EXPLORING DIGITAL CURRENCIES
Designing a peer-to-peer exchange with use of Blockchain

MSc. Interaction Design 2015: Thesis Project I (KD643A) - 15 credits

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Date: June, 5th 2015
Place: Malmö University, Sweden
Abstract

Digital currencies represent complementary alternatives to fiat money in the conventional mental models of exchange. Blockchain, as the underlying technology of Bitcoin, holds a potential to influence a peer-to-peer exchange in the perspective of trust and ownership. The underlying technologies of digital currencies may be part of concepts, where designers have a possibility to define their own exchange articles for specific needs of the exchange. The ambition of this report is to illustrate the possibilities for the initiation of a peer-to-peer exchange with use of the underlying technologies beyond Bitcoin. The explorative approach provided me material for the retrospective reflection to achieve this ambition. The thesis project consisted three iterations, one experiment, and a literature overview. The main conceptual work illustrates the result of explorative research, where blockchain ensures trust between participating parties. This ecosystem uses the principles of sharing economy for initialisation of exchange within the community. This concept demonstrates potential opportunities for future transactions, in which the exchange article replaces fiat money.

Keywords

exchange; transaction; interaction design; bitcoin; blockchain; digital wallet; digital money; digital currency; mobile payments; community; alternative currency; sustainability; prosocial computing; cognitive psychology; behavioural economy; social values; experience economy; value of data; digital property; self-leadership; sharing economy
Acknowledgment

The first thank you is going to my family for their support to fulfil my dream - study masters abroad. Especially, the unspeakable thank you is for my girlfriend Barbora for her patience to respect my decisions in last five years.

The special thank you is going to my supervisors, Jonas Löwgren and Clint Heyer. They pushed me to imprint my best into this work.

The big thank you is going to the studio USTWO — especially to Silvia Venditti. I appreciate her professional input to my work and positive attitude.

I would like to appreciate kindly the support from my classmates when we were connected almost like family in the studio and helped to each other. Guys, it was a great time!

Namely, I would like to thank you to David Cuartielles, Ondrej Valka, Petr Stedry, Anna Seravalli, Maisa Dabus, Ivana Kanuscakova, Yiannis Chountalas, Patrick Bours, Tilla Stendel, Monika Capova, Griffin Trent and Niki.

I cannot forget to thank you to all my business partners for cooperating on the remote basis during studies.

Thanks for designs by Freepik.com

Thank you.

P.
“I’ve always thought there are a number of things that you have achieved at the end of a project. There’s the object, the actual product itself, and then there’s all that you learned. What you learned is as tangible as the product itself, but much more valuable because that’s your future.”

— Jony Ive, speaking in Becoming Steve Jobs by Brent Schlender and Rick Tetzeli
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1. Introduction

Money seems to be simple. We use it on an everyday basis for a variety of exchange purposes. This term encompasses a wide variety of different topics. Primarily, this thesis deals with digital currencies but the outcomes of explorative research brought several other fields into the frame to design something meaningful. The design work contained the three iterations, where I changed the direction several times based on the outcomes of the performed work. Digital currencies represent one of the concrete implementations of the abstractional term money that opened this thesis at the beginning of 2015.

We use money on an everyday basis. Digital technologies change the way we manipulate with money, even though the essence is still same. Prof. Lietaer defined money as “an agreement within a community to use something as a medium of exchange (Lietaer, 2002)”. Currently, fiat money represents the most well-known agreement within a community, where we use a certain currency that derives its value from governmental regulation or law (Mankiw, 2014). Another well-known example is commodity money, whose value comes from a commodity of which it is made, e.g. gold, silver, copper (O’Sullivan & Sheffrin, 2003). Representative money is the third type that we usually perceive as certificates or any money that has a greater face value than its value as a material substance (Mundell, 2002). Fiat, commodity and representative money are the top-level categories for the categorisation of money.

Money has different forms. Digital currencies represent one form of money, which is crucial in the context of this thesis. I perceive digital currencies as currencies, where the medium of exchange is digitized. Malone defines medium of exchange “as a medium, which is used in a trade to avoid the inconveniences of a pure barter system (Malone, 2014)”. The medium of exchange represents or holds a value that is confirmed by at least two parties to perform an exchange. At this moment, money becomes just a layer of a wider system that is called exchange. People take a place on another layer because we represent the parties from the previous definition. For this reason, it is not appropriate to pick just a layer or an element from the ecosystem. We have to take into the consideration all elements or place a piece into a different context to design meaningful experiences.

Newly founded digital currencies are intangible. It is difficult to perceive their value without the possibility to associate them with something concrete. This happened with the use of Bitcoin as a cryptocurrency. The mainstream use of this cryptocurrency is similar to the use of fiat money. The technologies beyond digital currencies seem to be more interesting than a cryptocurrency itself. These technologies represent a design material with certain properties but without qualities (Löwgren & Stolterman, 2004). Designers and especially interaction designers are the ones, who have the power to place these technologies into the wider contexts and give them qualities because meaningful use forms the value of technologies, and therefore, of the digital currency as well.
Historically, the field of digital currencies gained popularity after Satoshi Nakamoto published a paper about Bitcoin as a peer-to-peer electronic cash system (2008). The first cryptocurrency with the same name was implemented one year later. Bitcoin as a cryptocurrency holds the same name as the proposal of the electronic cash system (Wallance, 2011). This is a phrasing issue because this substitution generates a perception in which, Bitcoin is perceived just as a currency and not as a technology.

A number of design challenges become much wider at the moment, when Bitcoin is perceived as a technology.

The initial implementation of Bitcoin attracted the interest of different mass media channels, governmental institutions and a broad spectrum of onlookers (Davis, 2011). Different groups of onlookers are curious about the possibilities of these alternative currencies and their underlying technologies. An interesting property of alternative currencies is the process of their creation. Not only can they can be created by an individual, a corporation or an organization, but also by a state, or a local government, or it can emerge naturally as people begin to use a certain commodity as a currency. The possibility to choose own commodity for exchange is one of the reasons because each of us can define his or her currency.

Another reason is that newly established digital currencies offer faster and cheaper exchange for mainstream users in comparison with services provided by traditional banking stakeholders. Bitcoin provides different opportunities in compare with the current banking system mainly because of the decentralized peer-to-peer exchange, which is the most disruptive feature of Bitcoin. However, another significant reason is the opportunity to use this currency for controversial purposes as in the case of Silk Road, which was the anonymous marketplace for drugs (Bearman & Hanuka, 2015).

As you can see, the discussion runs on a variety levels of interest because the overall field deals with a large spectrum of different issues. To summarise, the most common discussions run on levels such as the users’ perspectives, technological meaning, legal issues or regulations by legislative authorities around the world (HM Treasury, 2015).

Bitcoin represents a current state of the art in the sub-field called cryptocurrency. This subfield belongs to the field of digital currencies. Technically, cryptocurrencies uses cryptography techniques to secure the transactions and to control the establishment of new units (Graydon, 2014). One of the biggest advantages is a global scalability because they use the Internet for the exchange. Whereas the Bitcoin is not just a cryptocurrency, but it is an online exchange system for the digital age. The crucial part of Bitcoin is called Blockchain, which is a decentralized ledger that records and keeps all transactions. Bitcoin Wiki says, “the overall technology has a potential to change payment experiences, and allows to exchange value with anyone over the Internet (Bitcoin Wiki, 2015)”. Gartner mentions Bitcoin in the report called “Top Strategic Predictions for 2016 and Beyond: The Future Is a Digital Thing”, where they reported that the current market holds more than 500 bitcoin startups. These startups have a potential to disrupt the traditional banking system by their products or services (Burt et. all, 2014). In another report, they talk about Blockchain as a technology that has potential to deliver a disruptive change (Plummer et. all, 2015). These three references illustrate just a piece of different mentions or speculations that are
available online. However, there is something mysterious in this technology that is worth of exploratory interaction design research because people are going to use bitcoin-based products in future and designers will benefit from the experience with this material.

The journey of this thesis took several turns on the way to reach the current direction. The observations and discoveries were fruitful enough to change the path. I decided to present all important pieces of this journey because they influenced the decision making that leads me to the arguments, which I present later. It is important to mention that first and second iteration were performed under different research focus. This report represents a coherent answer to the explored problem during this journey.

1.1 Problem domain

Initially, I started with the exploration of digital currencies. The focus was on digital currencies as pay money, which are stored in digital wallets. Lately, I explored that potential users miss the meaning in the newly founded cryptocurrencies, which belong to the field of digital currencies. MIT, IDEO, IBM and others have begun to discuss the possibilities of Bitcoin in a wider context than just a cryptocurrency. At this moment, I asked myself - how might we take advantage of technologies beyond digital currencies and design new exchange experiences? As the current answer, I would say that Bitcoin is not just a cryptocurrency but technology that enables people to initiate a peer-to-peer exchange of digitized values over the Internet. Therefore, Bitcoin is the exchange protocol for the digital age in the first place. There is a future possibility that digital currencies will have nothing to do with the current perception of currency. This perception is equivalent to the everyday use of fiat money.

Bitcoin represents cryptocurrency in the mainstream perspective. This cryptocurrency has the same use as a complementar currency to fiat money - pay money. This implies that people do not see reasons to use these cryptocurrencies on the everyday basis because of lack of meaning, reliability issues and other connected facts to the properties of decentralization. However, Bitcoin can be perceived as a design material, which offers underlying technologies that could provide an infrastructure for exchange over the Internet. Designers do not consider this opportunity often. Therefore, we can see a majority of solutions, where usage of Bitcoin is in the sense of everyday currency.

