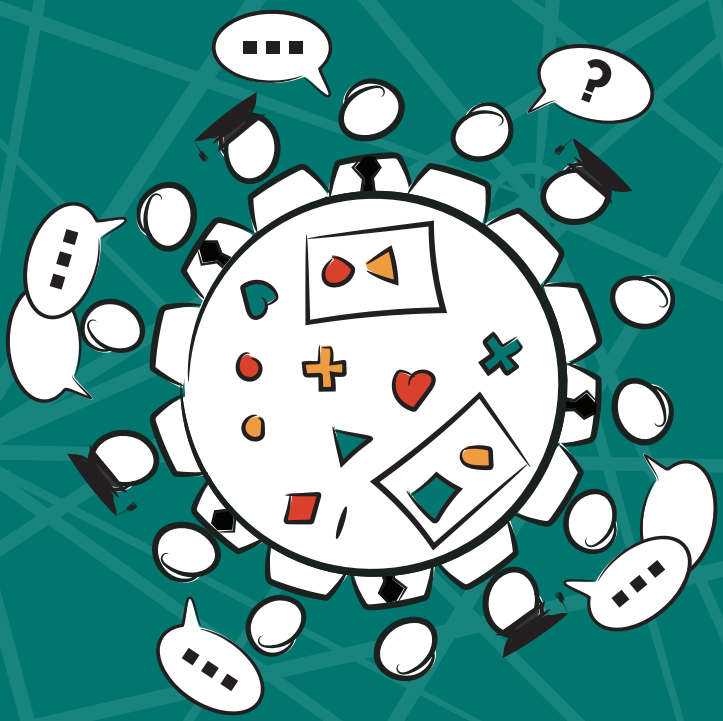
Consider the impossible

Helping collaborations discover common ground through the promises of blockchain.



Sander van Welsem

Consider the impossible

Helping collaboration discover common ground through the promises of blockchain

Double degree master thesis
Delft, March 2019

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Preface

Executive summary

The thesis in front of you has set out to explore what the impact of the combination of strategic and communication design can be for the adoption process of distributed ledger technology, more commonly referred to as blockchain. To structure this process, this thesis is divided into four parts. In this summary, the results of each part will be briefly discussed. This summary ends with a brief reflection on the general results.

Discover

The first part of this thesis focusses on discovering what information is already known about distributed ledger technology (DLT), its development, the innovation process and the current status of its adoption. What was found, is that most companies working with DLT are currently residing in the incubation phase. This means they focus on experimenting with the technology to learn about and develop the technical basis. This development causes three problems, which can be explained with the DLT-innovation figure below.

As mentioned, DLT-development is a technology push movement, focused on exploring the technology (1). This has caused DLT-enthusiasts to neglect the areas of 2) desirability (wanted/

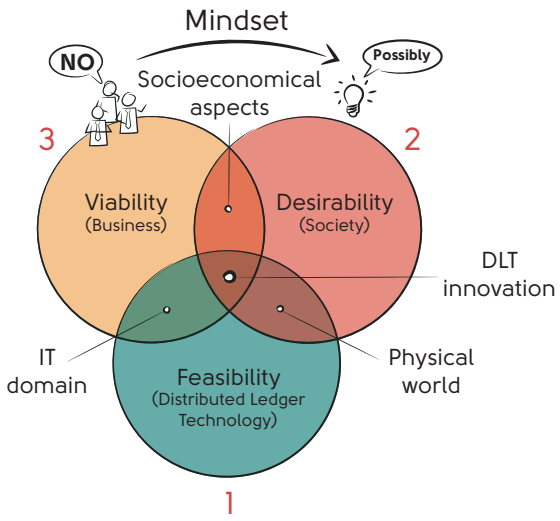

Figure 1: The six lenses of DLT-innovation and the three main problem areas

needed solutions) and 3) viability (business propositions). The neglect of these areas has caused a chasm between enthusiasts and the majority of business and society, creating an adoption problem.

Define

In the next part of the thesis, research in practice was done by interviewing eleven DLT-professionals. This research, which elaborated and built upon the insights of the first part, revealed two things. First, DLT and its disruptive potential depend on collaboration; as the technology provides opportunity for sharing data, only by working together new meaning can be created. Second, what DLT-adoption needs to cross the chasm, is a way to change the mindset about current DLT-development. Where now sceptics tend to focus on the viability of the technology, they should think in terms of socioeconomic possibilities. This renewed focus is needed to stimulate the disruptive development of distributed ledger technology, which depends entirely on fruitful collaboration.

To form these insights, this phase ends with a design brief. This design brief sets out to create a tool that helps both enthusiasts and sceptics of DLT by bringing them together and letting them explore the possibilities. The focus of the brief lies on creating a joyful, immersive experience for people new to DLT, that ultimately should broaden the mindset of the sceptics.

Develop

In the third phase of this thesis, the design brief is broken down and translated into a theoretical hypothesis model. This model consists of a set of theories that can be used to reframe a current context into a future scenario. With this model as the foundation of the design, a quick ideation is performed, aimed at creating a simple prototype. This prototype consist of two canvasses. The first focuses on creating an overview and understanding of the ecosystems in which the enthusiasts and sceptics operate. The second aims at exploring how DLT can influence the system to tailor its future needs.

Deliver

The final chapter of this thesis consists of a series of iterations that move from the first canvasses to a final set of four canvasses and an individual booklet. However, this does not yet conclude the thesis. As the thesis aims to find out what the impact of communication and strategic design can be, the insights that are gathered through the testing and the final reflection on these insights, create the final result of this thesis.

Conclusion

What was found, is that strategic and communication design are two fields that compliment each other in just right way to influence the adoption of DLT. Through the iterative and user focused process of strategic design, tools were created that help people to understand the complexity of DLT through a simple and smooth experience. At the same time, communication design provided the exact approach needed in guiding a group of people through the multiple layers of complexity of DLT-ecosystems. By understanding the abstraction of their own context in contrast to the technological possibilities, new understanding and appreciation of networked-collaboration was created. This new-found appreciation should ultimately result in a foundation of common ground and understanding, upon which the adoption of DLT can be built and spread.

