing economy platforms are the most pure form of capitalism, because it strives for free markets. One concern is whether this does not lead to a race to the bottom. A completely free market always leads to imitation. Imitation leads to more suppliers. A market with more suppliers lead to lower prices until there is supplier that has enough money to set the price below the costs. Followed by capture of market share that will eliminate all competitors, which allows the survivor to drive prices back up. In free markets this is a continuous cycle.

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Background interviewee

I went to university study economics, Bachelor of Science in Economics, and did some IT qualifications at Cisco. After 10 years of experience I started with an entrepreneurial project. We were helping them with their decentralized ride-sharing platform and I started Chasyr last year in July with my co founder Tommy Marquez.

Blockchain technology

At the moment, you need to make sure that your users, both supply side and demand side, are on board. So that means that they have to have access to some sort of technological plugin. So at the moment, we are working on an iOS and Android app. Relating to cryptocurrency, we need to have adequate wallets and have arrangement with payment providers, like MasterCard or visa. Decentralized sharing platforms need to have a good method of exchange set up. This exchange allows users to convert cryptocurrency into fiat currency and vice versa.

The token system, as an application of blockchain technology, is important for a decentralized platform. One of the capabilities of blockchain technology, the transparency, is important for the token. Token systems can be used across borders without exchange fees that are paid to a middleman. The disintermediation of the whole process, similar to Bitcoin, involves no middleman or anything like that. Users can go purchase tokens directly without a middleman or central authority and use this token as well without intermediation.

Decentralized applications

We will have an app where you can plug into, and so on. We want to make sure that we're different in the sense that we're creating a decentralized ride sharing app for our consumers at the moment. The platform can equalize fees globally. Therefore, users end up paying lower fees than traditional methods. In a centralized system, like Uber for example, all users have to pay to make use of the services. Decentralized sharing platforms can reduce the amount that both sides pay. One of the things is that we want everyone to be open to this platform. So in terms of like the drivers coming on, boards, I reckon, come on board and then the actual tokens that will have been up no life boundaries, in terms of national borders. Blockchain technology enables sharing platforms in a way where they no longer need a middleman. A utility token enables us to do this. So thanks to blockchain technology, we no longer need to have central companies to act as a middleman. The business models of the future will be software protocols that are governed and owned by the communities they support. The focus of centralized platforms isn't on wealth distribution, and the business objectives are primarily geared towards pleasing investors and shareholders. This is the main thing was to centralize the economy. Decentralized sharing platforms aim to make sure that the users are actually valued, by distributing value more in proportion to where the value in a platform comes from. Decentralized sharing platforms need to determine how centralized they're going to be.

We can use a smart contract for things like guaranteeing a ride, for example. If you need to be picked up in Amsterdam to go to Schiphol Airport, you put that request on the app. Then you can have a number of drivers that could respond with corresponding rates. We have to look into the pricing. We're looking at dynamic pricing, fluctuating pricing and other pricing models at the moment. Users can get presented with a number of options, which are the additional opt-in services that a platform needs to provide to the different demands of users. If users accept the ride, the money then goes into a smart contract that gets held in escrow until the journey is complete. This multi-signature escrow is an important application of blockchain technology that can be used by sharing platforms.

Value propositions

One main characteristic of decentralized sharing platforms it that they can be focused on the supply side of the market, whom actually create value for the platform, rather than being focused on the demand side and concentrated on market share. Lowering fees is an important element of transaction costs and attracts more users. There is the possibility that decentralized platforms can still charge transaction costs, as long as their community, customer support, innovation etcetera is better than competitors. The token system can be built with economic incentives that contribute to loyalty towards the platform. We offer opt-in services for example, features where you can reward tokens to another user, app advertising and subscription. A reputation system is an important element of a well-functioning platform. A decentralized platform can use smart contracts to store ratings on a blockchain. One where they'll say I rate yours five stars and then post and say how good the users are. Reputation systems show things like user activity. Users can see all these rating systems before you wrestle request a ride for example. Why do you want to ride with so that's really good in that sense, and vice versa. So that functionality allows more choice and the motivation to be an active member of the community. We've got to have incentives for both sides to join the network. For example, rewarding users for creating value for the platform and lowering fees for users of the services.

Centralized platforms are driving the unit cost for driving really low at the moment. That is their main objective. And it's always competitive coming into a marketplace where and where they're trying to drive the unit price down. There are also other competitors, but prices are not the only aspect of platforms that has competition. There are also strategies that focus on quality and customer service. We cannot have a company that aims for ‘the winner takes it all’ model, because it involves a centralized business model. We cannot predict how the future will look like with decentralized platforms.

Token systems, or cryptocurrencies, can reach nations where there are people that have no access to a back account. People do not need a back account or credit card, only a digital wallet for currencies. This opens up new marketplaces that do not exist today, because the traditional economic system only allows people to engage in economic activity by using fiat currencies that require a bank to facilitate transactions.

Applications

Centralized platforms could be responsible for background checks to verify identities of their users. When blockchain technology gets adopted a lot of these checks can be automated via smart contracts that store data on a blockchain. Decentralized platforms can use zero knowledge proofs to verify someone’s identity without revealing other information about the individual himself. This will facilitate a great move to the decentralization. Users of the platform have access to their own data, that he can just submit an upload. The platform itself or other users would have no direct access, but it would achieve greater due diligence rather than contacting insurance companies doing this. So it allows us to be more decentralized. Today's purchasing administration of insurances involves a lot of processes and a lot of third parties. There are companies in Identity Management at the moment that use blockchain. These initiatives provide some individuals to control to protect their identities. So this decentralization will help reduce the cost for not just for the platform, but also for the end user.