A standalone currency has no meaning. A currency must become a part of a larger context that has a label exchange. A transaction belongs to the exchange as a basic element in which a certain currency may participate. The literature studies provided me a clue towards possibilities for a design of exchange experiences with the use of the technologies beyond Bitcoin. In other words, the underlying technologies of digital currencies could take a part in the design of a variety exchanges if we perceive them as a design material with certain parameters. The intention of this report is to answer the following research question: How might we initiate a peer to peer exchange with use of the underlying technologies beyond Bitcoin?
1.2 The perspective triangle of the research focus

The perspective triangle demonstrates the key building blocks that are used in the conceptual design of the third iteration to answer the research question. The conceptual design illustrates one of the possibilities for the initialisation of a decentralized peer-to-peer exchange with use of technologies beyond digital currencies. Originally, the triangle is divided into the definition of use situation, technology and target group. The course guide recommends this approach for better decision-making about the topic of the thesis, but I decided to use this method for the illustration of the building blocks for the developed concept. The angles of the triangle represent a frame for the exchange in my perspective. The following chapters describe the parts of this triangle in a closer detail.

Future Transaction refers to the use situation. This term covers the most important piece of an exchange, where digital currency is a part of a medium of exchange. A general transaction should consist of all relevant data about the exchange that is necessary to store in a kind of ledger to verify a transaction.

A part of Bitcoin is the underlying technology called Blockchain, which offers greater potential in comparison with the use of Bitcoin solely as a cryptocurrency (Future Lab, 2015), (Gerber, 2015), (Panikkar et al., 2015). In general, blockchain is a public ledger that records and keeps all transactions. Therefore, Blockchain was chosen as the main design material because this material is one of the first digital technologies that enables users to store details about transactions in a decentralized way.

The target group is labeled as People because a peer-to-peer exchange is the most promising between human beings. A designer should know for whom he or she designs. Labelling people as the main target group is in a way too broad but the nature of the presented concept can be replicated for every owner of a WiFi router. Therefore, I do not specify the target group in the sense of who I design for in this stage but I am more focused on the development of the general concept that can be adjusted and replicated based on the specifics of a target group later in the process.
2. Theoretical overview

This thesis is about the exploration of design challenges in a peer-to-peer exchange with use of the underlying technologies of digital currencies. This kind of exchange combines several different fields. This combination creates a variety of misunderstandings and confusion. I experienced as the most problematic the inaccurate definitions or wrong naming. Those misunderstandings are a foundation of the wrong perception of certain elements as in the case of Bitcoin as cryptocurrency as opposed to Bitcoin as a cash system e.g. Therefore, I highly recommend paying attention to the theoretical foundation from the very beginning because otherwise a designer could perform a quite extensive design work in the limited or wrong perception.

The coherent source of information was not found during the initial research. The intention of the theoretical overview is to provide an elementary toolbox for designers that plan to perform a following design work in the similar sense as I did. This chapter contains three main sub-chapters. The first chapter deals with the exchange, where I discuss the elements as money, currency, transaction and exchange in general. The second chapter presents an overview about Bitcoin as the main technology together with a presentation of the important elements for the perception of this technology as a design material in the context of this thesis. The third sub-chapter discusses the sharing economy because people are in the heart of this economic movement, and the overall ecosystem is based on the peer-to-peer exchange, which goes together with the properties of Bitcoin.

2.1. Exchange

2.1.1. The perception of money

Money represents a topic that is hot, sensitive and sometimes a taboo. Money plays a major role in our lives as an access point to the opportunities of this world. There are misunderstandings in the mainstream perspective of money. We often define money by their common use instead of taking one step back for a more abstract perception. Many definitions present money by its function instead of its general essence. The not accurate definitions frame money as a standard of value, medium of exchange and storing value (Lietaer, 2002). Prof. Lietaer frames money as “an agreement to use something standardized for exchange in the community (Lietaer, 2010)”. This abstract definition is more important to have in the mind during a design process instead of functional possibilities of money. This frame opens new perspectives in the creation of exchange articles because the restricted frame of nowadays currencies does not limit a designer.

Money is in the renaissance phase. The usage of fiat money changed the mental model of quality to the model of quantity. We do not ask what and how, but how much (Simmel, 2004). Current examples of experience economy indicate a movement towards a model, where a customer looks for some experience instead of taking price
as the main decision parameter. This movement illustrates examples of Airbnb or Uber e.g. These players offer an experience that has a defined standard between customers. Therefore, the main decision parameter is the expected experience instead of taking money or an act of payment on the first position.

Money has several aspects, such as historical, economic, political, cultural, psychological and social. The interpretation of money is various. The basic one divides money on market money or special money. Money can have different forms - physical or digitized. Technological advancement supports the movement towards abstraction and opens a possibility to define different approaches in connection with the Lietaer definition. Money refers just to the abstractional term that sets the perceptual frame. For this reason, a currency is more important because every currency represents a concrete implementation for this perceptual frame.

2.1.2. The perception of currency

The Cambridge Business Dictionary defines currency as “the money that is used in a particular country at a particular time (Cambridge, 2015)”. This definition is quite limited and does not touch all different faces that a nowadays currency could offer. Digital currency has several interpretations e.g. One of them sees digital currency as every currency that has a digitized form. Another one portrays digital currency as a new type of currencies that Bitcoin represents e.g. The important part of every currency is the medium of exchange, which represents or holds a value. This thesis uses the interpretation of digital currency as every currency, where the medium of exchange is digitized. Generally speaking, a currency is the concrete implementation of the abstractional term money. If we move beyond the surface of well-known currencies, we can perceive as a currency every single digital information that is accepted by at least two parties as valuable for the exchange.

The pool of digital currencies includes digitized fiat money, virtual currencies, cryptocurrencies and a broad spectrum of alternative currencies. Virtual currency or virtual money was defined in 2012 by the European Central Bank as a type of unregulated digital money, which is issued and usually controlled by its developers and used and accepted among the members of a specific virtual community. It is a digital representation of value (ECB, 2012). Cryptocurrency is a type of currency, where the medium of exchange uses cryptography to secure the transactions and to control the establishment of new units. Cryptocurrencies are a subset of alternative currencies. Alternative currencies are currencies, which are used as alternatives to the dominant national or multinational currency systems (Lietaer, 2002). Not only it can be created by an individual, a corporation or an organization, but also by a state, or a local government, or it can emerge naturally as people begin to use a certain commodity as a currency.

2.1.3. The perception of transaction

A transaction covers the most important information about the exchange. The elements of a transaction are closely connected to the specifics of the exchange. The Cambridge Business Dictionary provides definitions as “an occasion when
someone buys or sells something” or “the process of doing business” (Cambridge, 2015). In this case, business is not necessary just financially oriented but it deals with general agreements between human beings as well. The human words are not strong enough to prove the agreement, and for this reason, the transaction must be proved by a third party or have a certain form. This form of transactions must be stored somewhere. It can be a paper invoice in the itinerary or a record in some database, e.g. The technologies beyond digital currencies offer a possibility to store these transactions without the participation of the third party. Therefore, the exchange can be almost peer-to-peer.

2.1.4. The perception of exchange

The exchange is the general term, where money plays an important role. The Cambridge dictionary defines an exchange as “the act of giving something to someone and them giving you something else (Cambridge, 2014)”. Participating parties and exchange articles are the most important elements for the general perception of the exchange in my opinion. Transaction proves the exchange. The transaction details have to be confirmed by the participating parties. The context of the exchange is an important thing to take into the consideration because the geographical location or any other detail can change the expectations of the exchange.

2.2. Bitcoin

Last seven years were the most progressive in the field of digital currency. All started with the paper that describes the technological proposal called Bitcoin (Nakamoto, 2008). The subsequent implementation revealed unexplored difficulties and weaknesses. It is important to mention that the cryptocurrency Bitcoin was one of the first explorative implementations of the payment system that holds the same name. Bitcoin is not just a cryptocurrency but more importantly - digital technology. Nowadays, Bitcoin is mainly used as an alternative currency to the dominant national or multinational currency. However, the technology offers wider possibilities not just for designers but for creators in general. This illustrates startups that use this technology as Chain¹, Ethereum², Ascribe³, etc. or other financial institutions as UBS⁴.

The following text combines a variety of available resources such as the paper about Bitcoin from Satoshi Nakamoto (2008), series of contribution from IDEO (Gerber, 2015), Satoshi Nakamoto Institute and others mentioned in the references.

¹ http://chain.com
² https://www.ethereum.org
³ https://www.ascribe.io
⁴ https://innovate.ubs.com
2.2.1. **What is Bitcoin?**

Bitcoin is labeled as the first cryptocurrency. Bitcoin as a currency is built on the peer-to-peer electronic cash system that holds the same name. The cryptocurrency has undoubted qualities and offers several opportunities. However, the main concerns lie within the field of usability for Interaction designers, which are not fruitful in the expected knowledge contribution for this thesis. The underlying technology of Bitcoin offers possibilities worth of further interest because blockchain has a potential to be disruptive in the field of trust (Ludwin, 2015). The trust is an important element of previously mentioned exchange. Blockchain has signs to be a new fundamental technological platform as the Internet (Rosenberg, 2015). For this reason, Bitcoin is a technology with certain parameters. Designers can perceive this technology a design material. The decentralized ledger is the most important part of this technology because blockchain disposes of possibilities to ensure trust in peer-to-peer exchange, *see Figure 2.*

![Figure 2 - Client-to-Server model vs. Peer-to-Peer model](image)

However, the full decentralization is a dystopia until the technological knowledge of users will be satisfying to perform all operations by themselves. Someone must undertake maintenance of the created service. The difference is in the possibility of having more control over the system. Members of the community could control the system. This approach brings a different specification during a design process, as it entails a higher amount of responsibility, e.g. for users and designers.