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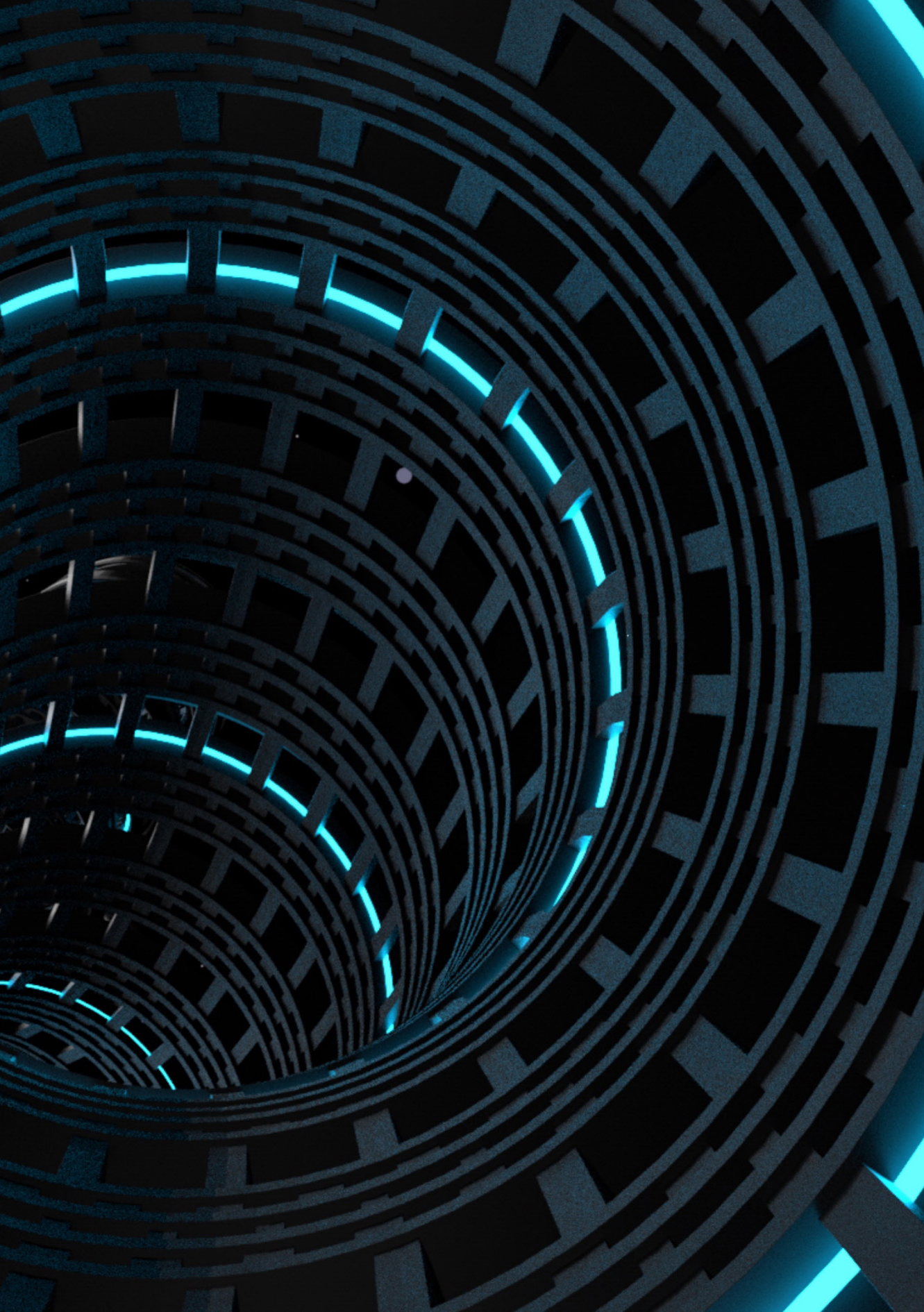
1. The thesis



1.1 Introducing the thesis

In the last couple of years blockchain has been booming. There were huge price hikes in cryptocurrencies like Bitcoin, but inevitably similar losses. Blockchain babies were born and blockchain marriages were registered. Blockchain helped the Chinese women to speak out their #metoo stories, without censorship. These examples are just some of the applications of blockchain; potentially as ground breaking as the internet. Yet, if you ask any person in the streets, they'll say it sounds like hocus pocus. Distant music they neither know nor like; society simply doesn't understand its existence.

> *Whereas most technologies tend to automate workers on the periphery doing menial tasks,* ***blockchains automate away the center****. Instead of putting the taxi driver out of a job, blockchain puts Uber out of a job and lets the taxi drivers work with the customer directly.*
>
> -
>
> Vitalek Buterin (Founder Ethereum)

This thesis will dive right into the technology that is known as blockchain. In this introduction its existence will briefly be explained, after which the researcher's background of communication and strategic design will be introduced.

Blockchain is mostly known as the technology behind the Bitcoin and other cryptocurrencies. Thus, what most people believe it to be is an online bank that isn't really a bank. This however is the wrong way of looking at it, as cryptocurrencies are simply one of the many applications. The technology behind this, that is what is referred to as blockchain, or the more technologically accurate name: Distributed Ledger Technology (DLT).

As the quote by blockchain guru Buterin shows, distributed ledger technology allows decentralized automation. This means as much as creating networked connections between any type of peers, without there being a supervisor or third party to rule or govern the system. In simple terms, a digital system where Alice can digitally trade with Bob directly, without the need for a bank or a licensing office such as a notary. Furthermore, distributed ledger technology also allows machines and even networks to trade and transact information directly, without limitations. In case of machine to machine communication, this is commonly known as the Internet of Things (IoT).

1.1.1 DLT design and innovation

The premise of distributed ledger technology is to create systems that can share information in a fast, safe and secure way, without the barriers of current transactions. Such barriers include physical limitations like third parties (e.g. banks), but more importantly it regards socioeconomic issues such as trust and ownership. The design of distributed ledger systems therefore treads a fine line between both the digital world and its influences on and in the physical world. When looked at from a designer's perspective, the different aspects of

DLT-design and, perhaps more importantly, DLT-innovation, are best defined as shown in figure 1. What this model shows, is that the complexity of DLT-innovation lies in its potential to impact all foundational aspects of both business and society.

As distributed ledger technology has such broad potential, it is often compared to the TCP/IP protocols that are the backbone of our modern internet. These protocols allow any person to connect to the internet and use it as they see fit. The outcome is a society that has greatly benefited the many possibilities, but that has also created many new vulnerabilities. On a daily basis there are data leaks, identity theft schemes, fraud and other crimes existing mainly through the digital world. If the development of the internet can teach DLT one thing, it is that one needs to be prepared for anything and everything. To steer its DLT-innovation in the right direction, business and society need people who can envision the broadness of possibilities, but at the same time address to full complexity of the potential issues.