Communities

You've got the platform, you get supply side and demand side. The actors in the network of decentralized platforms do not change. The hierarchy changes where local communities are empowered. Community managers, based on their reputation can take a leading position within the community. These users collectively can arbitrate disputes.

Trends and uncertainties

I mentioned before that a lot of people are not really ready to use blockchain technology, because how it's being projected by the media, like it could be a scam or it cannot be trusted. That's basically the ignorance of people that don't understand it yet. Decentralized platforms use technologies that allow many individuals to work together to reach mutually beneficial goals. That's the key thing, Facebook kind of does that for social networking. eBay does e-commerce. We do that for ride sharing. In order to provide this value offering to the platform users multiple goals need to be realized. There needs to be a true sense of community. Information should be available to the users, about the sharing platform, but also about blockchain technology. Communities are valuable because they are empowered to suggest new ideas. The key strategy to overcome social uncertainty with regard to cryptocurrency and blockchain technology is to educate the users of the platform. So there's a there's an element of education. We hold cryptocurrency educational meetings in order to raise awareness.

Now with smart contracts, decentralized applications are our new layer on top of that on top of the currencies, where it's just peer-to-peer transactions without a middleman. Now it will be peer-to-peer value exchanges without a middleman that it's not about not only about monetary value anymore. It's also about social value, for example. We just need people to get on the app basically and then give them access to additional services. We've been speaking to the app developers continuously. We need to know what we show users. These things can all be integrated later on. When the app comes out your will have educational features on it will have YouTube download videos, but this is a difficult. Decentralized platforms need to have integration possibilities for future development of the platform that allows new features.

Sharing ecosystem

Blockchain can enable a larger ecosystem for sharing. You can use your personal identity to connect to different decentralized platforms. Users of different services could then move seamlessly across the different platforms. Decentralized sharing platforms could collaborate whereby you can log in with your credentials to access both services.

When you want to log into a site, you sometimes got the option of signing in with your LinkedIn, Facebook or Google account. Having that cross functionality by using your personal identity allows that platforms can connect via their users. Communities could collaborate to let network effects work better. But everything so far now is, is centralized. All top the players in the platform industry so far are centralized. If you want that cross functionality it has to be on Google, Facebook or LinkedIn the majority of the time.

The consensus algorithms enable the empowerment of the communities. We were running kind of like a swarm wise organization that is reflected in our management structure. It's this decentralized in that sense where everyone have the same influence.

Revenues

One part of the revenue model will be related to the exchanges of currencies. Users are allowed to use multiple currencies, but are charges with a fee if they do not use the utility token of the platform. All these facilities within the app will give a token more utility and therefore the tokens will come back to the decentralized platform. You're going to have the ability to pay in different tokens and the ability to transfer in different tokens. Pricing is based on commission fees and opt-in services.

There's going to be a fixed amount of token supply to maintain stable value of the currency. The value proposition makes decentralized platforms more attractive for customers. The traditional ones without slowly they'll be like a phase out in that sense. It's going to take a movement in a sense of a revolution in the sense that communities will have a decentralized autonomous organization to facilitate them in their demands.

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Blockchain technology

We use blockchain for a few features that can make a platform application stand out. We wrote a smart contract. Smart contracts can be used in some sense as a middleman. Previously without smart contracts, a platform needs a middleman to handle everything, like Airbnb. Now we use smart contracts to process a lot of business logic. For example, rental booking is executed by a smart contract. The smart contract is the first part of the application. The second part is the distributed database, the blockchain. For example, transaction data or listing information are stored on a public blockchain, which is completely transparent for everybody. Blockchain technology is just an information technology on a process layer.

Decentralized applications

One of the applications is a currency. Blockchain technology enables that a platform has no middleman. A token system allows that the two sides of the market can directly interact with each other. For example, traditional platforms word if you pay in fiat currency. Guest is in Europe and host is in Japan. With fiat current payments, the users have to pay exchange fees. There are no exchange rates for cryptocurrencies, because all users can pay with the same token. Second is about rental booking. The Airbnb answer from the charge in total there's from the charge in against transactions and so this model meet them as a friend from business, we will really have a functional organization to as a middleman. So don't actually charge like a thirty per cent fee. We believe there is no fully decentralized world. So we allow local community members to act like local governance or local management for the community. For example, if you come to Tokyo, from Europe, and some dispute hackles up some people will help you to settle this dispute. In return, these community members are rewarded for their arbitration with tokens.

Customers and end-users

The customers of the platform remain partially the same. This relates to the demand and supply side of the platform. New customers are the owners of the cryptocurrency. These individuals purchase tokens in order to use the platform, without exchange rates or commissions. Airbnb users will be the customers Cryptocurrency owners will be customers. The end-users of the service are the ones that pay for the service.

Value proposition

Local guides were most similar to Airbnb. And also we provide some value added services to enhance user experience. This is something we're different from everybody. For example, if you want to talk to the owner directly, using voice call, that means that you can lower your communication costs. Value added services are charged with fees. We have we have some functions (like Amazon's one click shopping). Platforms can apply very innovative functions. Customer profiles are similarly managed as centralized platforms. Using blockchain technology does not directly impact secure access to the services.