2.2.2. **How to imagine a function of Bitcoin?**

One of the most efficient ways to explain the function of Bitcoin is to compare it with BitTorrent (Lantz, 2015). BitTorrent is a decentralized peer-to-peer file sharing protocol. The protocol uses the Internet for the distribution of data. You share many files with the same content. The exchange is direct between users, without a middleman or central authorities that control the exchange, *see Figure 3.*
The biggest difference between BitTorrent and Bitcoin is the possibility of sharing unique content on the Internet. Everyone can access the shared data once somebody uploads them to the network, in the case of BitTorrent. In the case of Bitcoin, however, data cannot be accessed without ownership of the keys. These keys are hash codes that enable access to information stored in the blockchain. The hash is an algorithm that proves the ownership.

2.2.3. What is Blockchain?

Blockchain is a part of the Bitcoin. The name represents a ledger of blocks, which are publicly shared on the network - the Internet. Blockchain can be perceived as a decentralized distributed object database. A user does not have to trust the one owner of the ledger, as it is the case with the centralized model. Blockchain is a crucial innovation because different connected nodes of the network have their copy of a ledger. Connected nodes have to confirm a transaction before the transaction is added to the block. A confirmation happens at the moment when the node with a name miner finds a solution for the mathematical algorithm, and sends a signal called “proof-of-work” to the network.

Figure 3 - A comparison of the centralized and decentralized model

Figure 4 - Visualisation of transactions in Blockchain by IDEO⁵

⁵ http://hellobitcoin.ideofutures.com
IDEO tried to visualise a blockchain, see Figure 4. The green blocks represent the confirmed transactions in the blockchain. The confirmation usually happens every ten minutes in the case of Bitcoin as a currency. Miners reach coins as a reward when they solve the mathematical problem. The blockchain is public, and it is available at blockchain.info6.

2.2.4. How does Bitcoin work?

The person with the hash is the owner of the bits (data), that were transferred through the Internet and are stored in blockchain. The overall transaction is recorded in blockchain. The hash is a digital fingerprint of some binary input and can be understood as the accessing key to the data. Every user has one or more private keys. These keys are stored in a keychain, mainly called a digital wallet. A private key is a secret number allowing to access content in blockchain. Therefore, the holder of the private key is the person, who can access the content stored in blockchain.

The blockchain is publicly anonymous. The recorded transactions in each block are publicly available. Bitcoin uses the Public-key cryptography (Ferguson & Schneier, 2003), which is a cryptographic protocol requiring two keys - private and public. Blockchain records the public keys. The knowledge of a public key is necessary to identify the identity. The identity can be represented based on the specific use case.

2.2.5. What does this mean for users?

The technical mechanism allows to build concepts, where trust, credibility and ownership are needed directly between participating entities. A variety of exchange articles can be defined due to features of the blockchain. One of those articles is the Internet connection used in the exchange (Ludwin, 2015). The whole field of Bitcoin offers a technical mechanism with a significant potential. The question is where, how and what for to use this technology. The actual well-known cases are, for example, alternative exchange systems for communities, alternative currencies or proof of the ownership.

6 https://blockchain.info
2.3. Sharing economy

The previous chapters covered two angles of the perspective triangle. People represent the last angle. Blockchain offers a way to initiate a peer-to-peer exchange and ensure trust between participating parties by recording and storing transactions in the public ledger called blockchain. The principles of sharing economy are the most promising to apply during the design process because people are at the heart of sharing economy (Matofksa, 2014).

2.3.1. What is sharing economy?

The sharing economy has not the standardize definition yet. The most promising explanations are by Botsman (2014) and Matofksa (2014). It is important to perceive the sharing economy as a set of principles for an initialisation of exchange between people. The sharing economy represents an economic system based on a peer-to-peer exchange of shareable assets or services, which are labeled as exchange articles. The sharing economy is comprised by ten building blocks, in Matofksa’s view (2014). These building blocks are people, production, value & system exchange, distribution, planet, power, shared law, communications, culture, and future. The sharing economy encompasses many different aspects, such as swapping, exchanging, collective purchasing, trading, renting, crowdsourcing, etc. In my opinion, all of them can be generalised to the term exchange.

2.3.2. People and sharing economy

People are at the heart of sharing economy. They can have different roles in the ecosystem, as creators, collaborators, producers, co-producers, distributors, re-distributors or consumers. The peer-to-peer exchange can be established in the sense of one to one, or one to many. The sharing economy is not just about the exchange. The relationship is an important element (Botsman, 2014). The beauty of the sharing economy is a mindset of participating users. They are looking for a specific product, service or experience with certain features or values in mind, and not just for consumption purposes.

2.3.3. Business and sharing economy

A business model is an integral part of sharing economy. The business must be part of sharing economy to make the ecosystem sustainable for participating parties. The business is not always financially oriented. Sharing economy can use alternative currencies, local currencies, time banks, social investment or social capital for trading. The well-known business models are access based models, services, subscription, rental, collaborative and peer-to-peer models.

Disruptive innovation, sharepreneurship, creative entrepreneurship, intrapreneuship, and micro-entrepreneurship are common features of a sharing economy. The sharing economy is powerful in the sense of making the most from owned resources. The benefits have an impact on the economic side, but more importantly on social
aspects in the society. The ownership does not satisfy us as much as the comfortable access to the expected experience; as the example with ownership of CDs, in contrast to the experience of listening to music (Botsman, 2014).

2.3.4. Digital currency and sharing economy

People move from passive consumers to active collaborators, when they become a part of a community in the ecosystem build on principles of sharing economy (Botsman, 2014). This has a significant influence on the thought process of consumption. Digital currency and sharing economy are fields with a potential to be connected. The exchange can be established with or without the participation of money as a payment tool. This fact is strongly connected to the concrete specification of exchange and the overall ecosystem. The technology beyond Bitcoin offers possibilities to trade a wide variety of goods in a trustful way. Therefore, Bitcoin has a potential to fulfill the promises of sharing economy because the blockchain can ensure that all records about the exchange will be stored as transactions in this ledger.

Rachel Botsman described the movement from the hyper-consumption to collaborative consumption in her book (2011). One of the ideas illustrated in it is the swapping between participants of a community. This approach defines a sort of social currency that needs a trust mechanism to be established. The social currency can be perceived as a previously mentioned exchange article, and blockchain can be used as a trust mechanism as it is in the designed concept during the third iteration.

2.3.5. Sustainability of sharing economy

The main potential of sharing economy lies in sustainability because sharing is the natural behavior of human beings. We share content on social networks; we share apartments or laundry rooms, and we all share the Earth in essence. The sharing economy is a very broad term and covers many elements. Therefore, it is difficult to grasp this field on the abstraction level. It is vital to approach it by taking certain elements and applying them to the design work. Sharing economy as the ecosystem provides a wide range of approaches for the establishment of concepts in the context of this thesis.
3. Design research and methodology

3.1. A methodology of design research

Research through Design is well-known as a research approach that employs a method of inquiry. In general, it is a generative process, where an outcome represents a conceptual work with recorded results in the specific context. Zimmerman et al. (2007) characterize Research through Design as a research method focused on future development. The goal of this thesis was to perform an explorative interaction design research in the field of digital currency. The thesis report answers the research question based on this explorative research. The direction of research was intended towards Theory for Design, which represents an approach to improve the practice of design.

The exploratory approach requires an efficient evaluation of short sprints. A designer should be able to evaluate outcomes and make decisions for the further work based on the evaluation of these outcomes. For this reason, I decided to follow the agile approach, which I perceive as appropriate for the innovative development. In general, the design process contained three iterations. An iteration was divided into the successive phases -- research, ideation, concept development, prototyping, validation, and evaluation. On the beginning, I defined goals for each of the iterations. Lately, I evaluated the outcomes according to the defined goals. This decision helped me to learn more progressively and become familiar with the new field in a short period.

The project proposal contained a timetable, where I wanted to develop three incremental prototypes in a period of six weeks. This plan changed during the second iteration because the outcomes of literature studies and performed designed work opened doors for richer knowledge contribution. This fact was influenced by the application of techniques mentioned in the Lean UX (Gothelf, 2013), Human Centred Design (IDEO, 2015) and Thoughtful Interaction Design (Löwgren & Stolterman, 2004), which became the main design methodologies for this thesis.

3.2. A journey of the design work

The field of digital currencies is in the renaissance phase. Several new materials that contain new discoveries occur frequently. The gained knowledge can change initial presumptions, and the vision can be re-framed based on the findings during the continuous development. All of those possibilities happened to me during the design process. Therefore, I see the concrete direction as unpredictable for an explorative research without previous knowledge of the field. A designer or researcher should keep in mind an option for directional changes if the application of new findings has a potential to deliver a better outcome. This subchapter provides an overview of the thesis journey.
Figure 5 - The map of a design process.
An ideation for this thesis topic started two months before the course. Several meetings, such as expert interviews with researchers and practitioners, were organized with an expectation to reveal different perspectives on the field of digital currencies. The expert interviews helped me to obtain initial focus points for the research. The initial research opened several possible directions. However, I started without a clear vision for the overall thesis because the research period was insufficient if I consider my ambitions retrospectively.