1.1.2 The impact of strategic design

What has changed since the early days of the internet, is the development of the field of design. Where in the early days it focused mainly on physical form and function, modern design looks to impact every aspect of business and society. When looking in particular at the field of strategic design, design is being used to facilitate and accelerate innovation. It can help organisations to find guidance in choosing the right path to deal with rapid developments such as the internet or distributed ledger technology. The designer's methods and tools aim to create a broader understanding of the needs and values that are relevant to all parties in an innovation project. They address and connect all three fields of successful innovation according to the three lens model by IDEO, which make up the core of the six lens model shown in figure 1: feasibility, desirability and viability. This makes strategic designers well equipped to deal with the problems of innovation on all fronts needed.

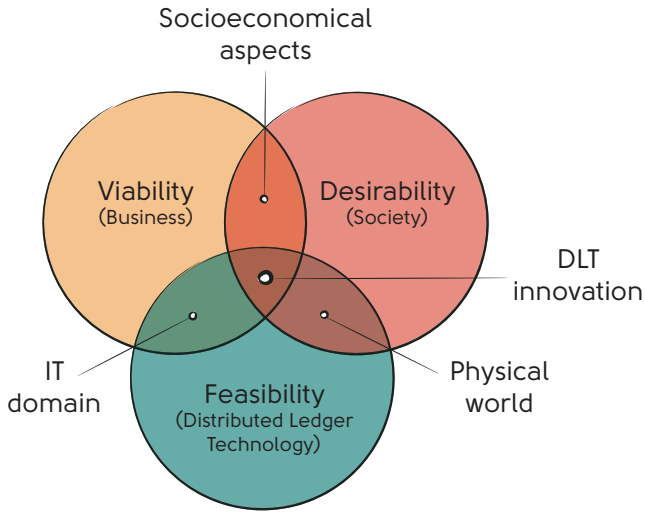


Figure 1: The six lenses of DLT-innovation

1.1.3 Need for communication design

The broadness of distributed ledger technology means it can have impact on a micro as well as a macro scale. Meaning, it deals with individual (end) users in the same manner that it deals with large societal structures. To address such a complexity in abstraction, communication design for innovation is used. While strategic designers are excellent at working on a highly detailed level of understanding, they are not very well equipped to address problems on a macro scale. Communication designers can deal with a divergence of perspectives on the broadest scales possible. Communication designers operate as the connectors between the abstract and the concrete layers of a project.

1.1.4 The best of both worlds

Distributed ledger technology demands its developers to look beyond their individual boundaries. The technology has the potential to create connections and collaborations between everyone and everything on a scale that is not seen before. This makes its development inherently complex. As much is unknown, there is a need for guidance. Guidance in the form of those who understand all relevant fields, players, needs and values, and guidance from those who can tackle issues at a diversity of abstractions. In my opinion, what DLT-innovation needs is a combination of strategic design and design for communication.

1.2 Research aim and objective

This master thesis is the result of a combination of two master studies in the fields of Science Communication and Strategic Product Design. With this combination in mind, the project searches to apply the best of both worlds in order to find, create and apply new knowledge to advance the process of distributed ledger technology innovation.

As the field of distributed ledger technology is still young and immature, the aim of this project is to *understand what drives its creation and what can be done to advance its development*. It does so by researching what impact design and communication can have on the field of DLT-innovation. The help of new disciplines is needed, as current DLT development is halted by a complex set of problems, both in the digital and in the physical world, that cannot be solved by the IT-industry alone.

To achieve this aim, the current state of distributed ledger technology development is analysed both through theory and practice. The barriers and enabling factors that arise from this research, combined with the knowledge from both study fields, is then used to design a set of tools to aid part of the development process of DLT. These tools, their iterative design process and the evaluation of their use, create a variety of useful insights and links to theory, that will form the conclusion of this research.

1.2.1 Knowledge gaps

On a first glance, there is a wide range of research ongoing in the field of the development of distributed ledger technology. A common topic is the current technical limitations of DLT (Aste et al., 2017; Mylrea & Gourisetti, 2017; Swan, 2015). Furthermore, researchers lay bare the regulatory and ethical challenges that are created by the advancement of DLT (Böhme, et al., 2015; Ducas & Wilner, 2017; Kiviat, 2015). Lastly, there is a vast amount of inspiration available on the potential impact the technology can have on a wide variety of sectors, from banking to logistics, from social and medical to industrial.

There is however, apart from the technical advancements, little knowledge available on the actual impact distributed ledger development has on business and society. Questions about the socio-economical impact of distributed ledger systems as a collaborative construct or a vessel for change, remain largely unanswered. Even though it is known from the development of the internet that digital change can impact the core of societal and industrial life. Whereas the media like to focus on everything it is not or every promise it has yet to deliver on (Haegens, 2018), research falls behind when looking at the possibilities for DLT as a catalytic means rather than a goal in and on itself.

1.2.2 Significance of this thesis

As described by the aim, this thesis seeks to understand the potential of DLT-development and use both its benefits and disadvantages to strengthen and accelerate the developmental process. In doing so, it fills the gap between current research, which is mainly focused on understanding its technical abilities and limitations, and the underexposed domain of socio-ethical problematic.

For the field of Communication Design for Innovation, which is part of the department of Science Education and Communication, this thesis aims to explore topics such as inter-organisational collaboration, the anticipation and appropriation of new knowledge in a socioeconomic setting, and the communication of new technologies in business and society.

For the field of Strategic Product Design is one of the three pillars, this thesis seeks to contribute to the areas of *networked innovation*, *design for emerging technologies* and *iterative tool building* with the aim of creating strategic insights.

For the combination of both fields of communication design for innovation and strategic products design, this thesis seeks to apply their knowledge in a context that is still relatively new to both worlds: networked software design. However, primarily it combines the two fields to seek how they complement each other and to find what strengths lie in their overlap, which is the primary focus of this research. In the end, the significance of this thesis lays in the insights generated by the combination of both fields.

1.3 Problem identification

In order to further the development of distributed ledger technology, it is wise to first understand the difficulties DLT-innovation faces. Through researching available literature, making observations and doing interviews, a list of five problems is compiled. These difficulties, which are displayed per area in figure 2, will briefly be discussed in their order of appearance.

1. Experimentation

DLT is in its nature an IT solution. The technology field is still young and immature and has just passed the hype (Panetta, 2018), as can be seen in figure 3. Currently, there is little knowledge on how to program DLSs and how to use them. Time is needed to experiment, causing most companies to hang around in the incubation phase, see figure 4 (Beck & Müller-Bloch, 2017).

2. Technology push focused

As most companies are in the experimental phase, their focus is mostly on the technology itself. Almost all projects are driven by technology push innovation, to understand its technological potential.