Revenues

Right now, we just use value added services that bring some new functions we allow the user to use. These opt-in services allow the multi-sided platform to become profitable, rather than charging transaction fees. Users incur almost zero additional costs compared with other platforms. So, we also delivering more new value added services for the owners resemble we are looking at for why the local travel. The travel guide by some other some cyclical and in the weekend from the service providers are integrated within the platform. This comprises accommodation booking plus a local guide booking.

There is a difference between importing a wallet and using a wallet from the platform itself. People can use their own wallet, that can be integrated to the platform or users can make a new wallet.

We take 2-3 % commissions and provide it to community leaders. The transaction costs are reduced, resulting in a reduction of the total cost of business. That's the total cost that normally a middleman would incur and now nobody incurs it.

Sharing ecosystem
Right now it’s for rental booking that has mono-focus. As you can see that if you isolate every component everything can be an individual's owner, individual service provider, even the rental booking can be a service that as an individual. If you isolate other services the decentralized platform will not be mostly profitable. So we'll start with rental booking. So people can exchange values. As an owner in this community, you can also share those values. When you are a professional photographer, you can provide services to the community members, right? Yes, but it's more than just like are you are working here. You're here to make the rules. You can share your skills in service whatever service provides. For example, a company to do the transportation and now you have a car you can be a little similar to like Uber driver or your guest.

Centralized database still need to be used to ensure the user experience is good. Blockchain technology offers its technical capabilities, through distributed ledger and decentralized consensus. Trust and credit can be built with blockchain technology that is most important for a platform business.

No need to use centralized database to ensure good user experience structure. The community realizes this structure. Building the trust when you tell everyone that whatever you have done, whatever you have transaction is recorded publicly. The challenge with the use of blockchain technology is to build decentralized trust in the platform and its services (e.g. Transportation service).

A token is a crucial element to make this successful and it can give a lot of acceleration to the relevance of this community because was a total people were motivated to do something for others, because tokens have economic motivation to reward. Utility value of the token is important! This is directly connected to positive network effects of a platform. If the economic incentives are built correctly in the token the whole ecosystem will evolve in a very positive way. If the token is not used properly, the price is going down, every token owner want wants to sell and the platform will not work (negative network effects). That's not the purpose because it's not working. If everyone is just holding to, it's not being used to gain the actual access to service.

Decentralized applications differ from traditional platform businesses in how they reach their critical mass. You can look at traditional platform business, how they acquire users. They spend a lot of money to attract the supply and demand side of the market. The value proposition of decentralized sharing platforms is differentiated from established platforms. Decentralized platforms have to acquire users by marketing the message that you sure to join us to get rewarded. So, ready to use money for acquiring users or properties. And these users will come to you naturally. Acquiring customers is very different from traditional platform business. We will do a lot of marketing to educate the market come join our community. Any small favour you have done in this community is rewarded. If you have a property, this can be listed to the platform. The supply and demand side will grow in a more organic and natural way. Blockchain cultivates a lot of people and people come and join this community. Why do you have to prove yourself. You have to be very profitable in some way to have a lot of users.

Identity and reputation system
Personal reputation is basically the review that people can give to you about all interactions with other customers. Based on the network theory, the more good things you've done, the better reputation you have. Basically if you try to realize a change, as much work being done by the community as possible. They can be assigned with role that you signed something for the community. Well, one person decide everything is not every misunderstood.

Actors
Build on the Ethereum blockchain, so using proof of stake rather than proof of work does that reflect in the governance of public stays well like if someone has more stake in the profit? For example, if somebody has governance of all the tokens. Platform users will not get a bigger vote in the system, if they have done much work that rewards them with a good reputation. Every second decision makers will be changed. So it's not like one person can rule forever. It's time for them up do bad things you do bad things. You have lots of votes in the community. This is a dynamic change, which is something very similar to decentralized platforms.

Something we learned from the US is autonomous management. Autonomous management will be fair and realistic. You cannot say: I like this decentralized idea but if I need help no organization can represent me. We want to enjoy the low cost of peer-to-peer transaction, but if something happens the users of the platform need protection as well. A third party, like the traditional platform middleman should not be a central authority that has all power. For decentralized platforms, the communities should be built that consist of member that will help to solve disputes. The community can be built by giving platforms users with a high reputation rated by other users, consisting of members from both supply and demand side.

Revenues
As one part up have obtained services premium services, there could be a possibility to make exchange fees part of the revenue model as well. Users can be enabled to transact with different currencies. If users buy the token of the decentralized platform, for example a token for peer-to-peer goods sharing, they can access the service of the platform for free by using those tokens. Decentralized platforms could allow users to pay with fiat currency or other cryptocurrencies. Then these users will incur exchange prices, which will be part of the revenue model. The decentralized platform charges an exchange fee when users don't use their token. This gives the users an incentive to buy the token, because it means that they can access the service for free.

Basically, the blockchain protocol is open source. It is possible for competition to imitate the services of a platform very easily. This would make competition among platforms like perfect competition. Platforms will compete with each other by charging lower fees than its competitors. In the long term, decentralized platforms will not have a sustainable revenue model by charging fees on transaction costs. Decentralized platforms, and it also concerns centralized platforms, have to provide value added services to their users. Because of competition a decentralized platform should look into different directions. A lot of a lot of things start-ups decentralize apps are trying to still focus on charging commissions. But eventually the market will find a new equilibrium.