The entering point was a hypothesis that deals with the influencing factors of digitalization on the perception of values. Professor Ariely (2008) discusses different influencing factors in his studies, where a medium of exchange is digitized and according to that, the perception of values is continuously changing in the society. This hypothesis was briefly validated during random interviews by questioning participants about their ability to control expenses on their bank accounts. The result confirmed difficulties in the management of expenses, where digitisation could be a source of those issues.

The official research part took place during the first week of the course before the first iteration. My initial vision was dealing with a humanisation of Bitcoin. I tried to explore different possibilities for the representation of values in the digital wallets. The research part was performed in a wider perspective, where I wanted to build a ground that would consist an overview of the literature dealing with digital currency, different kinds of economies, etc. In this stage, the main focus was on the act of payment and the representation of values without consideration of a certain currency as the main one.

The experiment with a consequent qualitative interview became a highlight of the first iteration. Those interviews provided me a clue towards the potential white spot in the sense of lack of a meaning in the use of Bitcoin as a digital currency. Some of the participants would like to enter the field of digital currencies, but they did not see a reason to enter. It was challenging to come with ideas that could provide me satisfying knowledge contribution with the use of Bitcoin as a currency. I was not able to think visionary and ideate meaningful concepts, where digitized currencies could have a dominant role. The general true is that visionary thinking is possible at the moment of sufficient knowledge for a certain field. The initial research provided me insufficient grounding for visionary thinking and some blindness. This blindness causes a limited perspective, where the currency figured as the main part during the act of payment, instead of taking into the consideration the overall experience together with the material qualities of a currency.

The step back decision removed this blindness at the beginning of the second iteration. Bitcoin was not just a currency anymore. This happened at the moment when I decided to review some of the materials again and research the new one. Retrospectively, I perceive this as the crucial moment because I started to perceive a digital currency by a recognition of the material qualities of underlying technologies instead of the complementary use for the exchange. The result was a perception, where Bitcoin represents a design material that offers a variety of opportunities for designers.
At this moment, Bitcoin became the main design material of this thesis. I started to questioning myself: what to make out of this technology and where to use their properties? The sketching approach (Buxton, 2010) helped to communicate ideas more clearly and validate them during interviews with professionals in the fields as social innovation, participatory design or coworking places. The interviews covered a validation for a logical and functional feasibility of further development. In the end, the outcome of the second iteration was a couple of conceptual ideas as a reaction to the previously mentioned questions. The final conceptual idea was chosen pursuant to the time and resources limitation for this project in order to design a concrete concept in time.

The third iteration was the most collaborative in the sense of a design methodology. I decided to organize a co-design session inspired by the Future workshop (Löwgren & Stolterman, 2004). The intention was to bring a new perspective into the design process and validate some of the decisions. This workshop together with a participation at the Startup Camp in Lund ensured higher qualities of a final design. I was able to bring different perspectives and opinions into the project and adjust the designs according to them.
4. The experiment and prototypes

The following chapter reports a performed design work during nine weeks. The initial experiment together with the first iteration had a different research focus. Initially, I wanted to humanise Bitcoin by an exploration of different possibilities for the representation of values in a digital wallet. The research focus changed into the exploration of design opportunities with a Bitcoin as a design material in the context of exchange during the second iteration. The difference between an experiment and iteration is in the sense of complexity, where the iteration covers certain steps as it is described in the previous chapter.

4.1. Initial experiment - Money and Value recognition

The initial experiment had to explore a mental model of preschoolers, which involves the perception of values at this early age. The preschoolers represented a potential focus group for next iterations. The value system begins to form in the early age when preschoolers start to perceive and interact with objects that represent certain values together with an influence of the surrounding environment. I wanted to experience their reaction to different representations of physical objects that represent a certain value.

The experiment was designed as a dialogue between the participant and researcher in a non-disruptive environment to ensure maximal focus on the ongoing activity. The researcher placed different objects that represent elementary values for preschoolers such as a paper money, coins, credit card and banana in front of the participant. Firstly, the participant had to identify all objects. Secondly, the researcher asked questions: What is money?; Can you show me money?; What do you think is most important?

![Figure 6 - Money and Values recognition experiment](image-url)
The participant had difficulties to identify the banknote and credit card. She thought that the banknote was just a piece of paper. Her experience with those objects has not been strong enough to build an association in the brain yet. I predicted that participants will mostly point on coins for the first question and the banana or banknote after the second question. This participant pointed to the coins for all of the questions, see Figure 6.

This implies that the understanding of values is influenced by two stimuli at least. One of them is a monetary value, which is assigned to the medium of exchange. A second influencing factor is the form of the medium of exchange. The representation played a major role in this case because the participant was probably most familiar with the coins as a form of money. An important aspect to take into consideration are children born into the digital age. They do not divide our world into real and digital. They perceive digital space as a part of the complex world, because their online identities, such as profiles on social media channels, are closely connected to their everyday life. Therefore, I am confident about changes in the perception of values and money in the future. This experiment was carried out with only one participant. It is important to perform a more advanced experiment with a higher amount of participants to verify the result. However, the result initiated the preliminary research focus in the direction of representation of values and helped me to envision further direction.
4.2. First iteration - Digital Paradise Café

The initial experiment uncovered the importance of a medium of exchange for the perception of values. The first iteration was aimed to build upon the mentioned exploration, but more importantly, to expand perspective in the field of digital currency and cashless payment systems. The intention was to build empathy by interacting with different users for the subsequent design process during the performed workshop (Snyder, 2003).

4.2.1. Research

The main part of the research was aimed for the exploration of available solutions in the direction of digital wallets and cashless payment systems. A digital wallet represents a medium that enables users to perform certain operations with a digital currency. Exchange of money is the essential operation that a wallet should provide. More generally, the main purpose of a digital wallet is to allow manipulation with stored resources. A wallet is an insufficient tool to perform an exchange between a payer and a vendor. Therefore, I focused on cashless payment systems to obtain an overview of the act of payment in general. I found that the market offers a variety of satisfying solutions to perform cashless payments in developed countries like Sweden and completely different approaches in developing countries in Africa. The following subchapters present current states of the art for Bitcoin wallets and a general overview of cashless payment systems.

4.2.1.1. Bitcoin wallets

A bitcoin wallet represents one of the current states of the art in the field of digital currency, where Bitcoin is perceived as a currency. I evaluated the Bitcoin wallets by criteria, such as first impression, information about Bitcoin, and approach to the security and usability. The test covered nine wallets from available products in the App store. I selected two of them to demonstrate interesting approaches for a design of wallets.

The Breadwallet⁷ is a standalone bitcoin client. This application accesses the user’s bitcoins directly from the blockchain without any server of a provider, which is a not common approach. The overall design of the app did not raise a trustful feeling during the first impression from the perspective of a mainstream user. The impression of a user interface does not create a feeling for a manipulation with money, see Figure 7. However, the main goal is to enable a simple exchange of Bitcoins. This purpose is achieved very well. Therefore, I see the Breadwallet as a good wallet for people with a higher technological knowledge and previous understanding of Bitcoin as a currency because a user does not have to trust to the third party.

⁷ http://breadwallet.com
The first impression of the CIRCLE app\textsuperscript{8} stands in the contrast to the previously mentioned Breadwallet, see Figure 7. The moment of registration with the confirmation email is an important element, however, not always appreciated. This approach breaks the decentralized model by a need of having an account to the services of a third party. However, the act of registration creates a trustful feeling for mainstream users, which can be crucial for building a trust for a manipulation with money.

The essential functionality of the CIRCLE app can be compared with the Breadwallet app. The main goal is to send and receive bitcoins. However, the CIRCLE app

\textsuperscript{8} \url{https://www.circle.com}
presents an approach, which is more convenient for mainstream users as a wallet for everyday payments. This fact illustrates the use of words, where they use money instead of bitcoins e.g. Generally, a user does not need to understand the elements of underlying technology. The user must perceive the meaning of the designed solution in the sense of recognition for a certain use case.

The usability and mobility are the most important elements for digital wallets. Their main use is on the go. The Circle app is evaluated as a current state of the art in the field of Bitcoin wallets for iOS because their iOS wallet has a high degree of usability and the overall brand communication evokes a feeling of confidence and security for a manipulation with money.

4.2.1.2. Cashless payment systems

The cashless payment systems were researched by the online research of available products. The aim was to obtain a general overview of actual possibilities. Currently, the market offers a variety of solutions for individuals, as well as to more advanced merchants. The iZettle\(^9\) is an ecosystem enabling the creation of a terminal for exchange by use of a payment card from the combination of user’s smartphone and additional hardware. The Apple Pay\(^{10}\) is a mobile wallet, where a user can connect his or her payment cards. The use of stored cards is for NFC or online payments. A solution named Poynt\(^{11}\) is expected to be realized during the third quarter of 2015. They plan to introduce the first smart payment terminal that combines different payment options such as NFC, Bluetooth, EMV/MSR card reader, etc. into one device. The research conveyed a very competitive and satisfactory filled market, where further investigation is not contributory in the context of this thesis.