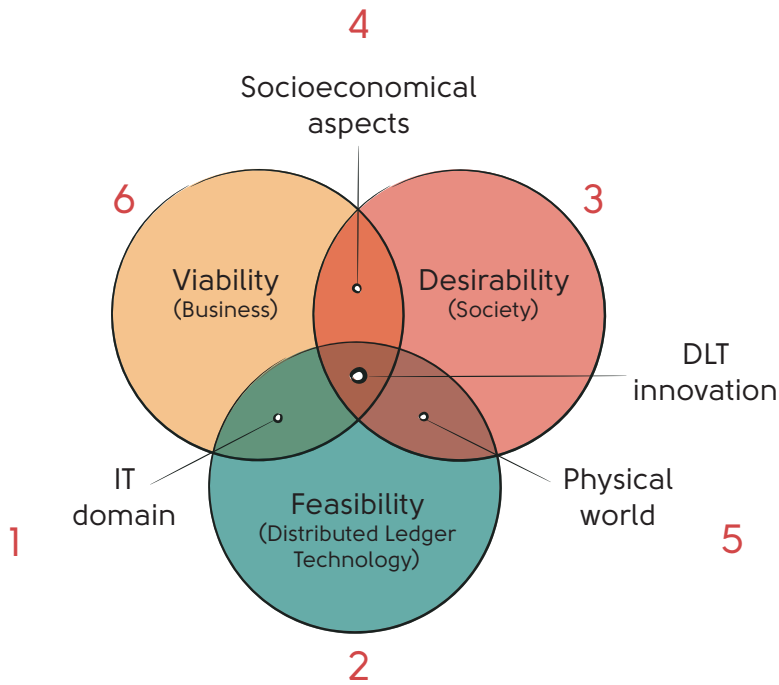


Figure 2: The six problems areas of DLT-innovation

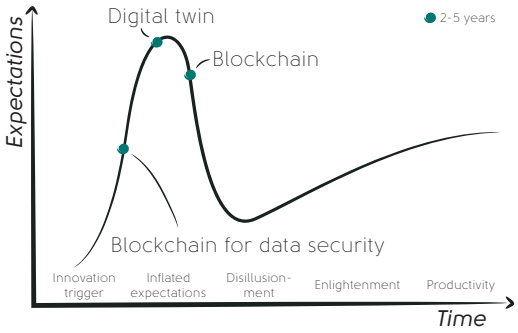


Figure 3: Blockchain hype cycle by Gartner (Panetta, 2018)

3. *Desirability is neglected*

There is little focus on the (end)users and other influenced stakeholders in DLT innovation, due to its technology push nature. Desirability is neglected and projects run into problems as they do not address a need or create desire.

4. *Discussion on socioeconomic issues*

As desirability is largely neglected in DLT-development, most discussions and barriers in the studied projects arose in the socioeconomic domain.

5. *Problems with link to physical world*

Directly related to problem 4, the largest barriers are found in the link with DLT to the physical world. Digital identity confirmation (digital twin) is one of the biggest discussions on DLT and it's far from developed; shown in figure 3.

6. *Viability is the biggest obstacle*

As there are no direct needs to address or desires to fulfil, companies and societies at large find themselves wondering of what value DLT is to them. Currently, the naysayers and sceptics have the overhand and adoption is slowed by their influence on the early majority both in business and society. This has created a chasm in the development and adoption of DLT, as can be seen in figure 4.

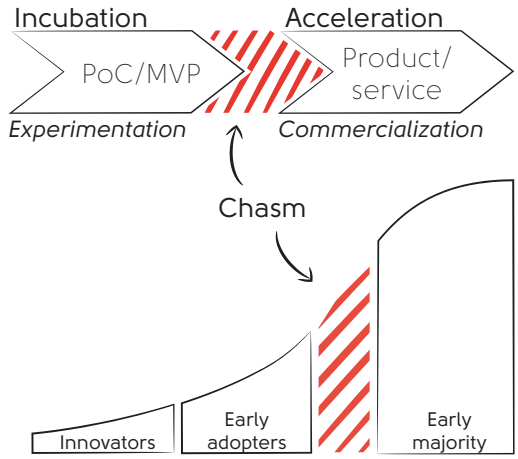


Figure 4: DLT innovation and adoption chasm

These 5 factors combined make up the problem framework of DLT-innovation. What complicates the situation is that all factors influence each other, as if they were in a complex ecosystem themselves.

1.3.1 Problem statement

As mentioned, the problems of DLT-innovation are quite complex and elaborate. As the development of the technology needs time, the problems regarding IT and feasibility (1 & 2) will not be addressed in this thesis. In order to maintain a focus in line with communication and strategic design, this thesis will focus mainly on trying to address the naysayers and sceptics by taking them along in the development process. This leads the scope of this thesis to focus mainly on problems 3, 4 and 5: the adoption chasm as caused by the lack of focus on the socioeconomic aspects and viability of DLT-innovation and the impact this has on the desirability of the technology.

To summarize, DLT-innovation is a new technology which has just passed the hype and is mostly run by enthusiasts with an IT background. Currently, the focus of these enthusiasts is on getting to know the technology, but they are not equipped to address issues regarding desirability, socioeconomic needs and viability. This is why there is a need for others to step in to help the adoption of DLT development and innovation. The problem statements this thesis addresses is as follows:

DLT-development is halted by those who cannot see past its current lack of viability. As the values and needs of society and business are largely neglected, a chasm has appeared which halts DLT's adoption. What is needed is an outside perspective in order to help and look past the current boundaries and to create true desirability.

1.3.2 Research question

As this thesis aims to explore what the impact of strategic and communication design can be in the development and how it can help with the adoption problem of DLT-innovation at hand, the research question takes this as its main focus:

How can combined strategic and communication design be applied to aid adoption of distributed ledger technology?

This research question is further defined by the following sub questions (SQ):

***SQ1:** What are the current needs in the adoption process of distributed ledger technology?*

***SQ2:** What is the role of collaboration in the adoption of distributed ledger technology?*

***SQ3:** In what way is design currently used to aid the adoption of software products and services?*

***SQ4a:** What are the current barriers and enablers of DLS development in practice?*

***SQ4b:** What is the role of collaboration in DLS development in practice?*

***SQ4c:** How can design tools be used to aid the needs for the adoption of distributed ledger technology?*

1.4 Approach

To find an answer to the research question, a structured process will be followed. Having a structured process allows a designer to apply different methodologies in such a way that they strengthen the outcome. As this thesis is also about understanding and applying the process of the designer, it is important to understand the different steps and iterations. This chapter will describe the followed structure and show which steps were taken in order to arrive at a well thought through discussion and conclusion.