Competition with established platform monopolists
Besides the lower commission cost is only the difference in prices is going to do difference because they have a good reputation. They have a brand image, people are used to do it blockchain is still insecure. I don't see them as our competitor. We see them as example our model we learn a lot from them. No personally, I think, their centralized business model is not perfect. They definitely have their weakness for decentralized platforms. We are so familiar with them. We, at least we see one weakness, which is something is our strong points for you. So we found some goodness of Airbnb, and we use our businesses to enhance the user

experience. They have a very low level of service and their buyers have experience. Because better service of decentralized platforms customers will gradually migrate from Airbnb throughout our community members. So I think we are confident as well. We have as it always all execute as we planned it. Then we will at least to be a difference.

Trends and uncertainties

Trust and reputation is most important capability to blockchain technology. The centralized system have been having that system for a long time and people are use to centralized services. When these companies become bigger the quality of the services that centralized platforms provide decreases. Blockchain technology allows that trust becomes scalable and quantifiable. Technology is used to quantify trust, which will disrupt centralized platforms. This is possible using blockchain and well make a significant impact.

The payment process, from the fiat currency to the token and vice versa, needs to improve. There's something quite challenging, you know, in some country they don't allow you to cover right to the tokens. Some countries don't allow that fiat currencies are converted to cryptocurrencies. The current solution is over the counter transactions. This will be something we need to solve before we can scale massively. This is an emotional issue, because when people want to have a token that is liquid.

The decentralized world is still in a very early stage. There is much speculated with cryptocurrencies as an asset rather than a utility token. This means that the actual intended use of a token is not realized. Bitcoin is not used much to pay for something, but people buy and sell bitcoins to create arbitrage opportunities. There is no trust about blockchain from society. This is a challenge for decentralized platforms. I believe in the next five years, we have to combine value added services with blockchain to decentralize the platform. The users must be educated about blockchain technology.

Regulation of the technology is good, but the regulatory environment is quickly changing and hard to predict. Japanese government has done a good job, because they understand the technology. Annual application review is published. They see the contribution of blockchain for economic purpose. This is not the approach to blockchain technology in every industry. They have published like an annual review or changes in blockchain applications. So they see the contribution and they see the cultivation of using blockchain for economic purposes. So we will start with Japan first. Make a good example to educate governments.

Coexistence of platforms

With a peer-to-peer multi-sided platform, you need to grow, scale and benefit from networking effects. So if you have one more user with a listening on the website with an accommodation, the value is increasing. And I'm very curious about that how that will be in the future with blockchain technology. There will probably be lots of localized and original communities for sharing in different sectors. Collaboration of decentralized application will be the trend.

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Background interviewee

The last four years I was working as a PhD candidate on the sharing economy at the Charles University of Prague. The dissertation analyses the historical transformation of the sharing economy from a sociological perspective. I am the coordinator of the Sharing Economy Research Network, sharing economy advisor at HireGo and active participant in OuiShare events.

Blockchain technology

There are different technical capabilities of blockchain for platforms. What I consider important capabilities of blockchain technology is the decentralization of intermediaries as a result of a fully distributed storage of data. This principle allows that ecosystems have no hierarchy. It democratized the platform. This is what empowers the users of the platform and the transparency of blockchain technology helps allows all actors in a network to have the same information all al moments in time. The openness of the system is another important characteristic of decentralized sharing platforms. These characteristics fit very well with the sharing economy. The sharing economy needs to have a technology that can help the transition towards a more shared-based society.

Customers and end-users

The customers and end-users for any sharing platform will stay the same, even if the platforms are decentralized. The market is the factor that determines the customers and end-users. For sharing platforms, the end-users are the ones that pay for the service as well, so they are the same group. The current users of platforms are the demand and supply side and they can take up both roles. Decentralized platforms that use blockchain will not change this group. I do not know whether there will be new types of customers attracted to decentralized platforms. It depends on the business itself. If platforms allow the integration of private companies, so other third parties, new customers could adopt the services of the platform. Blockchain technology, however, does not change this.

Value propositions

The use of blockchain technology allows companies to bring a lot of new value actually. The value is directed mostly to the society itself. The value of platforms comes from the value that users create and exchange. Central platforms charge high fees, so users of a platform are not rewarded proportionally with the value that they bring to the community. The service becomes much more friendly to the users by bringing more social value. Parts of the value proposition of decentralized platforms follow the same strategy as normal platforms, because they will offer additional services to their customers by allowing services of other companies on their platforms. These third parties do not necessarily need to be using blockchain.

Technical functionality

The hierarchy of platforms will change from decentralization. It is still unsure what the total impact of blockchain will be on the business functions of platforms directly. Obviously it changes the way platforms facilitate transactions. Another way that it will impact platforms is the way customers interact with each other. The reputation systems that these companies use are very important for all users, as it will enhance trust within the community. If true peer-to-peer transactions and interactions are facilitated it will affect every citizen. It is a big challenge, but I see that it changes how people think and engage in economic activities.

Privacy is becoming more important for people. This is a big question for the future of blockchain technology. Privacy of users will be impacted by blockchain technology. Blockchains are open and everyone can see your data. The thing is, people will like that or not. New generations are impacted differently from these changes than older generations. Young people are getting used to their data being exposed. The decentralized platforms can make access to the service more secure. Smart contracts and other uses of blockchain, for example, make it possible for users to trust the other person they do business with. Trust is the most important element for the sharing economy to work. Decentralizing platforms reallocates this trust from a third party to a technology. There is a conflict between transparency and privacy as well. This is a social dilemma. Do we want someone controlling me, but also protecting me? Or do we want to be in control ourselves without being really secure.