![Figure 9 - The POYNT payment terminal (source: getpoynt.com)](image)

Mobile Money as M-Pesa (Jack & Suri, 2011) represents different approaches to cashless payment systems. The field of Mobile Money grows especially in developing countries. The main use is for micro-transactions. These cashless payment systems appear to be quite refreshing. They have a potential to solve big issues, such as

\(^9\) https://www.izettle.com

\(^{10}\) http://www.apple.com/apple-pay/

\(^{11}\) https://poynt.com
expensive bank accounts. They are not only alternatives to the working system in countries like Sweden. This means that developing countries can pass over several years of development in the financial infrastructure (Végh, 1992). Designing for developing countries is almost impossible if the designer does not have the ability to visit the country in question. The personal experience is important for the development of empathy, proper research and user-testing. Therefore, I decided not to include this field into the design work for this thesis but they are worth mentioning.

4.2.2. Ideation

The representation of values in digital wallets was the most promising direction if I consider the previous research. Values are mostly illustrated in two different ways. The numeric visualisation represents the most dominant one. The second approach is a takeover of tangible mediums of exchange into the digital environment as a direct copy. For instance, this approach uses Apple Pay by duplicating physical credit cards into the digital forms, which are then available in the app to perform certain tasks as with the tangible mediums. The second approach seems to be promising for making sense in the movement of tangible artefacts to the digital environment by direct assimilation because it does not make users think about the differences in different mediums of exchange. The previously mentioned finding influenced the definition of a design opening. I wanted to achieve a design experience that deals with a representation of values in digital wallets — How to represent a value of digital currency in the digital wallet?

4.2.3. Concept

The creation of the concept was not smooth as I would expect. It was difficult to narrow thoughts back down because I reached a high level of abstraction. The second challenge was to find a scenario, where I would be able to design different comparable solutions for the same use case. The experimental idea was to create three different payment options by a digital wallet. I wanted to see how people perceive and react to different payment possibilities, where some of them are intentionally confusing. The confusion was chosen as a trigger for a stronger critique from participants, and to make them think more deeply about their actual behavior.

The concept was created for three payment possibilities:

* choose one card from a range of displayed cards,
* enter an amount of money by yourself,
* use virtual/local currency.

The use case was played out in the café bar called “Digital Paradise Café”, where the participants ordered a coffee, cake and soda. The order was followed by the act of payment, which was performed with the designed wallets.
4.2.4. Prototyping

The prototyping started with sketching of use-cases and storyboards (Buxton, 2010). A designer can be distracted more easily by possibilities of digital prototyping tools in contrast to the paper prototyping. I perceive the paper-pen approach as more promising on the beginning because it is easier to focus on initial ideas. The process of sketching, as well as the mentoring session with Silvia in the USTWO studio, helped me to explore gaps in the concept before I performed the materialisation to the digital form. The paper prototypes were materialized to digital form with the use of Affinity Designer, and clickable prototypes were developed in InVision, which enables the rapid creation of prototypes from designed images.

![Figure 10 - Paper prototyping during first iteration](image)

The designed wallets have an integration of the pain of paying, which is a term from the psychology of money. The pain of paying represents a very strong influencer for the perception of values (Ariely & Silva, 2002). The smart integration of the pain of paying can influence a behavior of a payer. The good side of a smart integration has a potential to help users perceive values in a thrifty way. However, the dark integration can push a payer to spend more money.

The first wallet has simplified and confused visual representation. The intention was not to evoke any emotion or relation to the current representation of payment cards, see Figure 10. The emotion or relation could influence the result based on the personal experience with this tool for exchange. The design was created with the intention to limit the pain of paying by not seeing the amount of money.
The second wallet, see Figure 12, was designed with the intention to increase a feeling of security and the pain of paying when the user has to enter and confirm the amount by themselves. The wording as Trade or Repair were used for exploration of the participant's presence, and deepness of reading and thinking at one time.

The third prototype, see Figure 13, presents a sketch of designed local currency for Malmö city. The intention was to explore the connection to the localism based on the currency. The perception of values together with the pain of paying were implemented as a comparison on the third screen.
Figure 13 - Prototype 3: use virtual/local currency

The session was designed as an experiment for 20 minutes divided into two parts. The first part was the payment with designed wallets, followed by a qualitative research focusing on the aspects of money, digital currencies and localism.

4.2.5. Validation

The validation was divided into an internal and external part, where the internal part was used to improve the overall experiment, before the external validation with recruited participants. The intention of the validation was to explore reactions to designed wallets and to build an overview together with empathy by use of qualitative interviews.

4.2.5.1. Internal validation

The agenda of the experiment was divided into the introduction of the use-case, experiencing the payment with the digital wallets, discussing designed screens and qualitative interviews. The internal validation took place in the studio, where I asked two of my classmates for their participation. The internal validation revealed weaknesses of the designed experiment, e.g. usability issues of prototypes or selection of researching questions. The environment was equipped with coffee and cake, to support a sense of a simulated place and to reward participants for their engagement.
4.2.5.2. External validation

The external validation took place in the office of the USTWO studio in Malmö. The experiment was performed eight times, with different participants in the age range from 26 to 35 years old, working mainly in the digital industry as designers, coders, marketers and business developers. This target group was chosen intentionally because they have a great overview and could be early adopters for designed solutions.

The outcomes of validation for prototypes

The validation confirmed an iconography as sensitive in the context of money. The participants had patterns or stereotypes based on the previous use of wording and iconography. The words were commented on as being more human than icons. I consider as important to follow recommended or coherent wording phrases supported by iconography in this sensitive context, to eliminate negative factors influencing trust.

The second interesting outcome is the relation between digits and money. Participants had formed a direct association between the representation of digits and money. They commented the numeric representation as easy to process. Therefore,
I see the numeric representation as the most efficient option for representation of values during the act of payment.

A local currency was intended to reach a general sense of thinking processes dealing with localism. The local currency mainly brought questions about the exchange rate and distribution. Participants did not see local currency as appropriate for a support of localism. They labeled this sort of currency as a disruptive element, which is making things even more complicated. This is not necessarily true since there are many examples of positive impacts of local currencies, e.g. Bristol pound (Ferreira & Perry, 2015).

The outcome of qualitative interviews

An expansion of different approaches was mentioned in the connection with experience and sharing economy for services such as Airbnb, Uber, etc. Those services are becoming more and more popular. An important fact is an overall experience, which is scalable globally. One of the participants mentioned the preferred usage of global and well-known services instead of searching for local possibilities because of issues with trust.

Certain mental models were repeatedly seen during interviews. Especially at the moment, when we started to talk about money and currencies. Often, participants compared the price of an item according to a strong previous experience. They were trying to be rational in the sense of being confident about the proper behavior. In many cases, however, we are driven by our current state of mind and other influencing factors, where our behavior is very often irrational (Ariely, 2014). Another mental model was connected to the payments abroad when the payer can choose between their home currency and the local currency. People willing to choose something they believe in instead of more convenient choices (Ariely, 2014).

The use of digital technologies should be simple. However, extreme simplicity is not appropriate for a secure feeling, in the view of participants. Some of them see as not relevant to perceive the amount during the act of payment when they pay with a credit card or in the case of micro-transactions. They perceive the value before or backward when they check their balance on accounts. This means that the behavior of payers is influenced by forms of the medium of exchange and concrete use case (Ariely, 2014).

Another interesting fact represents the exchange rate as the problematic issue for people living abroad. They usually keep their home or most used currency as a comparison value for their spendings. The international market has a comparison standard in the US Dollar. Digital currencies have no such standard yet. The value is mainly compared to the US Dollar, and digital currencies are perceived as an alternative to fiat money. Therefore, cryptocurrencies are recognized as trading money or investments. Some participants do not understand this world at all, to others it represented a risky and private enterprise, and some of them are waiting for the meaning to enter. One of the participants mentioned the importance of well-known corporations, e.g. Visa or MasterCard, behind those services, to build a higher level of trust.
The user experience has a potential to grow if we manage to simplify and improve the act of payment together with the overall experience, e.g. covering the waiting time in the queue. All elements of shopping experience are parts of the Experience Economy (Pine & Gilmore, 1998) that designers have to consider during designing in this field.

4.2.6. The evaluation of the first iteration

The designed wallets were used as a tool for the experiment. Their main purpose was fulfilled, and minds of participants were brought into the topic. The level of confusion is not easy to set properly, and designers must work carefully not to annoy participants during these experiments. The qualitative interviews helped me to bring a fresh input to the project, build an overview about mental models of participants and showed me the importance of the overall experience with clues towards sharing economy. The empathy was strengthened, and some outcomes strongly influenced the following design process as a redirection towards overall experiences instead of dealing with just a piece of the chain.
4.3. **Second iteration - Going back and beyond**

The second iteration started with an evaluation of the first one. I was prepared to work on the ecosystem that supports the perception of values based on the cash flow reports retrospectively. The numeric representation was found as a good way for users to efficiently process the information during the act of payment. The focus for the perception of values should be intended for a different moment when the awareness will not disrupt the overall experience of exchange. However, the supervision before the second iteration opened a question of knowledge contribution for this solution. The development of this solution would probably generate another incrementation of an existing product. Thankfully, the previous validation brought a question of meaning in the current use of Bitcoin. Some participants would like to enter this field, but they miss meaningful experiences. I did not have visionary ideas for meaningful experiences at this moment because of lack of knowledge and expertise. Therefore, I decided to take one step back to review outcomes and to research new possibilities of Bitcoin in a closer detail to build a better base for ideation.