1.4.1 Double diamond model

If you ask designers where their strength lies, they will most likely mention their ability to rethink, reframe, and reconsider every move they make. This reflective mindset is best defined as the ability to iterate. Following this logic, most designers prefer a methodology that allows such behaviour, while also forcing them to reach a conclusion or a final design. The method used in this thesis to do so is called the Double Diamond model as created by the Design Council (n.d.). This model, which is shown in figure 5, consists of two diamond shaped phases, that each go through a divergent process, followed by a converging stage.

The main ideology behind this model is that it considers the iterative process to be two-fold. First, divergent thinking is used to discover the broadness of research and insights available, after which convergent thinking drives the designer to define and make choices as to what matters most. Following the same process, in the development stage, the broadness of ideation and idea creation is explored, after which the deliver phase focuses on working towards an end-goal. Both the divergent and convergent stages force the designer to use his skills to the best of his abilities. On the one hand, to explore all options and on the other, to make the right choices.

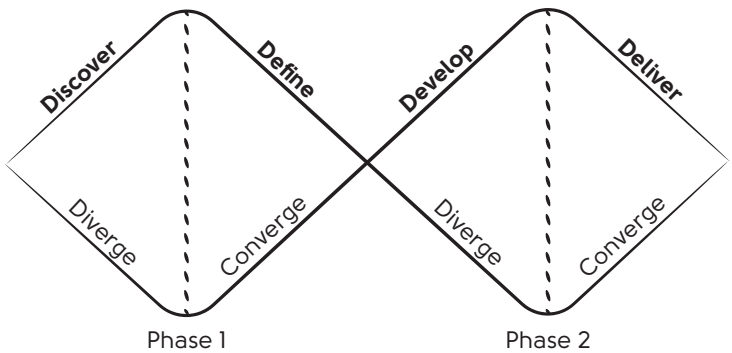


Figure 5: Double Diamond model (Design Council, n.d.)

1.4.2 Design Based Research

As this thesis seeks to find what the impact of both strategic and communication design can be, the final deliverable is not a design itself, but the reflection upon this design. This way, the thesis can serve as an exploratory basis for the application of design in networked software development. A sector that is relative unknown in the field of design. For this reason, a secondary methodology is introduced: Design Based Research.

Design Based Research (DBR) aims to use the design of processes and instruments to create knowledge through the application of both theory and practice. Their combination helps "both researchers and practitioners recognise theoretical blind spots from a practical point of view and practical blind spots from a theoretical point of view" (Sanden & Meijman, 2012, p.8). What makes this type of research particularly suiting to this thesis, is that it is built through collaboration, which is also the basis for the often inter-organisational process of DLT-development. Besides, as DLT-innovation is such a young field in the IT-domain, DBR can help to fill the gap between the only recently created field of academic research into DLT and the practical application of DLT in real life.

Much like the Double Diamond model, Design Based Research follows a four-step process (Eady, 2008). This process, which is shown in figure 6, is also aimed at being continuously iterative in nature. It starts with an analytic phase, which looks to explore both literature and practice. Next, solutions are developed, again with the help of existing practices. Here there is also the possibility to reconsider certain parts of the analysis and problem definition, if need be. Third in line is the iterative testing, which happens through the use of prototypes in practices. As this process may take multiple cycles, in which every time solutions are refined and put to the test. This allows iteration on the solution itself but also on its use in practice. The latter, is what the reflection stage mainly looks at. It aims to create new design principles and create theory on how to enhance the implementation of solutions in practice. The final deliverable is not just a design, but also new insights and reflective additions to existing knowledge.

As this thesis aims to find what the use of design can be in the development of distributed ledger technology, and how it can aide its developmental needs, Design Based Research can help by creating knowledge. It does so not only through theory but also through practical observation, interviews and primarily tests.

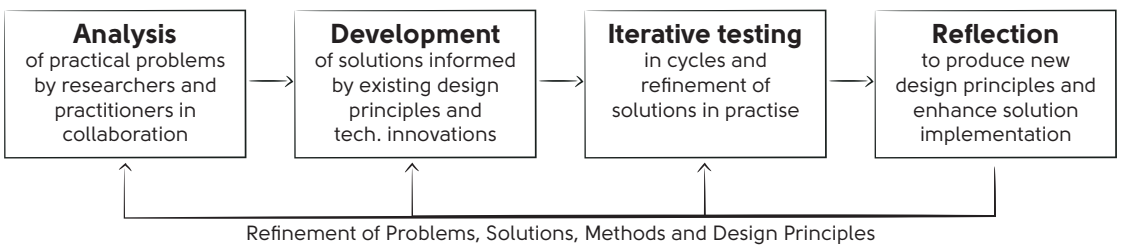


Figure 6: Design Based Research (Eady, 2008)

1.4.3 Combining Double Diamond with Design Based Research

As mentioned, this thesis aims to explore the use of strategic and communication design in the process of DLT-development and DLT-innovation. In order to allow both the field of strategic design and communication design to flourish throughout the process, a combination of the Double Diamond design ideology together with Design Based Research is proposed. This allows the researcher to follow the divergent and convergent steps of design, while also aiming produce theory on how design can be applied.

The combination of both methods is shown in figure 7.

As can be seen in figure 7, the process starts of as a regular design process. But from an early stage outside perspectives and practice are brought into the process through observations and conversations with DLT developers. When looking at the larger process steps of DBR, the combined model shows that analysis envelops the whole first diamond, where the rest of the steps are put more towards the end. This is done to create an alternate ending to the process, through the means of creating useful insights rather than a finalized design than a finalized design. Which is in line with the research question.