Actors

Actors in platform ecosystems are included in multi-sided markets where the intermediary aggregates supply side and demand side and it can take up different roles as 'prosumers'. The supplier could supply their goods, but could also be a customer that wants to rents stuff from another supplier. New roles will relate to the consensus algorithms, where users have to contribute to mining of tokens for example to validate the data on a blockchain. These individuals must be rewarded otherwise they will not participate in such activities.

From a societal perspective, the sharing economy disrupts the way people work, where we work, how we work. People can become micro entrepreneurs by sharing their goods or providing labour services in addition to renting out goods. The sharing economy already gives individuals this ability, but they depend on centralized platforms that are too expensive to use, but blockchain technology actually allows the distribution of value fairer for the users.

Revenues

The fees that platforms like Airbnb and Uber charge to users, in order to access the services, are a large percentage of the total cost. These fees can become really low. The percentages can become as low as 1 percent or even completely free. Decentralized platforms can still be profitable, but they have to think of different ways to earn revenues. Some examples are to advertise on the platform for other companies or to get funding from governments or private companies. Companies can do an ICO, where they sell their tokens that give access to the service, which is a method to raise funds. Blockchain technology could be used to make a cryptocurrency that can be used to charge commissions when people convert currencies. A good characteristic about cryptocurrencies is that these eliminate exchange rates across borders, like fiat currencies have. So in the Netherlands, where you pay with the euros, if you want to buy some property in the US these euros have to be converted to dollars, and that will cost you money. Everyone globally can make use of these cryptocurrencies.

Sharing ecosystem

A sharing ecosystem can be built by interconnecting different decentralized platforms by a common currency or different currencies that can be used on all platforms. This way everyone has the same means to access different services. Another possibility is that sharing platforms can be integrated within other sharing platforms. For example, a home sharing platform like Airbnb could integrate the transportation service from a decentralized Uber, but this is also possible without blockchain technology. The digital identify of users is a better example. A reputation system can be connected to an individual, rather than a specific company, that can be used at different sharing platforms.

Competition with platform

The established platforms are very strong monopolies built by large communities. Blockchain gives sharing platforms the ability to create new value propositions. Time will tell how these markets will evolve. They're characterized by the winner takes all markets. You only know one Airbnb. There's only one Uber. There's only one survivor without are real competitors, being able to survive in these markets. That's impossible to compete with it. The better values that decentralized platforms bring to their users have the ability to get market share in these markets that are dominated by monopolists, because users profit from this directly. For the society, it would be the best outcome if platforms will become as decentralized as possible. The platforms that now exist have a lot of power. How decentralized and centralized platforms will compete is something difficult to predict. It will depend on many factors.

Trends and uncertainties

Regulation is a very insecure domain at this moment. In every country there exist a different policy on the sharing economy. Blockchain technology is so novel and difficult that governments have insufficient understanding about its capabilities and applications. Many countries must become educated on this. Now they are not really capable to make regulation on blockchain technology, because they are not knowledgeable enough. Markets will show first what the possibilities are with decentralized applications and how they work. Governments can learn from that and become better able to make good regulation. Another problem for these businesses is that there is a lot of unawareness. People really don't trust blockchain technology. This is part of the process of innovations and it can only be resolved by informing people. It is also a matter of time before the people will get used to it, so they will feel comfortable using it.

Appendix F – Stress test workshop time schedule

TABLE 12 – TIME SCHEDULE OF BUSINESS MODEL STRESS TEST WORKSHOP		
Time	**Activities**	**Other**
13:45 – 14:00	▪ Welcome participants	–
14:00 – 14:30	▪ Introduction round between participants ▪ Introduce research ▪ Explain STOF business model ▪ Explain Business Model Stress Test method (by facilitator Timber Haaker)	▪ Ask permission to make audio recordings ▪ Present Peerby business model ▪ Show colouring legend
14:30 – 15:00	▪ Present decentralized business model ▪ Present selected stress factors	▪ Discuss business model ▪ Discuss selected stress factors
15:00 – 15:40	▪ Mapping business model to stress factors ▪ Heat map creation	▪ Heat map template ▪ Make notes of discussion
15:40 – 15:50	▪ Break	
15:50 – 16:30	▪ Mapping business model to stress factors ▪ Heat map creation	▪ Heat map template ▪ Make notes of discussion
16:30 – 16:55	▪ Analysing the heat map	▪ Sub-view analysis ▪ Pattern analysis ▪ Make notes of analysis
16:55 – 17:00	▪ Closing of stress test workshop	▪ Ask permission to disclose participants information in thesis report ▪ Inform participants of public thesis defence