4.3.1. **Connecting dots about Bitcoin**

Bitcoin as a cryptocurrency is usually recalculated to some of the national currencies for the exchange rate purposes. The exchange rate is one of the issues that triggers a limited perception for Bitcoin as a technology for exchange purposes. Currently, the most common is the recalculation to the US dollar. However, the initial design of Bitcoin aims to provide a payment system for the exchange of values over the Internet (Nakamoto, 2008). For this reason, I perceive limits in the current use of Bitcoin as a standalone cryptocurrency because the general intention is to use Bitcoin for the exchange of values over the Internet. Another possibility is to perceive Bitcoin as a technology that offers possibilities for a manipulation with different digitized commodities (Gerber, 2015). Ascribe[^12] and Onename[^13] are one the first services that use the underlying technology of Bitcoin called blockchain to record data into this ledger. This approach has a growing popularity because even big banks are interested in different possibilities for use of blockchain[^14].

The IDEO FUTURES has been one of the strongest influencers on the way to change a perception of Bitcoin. They published important series called Humans + Bits + Blocks by Weiss et al. (2015). This series is interesting for Interaction designers. They work with Bitcoin from the perspective of users benefits instead of placing this cryptocurrency to everyday life as fiat money. Bitcoin is presented as a technology for the exchange of digitized values on the Internet. We can take into the consideration that Bitcoin and more specifically Blockchain can be used for a manipulation of any property that is digitized. The digitized property can represent a simple information about user accounts or digital art or something completely else. Bitcoin can be even

[^12]: https://www.ascribe.io
[^13]: https://onename.com
[^14]: https://innovate.ubs.com
considered as a design material for use cases that are out of the current scale of
digital currency. However, the overall integration of blockchain into the everyday life
must be built on something that people will understand and trust from the very
beginning.

The perception of Bitcoin as a design material requires changes in the view on terms
as money, exchange, transaction, medium of exchange, etc. These terms must be
perceived on the philosophical level. Otherwise, it is almost not possible to change
rooted mental model about the exchange that are common in the mainstream
perspective. This approach is called Disruptive thinking (Williams, 2010), and
represents a way of thinking that produces an unexpected solution. In my case, this
unexpected solution is the use of the Internet as an exchange article, which can be
perceived as a kind of alternative currency, where Bitcoin represents a technology for
the infrastructure.

4.3.2. An exploration of the concrete use case

Sketching has been the main methodological approach for the development of new
ideas during the second iteration. The intention was to explore possibilities for
exchange experiences in the use of blockchain as the main design material. The
different variations of a perspective triangle were combined during the ideation, where
the principles of sharing economy were the most promising to apply. Bitcoin as
a technology allows to initiate a peer-to-peer exchange. This kind of exchange is
meaningful between people, and interaction designers mainly design for people.
These associations pointed on the logical connections for use of sharing economy as
a set of principles for the following design work because of direct similarities with the
properties of Bitcoin.

Figure 16 - An ideation session for sketching of a direction for the third iteration

I was able to produce several use cases that deal with the perception of values,
online identity, an exchange between different entities and digitized articles as
mediums of exchange. The process of synthesizing brought two major directions. One of them is an idea of the alternative currency that is used by devices in the concept of the Internet of Things. The second idea is an exchange system for communities in the coworking spaces. Both directions were validated with professionals on co-design, and by users of mentioned shared places during performed interviews. The intention of this validation was to obtain a sense of their experience for chosen issues and to verify the feasibility of chosen ideas. The interviews took place in Medea, STPLN and MINC because of direct connections to those places. The interview questions were followed by a discussion, where ideas were described in paper-based sketches. When the process of interviewing finished, the work continued by observations and users shadowing for a building of a further sense about selected places. Before the final decision was made, I considered criteria as overall feasibility and available resources for the following work. I decided to follow the direction of the alternative currency for connected devices because this idea had the most promising prerequisites to be finished in time. The initial idea was enriched by an additional layer that contains elements of sharing economy because I wanted to involve people in the design process.
4.4. Third iteration - United Øresund

The third iteration was more fluid in comparison with the first iteration. I found some limits in the strict compliance of the Lean UX approach (Gothelf, 2013). Instead of that, I decided to perform the design work more naturally, where a priority was defined by a current need for the ongoing process. The overall iteration contained the three major parts. The first part was focused on the further development of the abstract idea from the second iteration. The second part was divided into two parts: development of the concrete idea with the organization of the co-design session. The third part was dedicated to the development, implementation and validation of the conceptual idea for a specific use case.

4.4.1. Bringing sharing economy to the design process

The combination of blockchain and sharing economy seems to be promising for a design of peer-to-peer exchange. The blockchain offers a technological platform that supports the exchange between entities by recording transactions in this ledger. However, I needed to research further theoretical and practical views on this economic movement to involve sharing economy into the design process. The aim was to explore further possibilities for future transactions, where the sharing economy could dominate. The research was mainly focused on an exploration of practical examples, where a digital property became a resource for the exchange article. In this sense, FON fits into this frame and can be labeled as a current state of the art in the connection to the conceptual idea.

FON\textsuperscript{15} is a global WIFI network. The company offers services and products in the sphere of wireless communication and access points. Users can purchase their WIFI router, and become a member of the global network, which shares the Internet connection. FON’s routers create a crowdsourced WIFI network. The network is centralized, and the exchange is not peer-to-peer because FON poses as the middleman with strong managing power. Their product fits into the expected parameters covering principles of sharing economy because they use the digital property as an exchange article.

The method of experience mapping by Quattlebaum (2013) was performed for the main product of FON. Their main product is a router, which enables users to become a part of the global community that shares the Internet. The intention of mapping was to gain a better understanding of the logical functionality of this product. The experience mapping was divided into the definition of users, principles, touchpoints, channels and the user journey finished the experience mapping.

Fon users can be divided into the two groups. The first group contains members of the FON network. There are three ways to become a member: become an owner of the FON router, or a user of the partner telco provider, and buy credits for use in exchange. The second group is labeled FON for business, which provides WIFI for business places, e.g. cafés. FON provides several services such as analytics,

\textsuperscript{15} https://fon.com
marketing tools or customization in the business package. An offer of ubiquitous wifi, a decrease of overload for 3G or 4G and to provide global crowdsourced free WIFI are the core principles.

![FON app screenshots](source: Fon App for iOS)

The performed research showed eight available hotspots in Malmö during the first days of May 2015. The hotspots map is available online on FON’s websites, or as part of the app, which is available for iOS and Android, see Figure 17. Three users were shortly interviewed about their experience with FON. All of them concluded that, while the idea is very promising, however, the system often does not work. The user journey was experienced for the use case, where I wanted to buy credits for usage of available WIFI hotspots through their iOS app. The registration with the setup of Internet profiles went well. However, I was not able to buy credits, and that caused the end of my journey for their iOS app. The service seems reliable, and the core business does what it is supposed to do well, even though the experience is not positive.
4.4.2. The conceptual idea

The majority of us are owners of resources that can be shared for use of someone else. The wireless routers provide the Internet connection continuously. They are not always in our use because these devices belong to the certain place. The question is: how to use their potential more sufficiently? One of the possible solutions is to initiate an exchange in the sense, where a user provides some of his or her resources to the community, where he or she is a part of, and he or she can use certain resources of others in return, see Figure 18.

The conceptual idea is developed on the basis of the previously mentioned abstraction. The general principle is that members of the community exchange the ability to connect to the Internet with each other through the shared signal. The shared signal is broadcasted by their WIFI routers, and the shared connection is labeled as the exchange article. This exchange article has the same meaning as the medium of exchange, but this phrase was recognized as more understandable during discussions. The exchange is established as one-to-many in the connection to the peer-to-peer business model. The Internet connection represents an alternative currency within this community. However, this kind of exchange requires a mechanism to ensure trust among members of this community. The technology beyond Bitcoin has a potential to ensure needed trust by placing blockchain to the infrastructure as a ledger. This overall exchange approach illustrates the fact that digital currencies are not just complementary currencies to fiat money, but pure technologies that can be used beyond the mainstream perception of money. Figure 19 illustrates the overall concept.
I perceive the global scalability as the biggest advantage of this concept. Users still have to pay for their home use of the Internet, but they are connected in other places around the world as well. This approach decreases the overload of mobile networks and provides a more sustainable solution. The user experience should increase as well because the Internet connection becomes part of every connected device when the connected areas will be covered sufficiently. The exchange in this ecosystem is built on the principles of sharing economy. People become producers and consumers based on their current use of the system. The active members of this community may become active collaborators (Botsman, 2014). This collaboration has a potential to improve social relationships as well because more technically skilled members could provide a favour to less by helping them with the set-up of the shared signal on their devices.

4.4.3. The design challenges of the conceptual idea

A designer has to deal with the following necessities, which were explored during the design process and evaluated as important:

The shape and form of a transaction

- Which kind of information or data has to be recorded?
- Maintenance of the services
- The approach to the user’s identity
- A definition of technicalities beyond the user interface
- Rules for the community members
- Touch-points between system and users
- Minimal sharable resource - parameters of a shared resource

Technical necessities for the implementation

- Development of firmwares for routers to split a signal in a secure way without any impact on the owner
- A variety of interfaces for users and devices management

Figure 19 - A scheme of the concrete idea for a global crowdsourced WIFI network
• A back-end platform that supports the use of blockchain

The proposed ecosystem has prerequisites to be useful and fully feasible. The most important thing is the users experience in the case of overall signal coverage. A user can perceive the created experience as their home WIFI on the go, which is not possible yet.