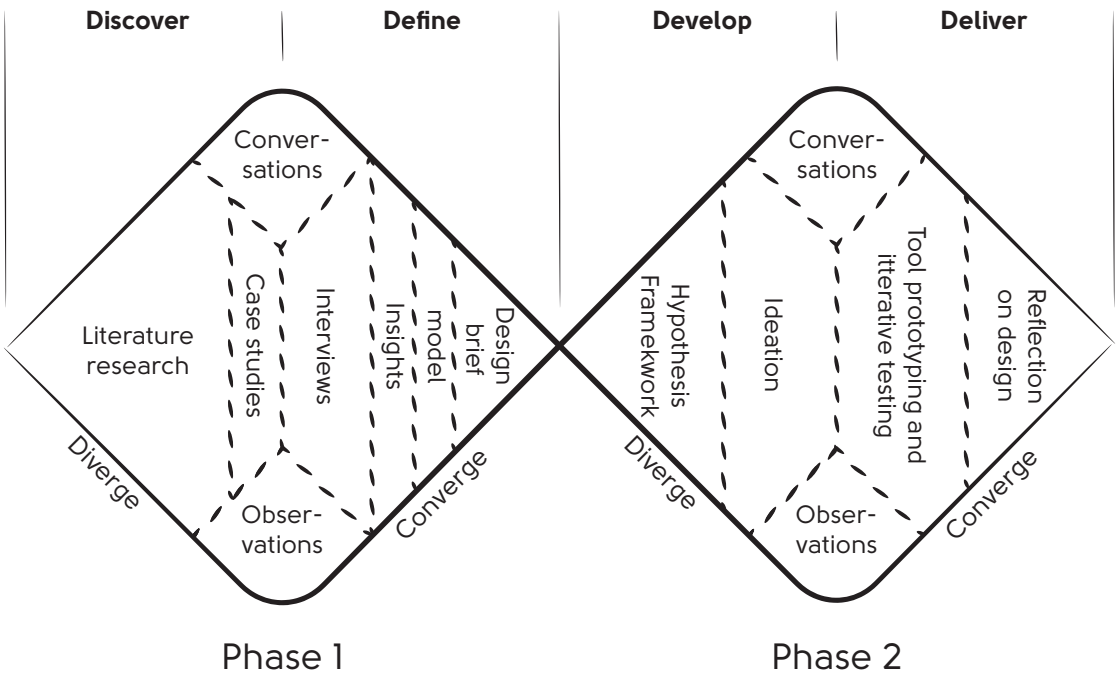


Figure 7: A combination of the Double Diamond model and Design Based Research

1.4.4 Applying the DD/ DBR model

As shown in figure 7, the combined model contains different steps to reach the end. These steps are more accurately explained in figure 8. Here, the red line throughout the process is shown. Each of the steps on this line will return in the different chapters of this thesis. What can be seen most clearly in this model, is that the process itself is rather messy and iterative as well. There is a continuous flow back and forth between theory and practice, allowing both sides to pick up where the other can't, filling the blind spots on the go.

Important to note are the red circles, which indicate a conference. These conferences are all focused on distributed ledger development and offer a great insight into what different stakeholders from the industry considered relevant. These events are used mainly to observe, but also to ask questions and interact with the participants at these events. The findings and insights of these event will be woven into the other findings and observations from literature.

To explain the different steps of the figure, each part and the build-up of the specific methods will briefly be discussed.

Discover

The Discover phase primarily aims to create a broad and divergent understanding of what DLT is and what it can do. This is done through doing basic background research into the technology. Next, a more detailed literature research is performed, based on the first three research questions. The exact methodology of this search will be discussed in the relevant chapters. To

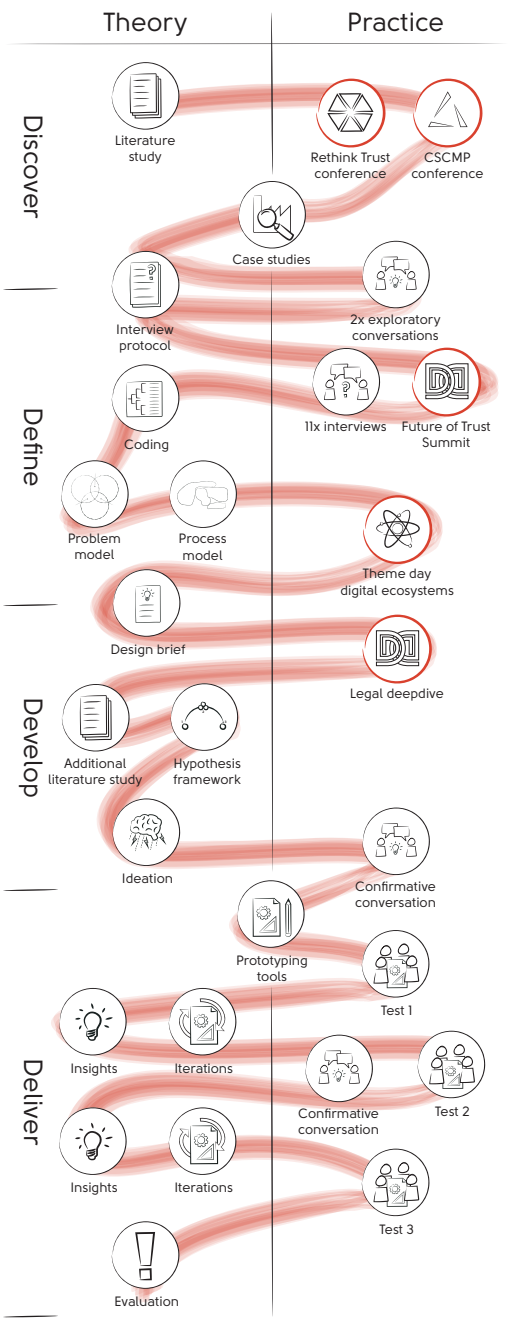


Figure 8: Process overview

ensure the design-based research methodology is guarded, the choice was made to also include knowledge gathered from conferences and case studies. This way the findings from theory can be verified in practice, creating a more wholesome story.

Define

After the discovery phase has dug up a broad set of insights, the define phase is used to converge towards the end of the first diamond, the design brief. This convergence is done through arranging a set of interviews from practice that will aim to answer research questions 4a&4b, scoping the found theory into a problem statement. This part primarily uses practical knowledge, such as interviews and observations, as this way, a clear and concrete image can be formed about what the biggest needs and demands are in the adoption of DLT. The methodology for this part is found in chapter 3.

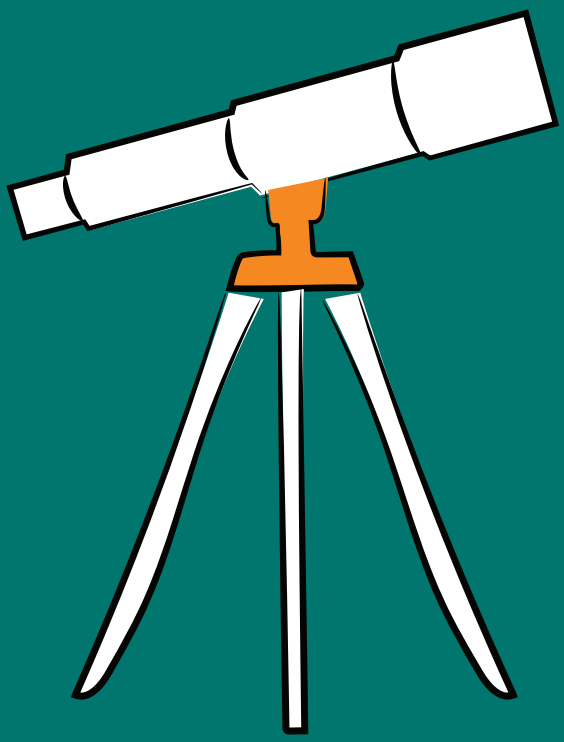
Develop

With the gathered knowledge from both theory and practice, and the design brief that follows from that, the design process is kicked off. As this stage is about both diverging into the creative phase and preparing for the iterative testing and reflection as mentioned in DBR, this part is split in two. First, an additional literature search is done to create the grounds for theoretical reflection. Here a specific combination of methodologies is chosen to offer guidance and to create a hypothesis. The latter is important, because the aim of this research is to produce new insights. Next, the create phase is started, which builds upon the gathered theories by exploring what possibilities both strategic and communication design offer in connection to the found methodologies.