Appendix G – Heat map from stress test workshop

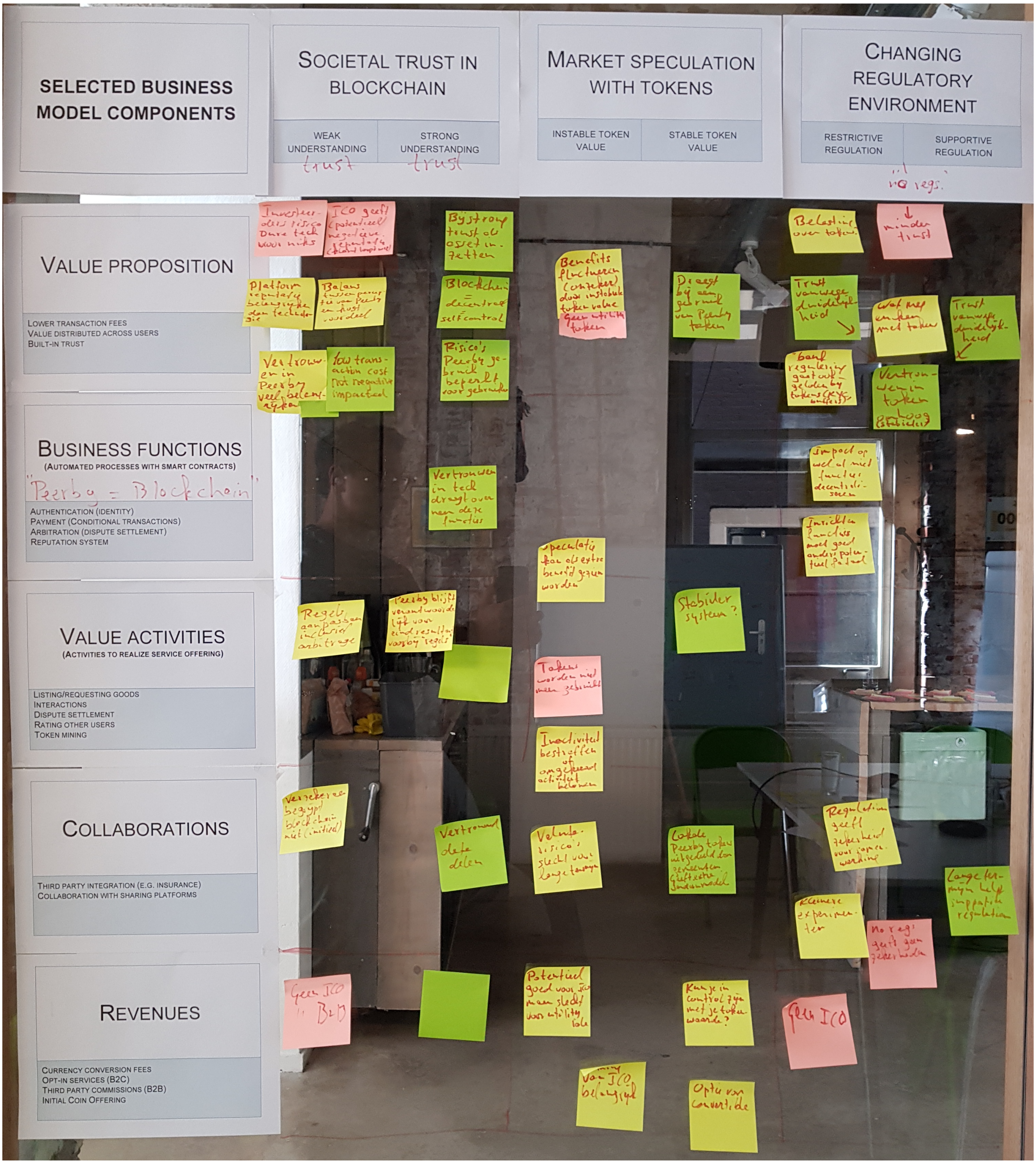

FIGURE 22 – HEAT MAP OF THE DECENTRALIZED BUSINESS MODEL (DUTCH)

Appendix H – Qualitative argumentation for heat map

Weak societal trust in blockchain technology

Table 13 on page 108 shows the stress factor results for the confrontation between the business model and weak societal trust. There is no causal relation between the business functions and this stress factor outcome.

- VSW-1 – Not feasible

The decision by Peerby to use blockchain technology to decentralize business processes is perceived as risky by stakeholders. Users do not realize that the decentralized platform provides secure access to its services. The intended value offering will not be realized. Stakeholders of Peerby have no trust in the usage of blockchain applications to decentralize the platform and are less inclined to use the platform. If the platform is less used there will be no positive network effects. The platform will not realize to expand its value network.

- VSW-2 – Not feasible

The token distribution via an Initial Coin Offering will have negative impact on Peerby its reputation. Initial Coin Offerings are associated with market speculation and fraud. Investors take a risk to invest in a novel technology that potentially does not bring the intended service offering to its users. The token is used to realize the value proposition, since the token system ensures that economic incentives motivate users to use the platforms and interact with peers.

- VSW-3 – No negative implications

The reputation and community that has been built by Peerby over six years time is stronger than the distrust that stakeholders have in blockchain technology. Peerby its reputation could lead to easier acceptance of blockchain applications. Users of could be inclined to trust the decision of Peerby and continue to make transactions on the platform.

- VSW-4 – No negative implications

Decentralized platforms will be able to offer lower transaction fees, despite the perception of stakeholders regarding blockchain technology. If Peerby decentralizes and automates its business processes via smart contracts there will always be a reduction of data verification costs. Trust in blockchain technology has no negative impact in the relative reduction of data verification cost.

- ASW-1 – Not viable

A decentralized arbitration system will not be possible if users have no trust in the applications of blockchain technology. Users will not participate in dispute settlement. The value network of the platform will not be able to expand if users are not participating in value adding activities. The value proposition of decentralized business model is versatile. Therefore, this stress factor will not become a direct problem for the business model.

- ASW-2 – Not viable

Stakeholders of Peerby have no trust that the usage of blockchain technology helps them to reach their goals and therefore stop with their activities that create value for the platform. Economic incentives are not sufficient to motivate users to contribute to the value network.