4.4.4. The concrete use case - United Øresund

The concrete use case took an inspiration from the issues of the Internet connection in the Øresund region. The Øresund bridge connects Denmark and Sweden. However, users lose their Internet connection on the way to one of those countries without the usage of roaming. The wireless access points are place-specific, and we cannot take them on the go yet. The principle of shared exchange has a very strong potential to be applied in this case because I could stay connected by providing the Internet connection to other members of a community. The available access points can offer a shared signal with the same parameters all over the world. The solution connects existing access points and creates a global network of one community, which shares the Internet connection in a secure and reliable way. This is a difference in comparison with the service provided by FON, where a user has to purchase a router or become a customer of some Telco providers. The FON users are dependent on the third party, and once FON decides to close their business, the overall network will most probably terminate. The visionary idea requires concrete and focused approach for the specific case. Therefore, the exchange ecosystem is designed in the relation to the defined issues of the Øresund region.

The main element is the participation of the community members in this exchange ecosystem. They have to provide their Internet connection to use an access point of someone else. There is a need for some rules because something has to guide users behaviour. For this reason, I defined the minimal version of rules that cover basic principles and the most potential issues connected to this kind of exchange, see Figure 20.

Figure 20 - Proposed rules of the community

<table>
<thead>
<tr>
<th>Proposed rules of the community</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To get connection must provide connection.</td>
</tr>
<tr>
<td>2. Internet usage just for legal activities.</td>
</tr>
<tr>
<td>3. All users have same privilege in the community.</td>
</tr>
</tbody>
</table>
Every community is formed by their users. The Internet enables to be “anonymous”. The anonymity is not appropriate in the perception of the current Internet in my opinion. Actions taken on the Internet are comparable with actions taken on streets e.g. The digital identity is in hands of users because their online identity can be perceived as a mirror of behaviour that creates a basis for a reputation. User profiles challenge the issue of identity, see Figure 21. The intention was to define a profile with minimal options. The identities of users could be accessed via blockchain, as it is in the central place and used for multiple purposes. Similar behaviour can be seen e.g. by login via social media profile.

![Figure 21 - The user profile proposal](image)

Blockchain could be used as a storage for data about connected devices as well. Usage of blockchain will ensure that the system will run, even, when some of the nodes are down. This behaviour is important for sustainability because it is not dependent on the central authority as a company or certain servers. Therefore, the system will run until users provide the Internet connection.

The blockchain records transactions to ensure the requirements of the exchange ecosystem. Every transaction should contain at least the following details:

- ID of transaction
- ID of owner // pool of users that are co-owners of the access point
- ID of device
- Last time one

The parameters of a shared signal must be defined to ensure the fairness in the exchange. The intention was to define parameters for a mainstream use of the Internet:

- Download speed - 10 mbit/s
- Upload speed - 5 mbit/s
- Latency - max 100 ms
- Time for hotspot - max 30 minutes
Possible touch points for users interaction with the designed network:

- **Browser** - information about the concept, full functionality, community forum
- **Mobile** - divided into the app and mobile web - importance of relevant information on the websites for users that are not using the app
- **Bigger mobile** (tablet) - web + app, full functionality for device management
- **Small mobile** (watch) - informational app with e.g. map

Inspirational features for the implementation are illustrated on Figure 22. The building of relationships should be supported by profiles of members, community forum and by the possibility to provide assistance from more technically versed members. Those features are difficult to define further, as long as the core of the exchange ecosystem is not fully developed.

![Inspirational features for the implementation](image)

**Figure 22 - Inspirational features for the implementation**

The design of interfaces is the main tangible outcome of the performed prototyping process together with the illustrations of the concept. The overall process was carried in the rhythm of paper prototyping, followed by design of HiFi prototypes intended as a tool for the conversation and demonstration during the validation. The following figures reveal the process and parts of the last prototype, see Figures 23, 24, and 25.

![Sketches and prototypes created during the third iteration](image)

**Figure 23 - Sketches and prototypes created during the third iteration**
The HiFi prototype was developed based on validated paper prototypes. The validation was performed with another designer and a potential user with the explanation of my intentions on the LoFi sketches, see Figure 24. The feedback was considered and some of the mentions incorporated into the designs. The screens were designed in Sketch, and the functional prototype was created in inVision. Figure 25 illustrates a selection of designed screens.

The proposed concept should be feasible to implement according to the outcome of the validation process, where technical, economic and social aspects were validated with a variety of professionals during the Startup Camp 2015 in Lund. The validation process was carried mainly during interviews and the following discussions after presentational pitches of the concept. The validation does not include typical user testing and deep qualitative verifications because this kind of an explorative and conceptual work does not allow to perform those kinds of techniques.
4.4.5. The evaluation of the third iteration

The validation process brought importance for precise explanations to the different focus groups. A user does not care about the underlying technology in most cases. The benefit or meaning of the overall experience is the most important aspect for users. Therefore, the concept was described without mentioning the underlying technology in the end to validate the general direction. People started to think differently when the act of payment was removed from the transactions. They were willing to be more open and close to each other. One of the participants realized that it is meaningless to keep ownership of things with potential to be interconnected and shared. This sharing mechanism needs an element that supports trust between participating parties. Blockchain has parameters to fulfil this need.
5. Synthesis and reflection

5.1. Synthesis

The ambition of this report is to demonstrate the possibilities for the initiation of a peer-to-peer exchange with use of the underlying technologies beyond Bitcoin. This ambition is achieved as a retrospective reflection based on the performed explorative research during the thesis project. The thesis project consisted of three iterations, one experiment, and a literature overview. These activities generated results that answer the research question - How might we initiate a peer to peer exchange with use of the underlying technologies beyond Bitcoin

United Øresund represents one of the concrete conceptual possibilities that answers the research question of this thesis. This concept consists of three main layers in connection to the perspective triangle. The first layer covers the exchange article and defines the elements of a future transaction. The participating members create a community, which exchanges this article within this community. This community belongs to the second layer and has direct connections to the elements of sharing economy. The overall ecosystem requires a technological solution to ensure trust between the members of the community. Blockchain, as the third layer of this concept, has a back-end function to record and keep all transactions in this exchange.

The exchange article is a crucial part of every exchange. The participating parties use this article for exchange between each other. Nowadays, the providing party receives a reward in the form of fiat money in most cases. On the other hand, the pure barter system exchanges commodities directly without the use of fiat money. Historically, this system was found as inconvenient because it is difficult to find the equal properties for commodities in the physical world. However, the digital environment provides an ability to create a sample, which is globally scalable and the value is technically equal. Therefore, the ability to connect to the Internet can be used as an exchange article in a similar way as in the pure barter system without the inconveniences of this system.

Nowadays currencies represent one of the concrete implementations of abstract term “money”. A variety of different currencies can be perceived as an access key to different opportunities. The most common are payments with fiat money. This money can have different physical or digital forms. The digital age experiences can be designed without the usage of fiat money at all if we move towards abstraction and perceive money as an agreement within a community to use something as a medium of exchange (Lietaer, 2002). This creates a discussion about the exchange article. I argue that an exchange article is a kind of currency in the connection to the chosen definition of money. The exchange article represents a sort of alternative or social currency because it fits into this definition in the context of the overall exchange.
Fiat money can be perceived as an untrustworthy element in the exchange. The establishment of trust between participating parties is a more important element of the exchange because today’s currencies have a similar purpose as well. The performed design work and research revealed a possibility for a future exchange, where fiat money does not participate at all. The decentralized technologies in combination with the elements of a sharing economy may initiate an exchange without the participation of middlemen as well. This demonstrates the design of the third iteration by use of shared medium of exchange and community-based approach, where blockchain replaces a position of the middleman. This approach requires changes in the user behavior because the decentralization excepts a higher responsibility together with a participation of users. There is no one in the fully decentralized system, to whom users can turn with their difficulties in an official way. Therefore, every user should deeply consider actions taken with decentralized cryptocurrencies that are used in the same way as fiat money because this system does not provide support as banks nowadays.

The purpose of newly defined digital currencies is not to eliminate or replace dominant national currencies. Their purpose can be perceived in the sense of alternatives. These alternatives have a potential to increase or change the user experience by their meaningful implementation. A digital currency like Bitcoin should be perceived as a technology in the first place. This technology offers certain parameters that can be used for a design of different use-cases. However, it is more than important to consider a currency just as an element that belongs to the exchange and not to overlook other elements. The future of digital currencies may be no currency at all, but rather to make resources available and to give greater access to the opportunities of this world.

5.2. Designing with Bitcoin

The design work with Bitcoin requires a high level of technological understanding. I perceived Bitcoin as pay money, and this implied the limited research focus at the beginning. This perception changed at the moment when I moved beyond the mainstream mental model by taking one step back for further research. Retrospectively, the wrong naming and definitions very strongly influenced this limited perception. Now, it is clear that a Bitcoin wallet is not a wallet but it is a keychain, and the basic units of Bitcoin are not coins but transactions... All those small details supported the inaccurate interpretation of Bitcoin possibilities. These findings required a sufficient amount of resources for explorations of relative materials. Otherwise, I would be unable to break those stereotypes and design a concept that has the potential to bring expected knowledge contribution in the context of this thesis.

The technology alone is not strong enough to evoke meaning. The capabilities of technology must be married with specifics of human beings. This marriage should be certified by interaction designers because their mission is to bridge different fields with the intention to create meaning and values. The technology has to be combined with additional elements to evoke meaning. An essential way is to initiate a peer-to-peer exchange between people. The combination of Bitcoin and Sharing economy
has promising parameters to be applied for the future design beyond the digital currency, where the main focus lies in the exploration of peer to peer exchange.