Deliver

The deliver phase is focused solely on creating new insights. Therefore, it was chosen to immediately test the first rough prototype, tool 1.0, and start learning right at the beginning. From there, insights were gathered and adjustments were made for a new test. This process is performed a total of three times, in order to gather enough insights, as well as to show how this process can help create and iterate toward a better design. As is common in design-based research, this chapter ends with a broad reflection on the design and the gathered insights. This then forms the basis for the conclusion of this thesis.

2. Discover



In this part:

Literature study

Case studies

Rethink Trust conference

CSCMP conference

2.1 Introduction

The first part of this chapter, as explained in the approach, is the discovery phase. This phase aims to diverge into the depth of literature in order to create a wholesome overview of the knowledge on the different subjects that relate to this thesis. To scope the search, a set of research questions was formulated. Once a saturated number of theories is found in order to answer the research question, this phase will be concluded. The specific questions this part of the research dives into are:

> ***SQ1:*** *What are the current needs in the adoption process of distributed ledger technology?*
>
> ***SQ2:*** *What is the role of collaboration in the adoption of distributed ledger technology?*
>
> ***SQ3:*** *In what way is design currently used to aid the adoption of software products and services?*

The discovery part will do research in three major fields, in order to answer the research questions. These fields are Distributed Ledger Technology, Collaboration in Distributed Ledger Technology and the role of design in IT-development and.

In general, the process followed in this part of the thesis is that first a number of elements of the theory on a specific topic will be explained, after which the concluding remarks look to sum up the relevant insights. From these insights a concluding model is made that will serve as a foundation for the rest of the thesis.

Case studies

As this thesis follows a Design-Based Research approach, insights from practice are seen as equally valuable to theory in the research process. To ensure that the discovery part does not merely focus on theory, the perspective of practice was added through case studies.

Blocklab, the DLT fieldlab

In the part that researches DLT in theory, the perspective of Blocklab is added. Blocklab is a logistics and energy fieldlab specialised in developing DLT-application together with industry. The fieldlab status means they do not only develop DLT, but also facilitate learning in connection with both the academic and the business world. Through interviews with their two founders, relevant insights into the practice of DLT-development were gathered and findings from the literature search could be verified. A full introduction of Blocklab can be found in appendix xx.

The giants of the IT industry

For the second section of the research in this part of the thesis, the four companies on the left were studied. These multi billion-dollar companies are renowned as leaders of the disruptive IT-industry and they show good insight in how design can be used to influence IT-development, but also what the limitations of design are when it comes to the broader impact of disruptive services. The full case study document can be found in appendix xx.

Conference visits

In some chapters of this part of the thesis, the observations from the Rethink Trust and CSCMP conferences will be used to provide an insight in how the current industry is evolving. These observations served to gain practical insights and confirmation of the found theory.

2.2 Background: Distributed Ledger Technology

2.2.1 A brief history of blockchain

This chapter starts by exploring all basic aspects of distributed ledger technology in order to create a good understanding of the technology. To get to know DLT, it is wise to start at the beginning, back in 2008: the conception of the Bitcoin. In the midst of the infamous financial crisis of that year, the last day of October a mysterious pseudonym named Satoshi Nakamoto published a white paper called Bitcoin: A Peer-to-Peer Electronic Cash System (Nakamoto, 2008). In this paper, Nakamoto prompted the Bitcoin, a simple peer-to-peer electronic cash system, "based on cryptographic proof instead of trust … without the need for a trusted third party" (p.1), or central authority like a bank. The birth of the cryptocurrency.

At first, the paper circulated among a select group of believers, but come early 2010 it started to gain some real traction. The revolutionary proof of feasible peer-to-peer transactions was heralded as the transactional foundation that the fourth industrial revolution, "the age of smart manufacturing", "industrial internet" and "integrated industry", had been looking for (Hofmann & Rüsch, 2017; Schwab, 2015).

Now, ten years later, Bitcoin and other cryptocurrencies have swung up and down faster than the average rollercoaster, giving it the reputation of a stock exchange rather than a stable online currency. At the highest point in 2017, Bitcoin hit its highest value of 19,126 BTC/USD, after which it dropped by about 40% in a mere six days. During the writing of this report, it dropped volatile lows of 3,247 BTC/USD, leaving many to believe the bubble of Bitcoin is slowly bursting (Wolf, 2018).

Are journalists such as Wolf right? Are the believers obliviously standing at the deathbed of the roaring yet short-lived life of the blockchain? No, quite to the contrary. Like its predecessor, the modern internet and the TCP/IP protocol that is its backbone, blockchain follows the familiar path on the hype cycle by Gartner, as seen in figure 9 (Panetta, 2018). The bursting of the bubble and the wide scepticism of the effectiveness of the technology means it has just passed the peak of inflated expectations. Many challenges have risen and the technology is finding itself in the deep trough of

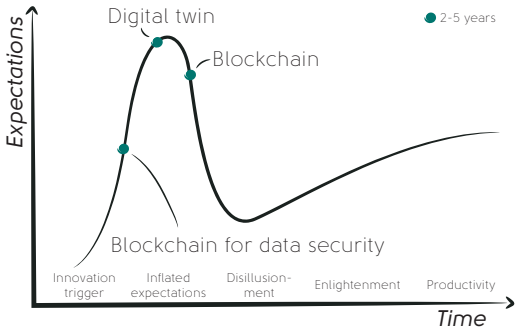


Figure 9: Gartner's hype cycle 2018 (Panetta, 2018)

disillusionment. This is a hopeful development, as this is where the slope of enlightenment begins.

Currently, new platforms and technological innovations are popping up everywhere, revolutionizing their respective industries. New forms of networks arise, private and public, alongside which new types of technology make their entrance. These new forms have also surpassed the traditional blocked network form, to be explained in chapters 2.3, creating the need for a new, more suitable and scientific terminology: Distributed Ledger Technology.