- ASW-3 – Not viable

The absence of trust in blockchain technology prevents that Peerby can successfully decentralize arbitration. Peerby will not eliminate incurred costs for arbitration if local communities do not fulfil the role to solve disputes. This means that Peerby remains responsible for arbitration. In the short-term this impacts the costs of arbitration, but in the long term is limits that strong communities as built.

- CSW-1 – Not viable

It is difficult to find third parties that are open for collaboration with Peerby, because the lack of trust in blockchain technology. Hence, third parties have more scepticism regarding the profitability of Peerby. Peerby will not be able to offer value added services to their end-users via third parties, nor will they collaborate with other sharing platforms.

- RSW-1 – Not feasible

There is no possibility that an Initial Coin Offering will attract actual end-users that have no speculative intents. The intent of the Initial Coin Offering to raise funds and distribute tokens among users will not be realized. The result of a failed Initial Coin Offering is that the token will not be used.

- RSW-2 – Not viable

The barrier for external parties to collaborate with Peerby obstructs a structural part of the revenue model. Third party commissions generate no income for the platform, because distrust in blockchain technology prevents collaboration with third parties. Peerby would still earn revenues from value added services that require no third party.

TABLE 13 – WEAK SOCIETAL TRUST IN BLOCKCHAIN TECHNOLOGY CONFRONTED WITH BUSINESS MODEL		
Value proposition		
(red)	VSW-1	No rewards for active users
(red)	VSW-2	Not possible to distribute tokens among platform users
(green)	VSW-3	Brand reputation more important than perception regarding blockchain technology
(green)	VSW-4	Decentralization leads to lower data verification costs
Value activities		
(orange)	ASW-1	Decentralized arbitration system will not work in practice
(orange)	ASW-2	Economic incentives do not do help to motivate users to perform value activities
(orange)	ASW-3	Smart contract rules must be revised to Peerby remains responsible for dispute settlement
Collaborations		
(orange)	CSW-1	Third parties incur a barrier to collaborate with Peerby
Revenues		
(red)	RSW-1	Investors that buy tokens at Initial Coin Offering are not end-users
(orange)	RSW-2	No revenues from third party commissions

Strong trust in blockchain by platform users

Table 14 on page 109 shows the stress factor results for the confrontation between the business model and strong societal trust. There is no causal relation between the business functions and this stress factor outcome.

- VSS-1 – No negative implications

When users trust the applications of blockchain technology this results in optimal usage of the platform. Platform users benefit from the (1) lower transaction fees, (2) obtained rewards for value added activities, (3) built-in trust and (4) transparency in the reputation of other users. The users will perceive the offered services as valuable.

- VSS-2 – No negative implications

Users will come to realization that decentralized platforms allow complete self-control of their data, including their user profiles. Again, users that trust blockchain technology are inclined to make use the decentralized sharing platform. Network effects are stimulated when users use the platform more.

- ASS-1 – No negative implications

The decentralized arbitration system will be completely effective, resulting in cost reduction for the platform and more effective dispute settlement that is governed by local communities according to the logic of the smart contract.

- CSS-1 – No negative implications

Collaboration with third parties allows the integration of value-added services that Peerby cannot offer to its users. The capabilities of third parties will more effective service offering to end-users that, in return, become more active on the platform. Positive network effects are stimulated if Peerby collaborates with third parties.

- RSS-1 – No negative implications

The revenue model is affected by collaborations with external parties. This commission-based revenue model will work if the trust in blockchain is strong. The revenue model is affected by collaborations with external parties. This allows more effective service offering to users that become more active on the platform.

- RSS-2 – No negative implications

The distribution of tokens with an Initial Coin Offering is valuable for stakeholders. The Initial Coin Offering will have no issues relating to scepticism and distrust in the technology. Peerby can distribute its tokens and raise funds. These funds are needed to build the decentralized platform.

TABLE 14 – STRONG SOCIETAL TRUST IN BLOCKCHAIN TECHNOLOGY CONFRONTED WITH BUSINESS MODEL		
Value proposition		
	VSS-1	Trust leads to active users that benefit from the value proposition
	VSS-2	Users benefit from self control
Value activities		
	ASS-1	Users actively contribute to dispute settlement
Collaborations		
	CSS-1	Third parties actively seek to collaborate with Peerby
Revenues		
	RSS-1	Third party commissions enabled by collaborations
	RSS-2	Token distribution among end-users and investors is possible

Token value depends on market speculation

Table 15 on page 110 shows the stress factor results for the confrontation between the business model and the market uncertainty that result in an instable token value. There is no causal relation between the business functions and this stress factor outcome.

- VMI-1 – Not feasible

The value proposition is not completely realized when the value of the token depends on market speculation on token value growth. The benefits for users to use tokens are not consistent.

- AMI-1 – Not feasible

Using tokens to make transactions can have negative implications for users if the value of a token is instable. The volatility of token value makes it insecure to predict what the monetary equivalent is. Platform users do not want to pay a premium to rent goods via Peerby and decide to hold the tokens.

- AMI-2 – Not viable

The rewards that users get to contribute to the value network are fluctuating. Users become less active on the platform, resulting in weaker network effects. The platform will not be able to realize the value proposition as a result (see VMI-1).

- CMI-1 – Not viable

The growth of Peerby is insecure with an instable token value. The instable token value represents instable value of the platform. The growth of Peerby is insecure when the token value depends on market speculation. This makes Peerby a risky partner for external parties.