5.3. Reflecting upon the design work

The preliminary work started a few months before the course. I wanted to challenge myself in a field that is complicated, and where results could have a huge impact. I did not have a vision at the beginning, but I had a working field. Now, I see this approach as more difficult, because a designer is limited to his or her chosen field, where he or she tries to formulate a vision based on discoveries. The theoretical grounding is mandatory for designers that decide to contribute to the field of digital currency because the overall topic is complex and sensitive. I was not sufficiently aware of theoretical grounding during the project proposal because I did not find a concise source of information at the beginning. Therefore, the direction changed during the design process a couple of times. However, I do not perceive these changes as inappropriate because they are part of an iterative design approach that is just not incremental. The following three observations represent the most important knowledge contribution based on the overall design work.

The perception of values is more difficult in the digitized society. I was able to validate this hypothesis during the first iteration. Users have difficulty with the perception of values in the case intangible mediums. The numeric representation is the most efficient approach to process a value during the act of payment. The representation of values or property in the digital environment could be based on the emotional relationship, or other triggering factors making users aware of different perspectives.

The act of payment will become secondary for a future transaction in some cases. Customers will go directly for a certain experience that holds expected qualities. This movement illustrates services such as Airbnb, Uber, eBay, etc. These services are usually place-specific, but scalable and understandable on a global level. Users will be able to decide more efficiently because of globally recognizable experiences. The possible disadvantage is a monopoly for certain stakeholders and limitation of happiness during exploration. This will probably not happen since users can choose from alternatives.

Cashless Societies will continue with global expansion. There is a possibility of movement into “moneyless societies” because of an ability to use different articles in the exchange. The moneyless approach is not only promising when it comes to conceptual advantages but for improvements in a social sphere as well. Relationships in a society can be improved by not using fiat money in the exchange between people, according to the validation of United Øresund, where participants were willing to share even more than just the Internet.
5.4. Plans vs. Reality

The main intention of the third iteration was to have an experience with the design process of an ecosystem powered by blockchain. The knowledge gained from this experience has a high value and can be used for other cases in the future. Frustration and incomprehension are common during design work with new technologies, and their application in disruptive use-cases. However, the impact has much higher potential in comparison with the incremental innovation. For this reason, I would choose a similar topic and try another approach because this method allows me to fail very often without major losses.

The plan was to develop three prototypes during three iterations. I was focusing more on concrete prototypes as products, instead of perceiving the prototype as a tool to reach an answer to a certain question. This finding is important for me because I did not perceive this strongly enough. This experience helped me to develop a design mindset during this thesis. Now, I perceive the design process in a different way than before. This will probably not happen without the application of critical thinking and learning by doing to the design work.

The design methodology or guidelines can be limiting because creativity is an important element of the design process. This happened to me during the first iteration. I applied the Lean UX methodology in a strict sense, where I was more focused on the execution of the processes than the design work. Therefore, the methodological guidelines should be a source of inspiration for personal adaptation of the design process, based on the needs of a designer to deliver the expected result.

In the beginning, I said that the intention of the exploration should be focused on the meaning of technology. I was not correct in this statement. The direct exploration of meaning for the technology is useless. We, as designers, must go towards the direction of meaningful concepts, where available technologies support the realization of our visions.

5.5. The next steps

Organizations and companies such as IDEO, MIT, IBM, etc. participate actively in the field of digital currency. Growth is expected based on interviews with people from a variety of international companies in the next quarters. Especially, outcomes presented by IDEO and MIT are sources of inspiration and knowledge, which had a high impact on the development of this thesis. The intention was to select the most promising openings from my perspective to provide starting points for future work. The openings are combined as a selection of resources by The Future Lab (Future Lab, 2015) and IDEO Futures (Weiss et al., 2015).

- What could transactions look like in the future?
- How might new participation platforms help people to build and exchange reputation or trust?
- Where can blockchains allow us to eliminate middlemen?
• How might micro-payments emerge and flourish in the world?
• Where can blockchains make service interactions more seamless?
• How might new businesses take advantage of what will be lower transaction costs?
• Where is unique content on the Internet important?
• How can blockchains help the sharing economy to fulfill its promise?
• How can the essence of bitcoin be of help to certain groups of people or individuals?
• How can blockchains remove the anxieties of exchange between people?

A variety of property or commodities can be used in the exchange where blockchain is applied to ensure trust between participating parties.
6. Conclusion

The highly detailed use-case is important for valuable validation and new input to the design work. The vision can have a global ambition, but it is important to start with a concrete implementation, which has prerequisites to produce expected knowledge for further work. Participants of the validation process must understand the meaning of the designed concept. The proper validation is difficult for concepts with a similar character to United Øresund. Those concepts can be validated, on a variety of perspectives, as logical, business, social, cultural or quality of design decisions. All these validations are just on the surface level until the service is implemented and used for a sufficient amount of time. I evaluated the award during Startup Camp in Lund 2015 as sufficient, together with offers for the investment into the further development of the concept for the validation purposes, because people and resources are crucial for the movement forward.

Bitcoin as a technology may have nothing to do with currencies in the future. The technology can be applied in some cases to ensure trust between participating parties in the context of the exchange. The current implementations demonstrate the initial possibilities that have been grasped for further development such as in the case of United Øresund, where a community-based exchange is more valuable than paying transactions with fiat money because this approach brings a stronger social aspect, which is more than needed in the current society.
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Appendix I. - The questions for qualitative interviews

The following questions were asked during the qualitative interviews of the first iteration.

The selection of research questions used for qualitative interviews:

- Introduce yourself: work position, age, characterise your shopping behaviour?
- What means money for you?
- What do you think about digital currencies?
- Do you see a difference when you are using different payment methods? Body state, shopping behaviour?
- Do you feel in control of your incomes and outcomes?
- What is your opinion on pre-paying or using credits for micro-transactions or regular shopping?
- How important is the feeling of being local to you?
- Are you using any finance-oriented app?
Appendix II. - The Future workshop

The Future workshop is mentioned in the book Thoughtful Interaction Design (Löwgren & Stolterman, 2005) in the section about methods and techniques. The concept development, concretely ideation, can be difficult at the moment when a designer works alone without the participation of other team members. Therefore, I decided to organize a co-design session inspired by the Future workshop, to bring new input to the concept development during the third iteration.

The Future workshop is, in essence, a method for participatory, social and organizational development. The aim of the Future workshop is to clarify the common problems for future users or stakeholders in their current situation, to create visions about the future, and to discuss how these visions could be realized. The setup of the workshop was modified to achieve the intended result.

Critique, fantasy and implementation are the three phases of the future workshop. The outcome should be a plan for further work. The plan specifies what, when and by whom it is going to happen. The main objectives were a clarification of issues in the concrete idea, the creation of a possible vision for the following implementation, and a discussion of options for the realization in case of different focus groups.

The workshop was designed as a twenty minutes session with a group of my classmates. The overall workshop covered six consecutive stages that were designed as exploratory or task based challenges for participants supported by a variety of offline materials.

Figure 26 - The preparation of materials for the workshop
The list of stages mapped to the stages of the Future workshop

- **Critique**: Definition and possibilities of the blockchain
- **Critique**: Explanation of FON with focus on the principles, users and touchpoint with description of the selected use case
- **Fantasy**: Group brainstorming with triggers connected to the field of WIFI
- **Fantasy**: Description of a concrete idea
- **Implementation**: Focus groups
- **Implementation**: Triggering questions for new input to the project

**Possibilities of blockchain** - simply reading out key possibilities of blockchain is not strong enough for self-explanatory purposes, because the level abstraction is too high to imagine something concrete. I recommend to use examples with selected keywords, or to include this stage later, when the concept is presented.

**Explanation of FON** - the outcome of the user journey for the FON was presented to participants with a suggested way for more appropriate implementation. This step was not necessarily needed, because a significant amount of time was lost during explanations.

**Group brainstorming** - the group brainstorming was performed as questioning with the intention to trigger discussion on connectivity, usage of WIFI and user behaviour in connection to the use of the Internet. The connection between questionnaire and brainstorming was found very fruitful, because an answer of one participant generated comments of other participants.

**Description of the concrete idea** - an explanation of a concrete idea brought a lot of questions about functionality of the overall ecosystem. There were three main questions: how the transaction should look like, how the earning should be set and how issues with illegal content should be dealt with. The following discussion influenced the final design because it was not laborious to implement changes.

Figure 27 - The discussion during the workshop
Focus groups - the overall group agreed that this service should have as little interaction with users as possible. This means that the overall functionality should be atomised sufficiently.

Triggering questions for new input to the project - the session was closed with question cards with the intention to bring final input to the concept development. The question cards contained the following questions:

- Do you have some vision of how it could help you?
- Which elements should be offered by the ecosystem?
- Where do you see touch points?
- How could the ecosystem look like?

The answers extended their previous input and the discussion was following a similar character as before. The following bullets represent the most interesting outcomes of this workshop.

- The interaction between users and the system should be automated as much as possible, because the service is a middle step for diverse achievements over the Internet.
- Hardly or not at all connected places could lead to frustration of participating users.
- The exchange rate between virtual currency and usage of the Internet connection can be problematic.
- An issue of users illegal activities and responsibilities of owners together with decentralisation.
- The setup of fair-use policy that will make users want to use the system.

The overall evaluation of the workshop may sound disappointing, because the prepared materials were overloaded for the designed session. The immediate evaluation was very negative, but it changed with hindsight. I had a feeling of not receiving the expected input for the development, but the outcome influenced the final concept very strongly.