- RMI-1 – Not feasible

Token holders can benefit from not using the token if its value is instable. The intended utility of the token is not realized: economic incentives are not effective, platform users are inclined to hold tokens and network effects are weak. There will be no revenues from opt-in services.

- RMI-2 – Not viable

Less collaboration with third parties (see CMI-1) makes a third party commissions not a viable revenue model. The business model constitutes of more revenue streams, which makes this stress factor outcome not a direct problem for Peerby.

- RMI-3 – No negative implications

When there is much speculation on the value growth of the platform there is a reasonable possibility that Initial Coin Offerings attract high-risk investors. An Initial Coin Offering allows the development of the decentralized platform. This might overcome other business model components that are not viable.

TABLE 15 – INSTABLE TOKEN VALUE CONFRONTED WITH BUSINESS MODEL		
Value proposition		
(red)	VMI-1	Fluctuating rewards for users
Value activities		
(red)	AMI-1	Tokens are not used to make transactions
(orange)	AMI-2	Economic incentives are not consistent
Collaborations		
(orange)	CMI-1	High risk for external parties to collaborate with Peerby
Revenues		
(red)	RMI-1	No payments for opt-in services
(orange)	RMI-2	No payments for third party commissions
(green)	RMI-3	Initial Coin Offerings raise much money

Token value independent from market speculation

Table 16 on page 111 shows the stress factor results for the confrontation between the business model and the market uncertainty that result in a stable token value. There is no causal relation between the business functions and this stress factor outcome.

- VMS-1 – No negative implications

The dependencies between business model components are not obstructed by the token volatility. The value proposition – lower transaction fees, rewards for users, built-in trust and transparency – is realized.

- AMS-1 – No negative implications

The economic incentives are consistent and have a stable impact on the activities of users. Network effects are realized and both the platform and users benefit from decentralization, respectively by lower costs and an improved value proposition.

- CMS-1 – No negative implications

Potential new parties want to collaborate with Peerby to reach mutual beneficial goals.

- RMS-1 – No negative implications

The revenues are based on the perceived value of the service offering to users and collaboration with third parties. The token utility still depends on network effects that are stimulated by active users.

TABLE 16 – STABLE TOKEN VALUE CONFRONTED WITH BUSINESS MODEL		
Value proposition		
	VMS-1	Stable token value contributes to realization of the value proposition
Value activities		
	AMS-1	Stable token value contributes to value activities
Collaborations		
	CMS-1	Third parties seek to collaborate with Peerby
Revenues		
	RMS-1	Revenue streams possible

Restrictive regulation for decentralized platforms

Table 17 on page 112 shows the stress factor results for the confrontation between the business model and the regulatory uncertainty that result restrictive regulation. This is the only stress factor outcome that impacts the business functions of the business model.

- VRR-1 – Not viable

Regulation could limit the extent of platform decentralization. Rewarding users for their contribution could be restricted. This restriction results in weakening of the network effect.

- VRR-2 – Not viable

Restrictive or even no regulation decreases trust of users in decentralized platforms. If there is no trust in the decentralized platform users will be less inclined to use the platform (VSM-1).

- VRR-3 – No negative implications

Regulation, either restrictive or supportive, contributes to clarity about blockchain technology. Stakeholders of Peerby gain trust in the decentralized platform.

- BRR-1 – Not viable

The use of certain applications of blockchain technology could become restricted, as the technology is still underdeveloped. Blockchain technology will be associated with market speculation as long as no good examples show regulatory institutions how blockchain technology has economical and societal benefits.

- ARR-1 – Not viable

Decentralized dispute settlement could be restricted if smart contracts do not comply with future regulation. There are no use cases of decentralized arbitration systems that have been explored. This application of blockchain technology is still developing.

- CRR-1 – Not viable

Third party services could be excluded from the platform, because these parties have to comply with different regulation on blockchain technology.

- CRR-2 – Not viable

Countries establish different policies regarding blockchain technology. This could restrict Peerby in the service offering to its users in other countries.

- RRR-1 – Not feasible

Different countries are developing strict regulation against or completely prohibit Initial Coin Offerings. It could become impossible to collect funding and distribute tokens. Peerby needs funding to develop the decentralized platform.

TABLE 17 – RESTRICTIVE REGULATORY ENVIRONMENT CONFRONTED WITH BUSINESS MODEL		
Value proposition		
	VRR-1	Uncertain about allowed applications of blockchain technology
	VRR-2	Transparency is not realized
	VRR-3	Increased trust from stakeholders
Business functions		
	BRR-1	Restriction of applications of blockchain technology
Value activities		
	ARR-1	Decentralized dispute settlement could be restricted
Collaborations		
	CRR-1	Exclusion of third party services
	CRR-2	Service offering of Peerby is restricted in other countries
Revenues		
	RRR-1	Initial Coin Offerings are restricted

Supportive regulation for decentralized platforms

Table 18 on page 112 shows the stress factor results for the confrontation between the business model and the regulatory uncertainty that result supportive regulation. This stress factor outcome only impacts the value proposition. There is no causal relation between the other components of the business model and this stress factor outcome.

- VRS-1 – No negative implications

Regulation, either restrictive or supportive, contributes to clarity about blockchain technology. Stakeholders of Peerby gain trust in the decentralized platform.

TABLE 18 – SUPPORTIVE REGULATORY ENVIRONMENT CONFRONTED WITH BUSINESS MODEL		
Revenues		
	VRS-3	Clarity and trust about blockchain technology