2.2.2 Blockchain in academia

Similar to the rise of the bitcoin course, the academic interest in blockchain and distributed ledger technology has risen exponentially. When looking through Scopus and Web of Science, the first published research naming blockchain appears in 2013. As can be seen in the graph from Scopus in figure 10, it has since grown exponentially. Early 2019, Scopus reported 3,026 documents who mention "blockchain" in their title, abstract or keywords, showing the huge interest editors have taken into publishing on the topic.

2.2.3 Defining the distributed ledger

As the research curve shows, blockchain and distributed ledger technology contributions have grown exponentially in research. The abundance makes it hard to come up with a solid definition for DLT. The most cited paper on Scopus, *Blockchains and Smart Contracts for the*

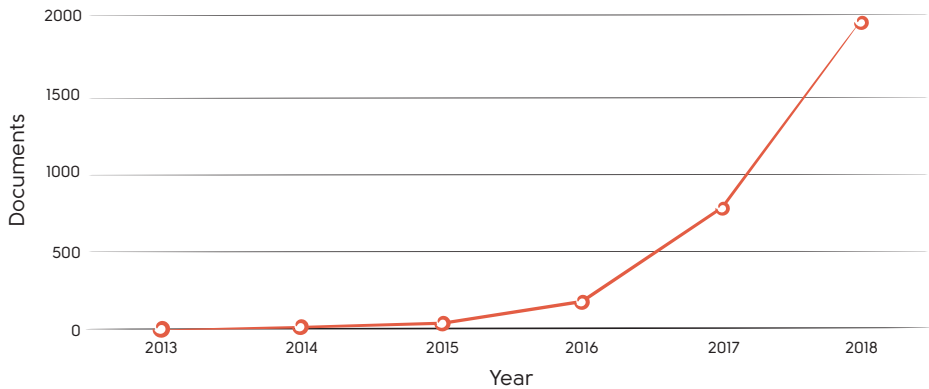


Figure 10: Scopus results on TITLE-ABS-KEY (blockchain)

Internet of Things by Christidis & Devetsikiotis (2016) defines it like so: "A blockchain is a distributed data structure that is replicated and shared among the members of a network" (p. 2293). In this network, cryptography is used to chain each "block" to the next through a signature, adds Walport (2016), another highly cited author. "This allows blockchains to be used like a ledger, which can be shared and corroborated by anyone with the appropriate permissions." (p. 17).

After a more careful analysis of a number of atoned research papers, it becomes apparent that the term "blockchain" itself does not always cover the right technology. Therefore, it was decided that in the furthering of this thesis the term distributed ledger (technology) will be used as the standard.

A distributed ledger consists of two things, namely a distributed network and a ledger. Because Nakamoto (2008) wanted to create a network of peers, the network needed to have a distributed nature. Figure 11 shows the types of network that are generally defined:

- Centralized: *a central node*
- Decentralized: *network of nodes*
- Distributed: *network of peers*

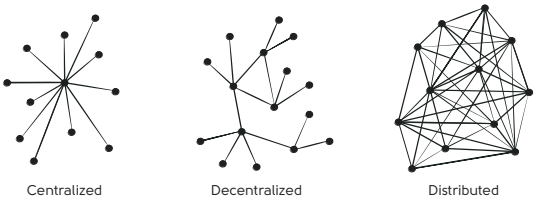


Figure 11: Types of networks

In DLT, across the distributed network, a single ledger is maintained. Historically speaking, a ledger is a book containing the accounts to which debits and credits are posted from books of original entry. In other words, a list of transaction outcomes. In a distributed ledger network, every node or peer has a copy of this ledger. When a new transaction comes in, all peers update their ledger accordingly. This way the entire network has an overview of current statuses, which allows them to check each other.

2.2.4 The technological basis of DLT

To understand why distributed ledger technology is seen as such a revolutionary means, the technological basis of DLT will briefly be explained. A more detailed explanation can be found in appendix XX.

In a regular secure database, anyone with a key can access the data and edit or update it to their own desire. However, when two entities want to trade data between databases, who is to say that the original data is honest? Trust and integrity are integral in trading, especially with new partners. Up till Nakamoto's invention (2008), you either had to truly believe the other party or go through an independent third party like a bank. Both being costly and time consuming.

What Nakamoto proposed is a system that can check and control itself. A system where anyone can trade with everyone, without any third parties or oversight. His theory is that if there is a large enough number of digital peers that agree with each other, >50% of the group, the whole group can reach agreement or consensus.

The technology, as can be seen in figure 12, is best summarized as follows. When someone makes a transaction, this needs to be added to the ledger. This update is sent out to the network, together with a unique number, called

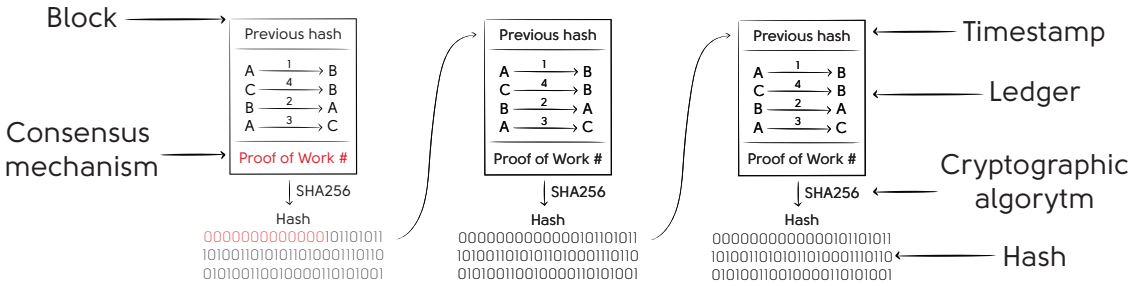


Figure 12: The blockchain behind the Bitcoin, as proposed by Nakamoto (2008)

proof of work. The update plus the number creates a unique hash code, that starts with a verifiable number of zeros (red in figure 12). Anyone in the network can use a cryptographic algorithm to check if the update is legit. To ensure no-one can tamper with the update afterwards, a block is linked with the previous blocks, through a timestamp.

What Nakamoto's system creates, is a ledger that is open to everyone, but completely tamperproof. Everyone can check all the blocks and see the current balance, but no-one can change any of the history or lie about their current balance. The result is a system where you can trade without needing to know or trust the other party, because you know that you cannot fool the system. Furthermore, the system is unchangeable, or immutable in DLT-terms, which means you can never lie about the past. In the end, this creates a fully transparent, immutable system in which trust is not an issue because the data is always verifiably integer.

2.2.5 The value of DLT

When looking at the value of DLT, experts feel DLT, together with Artificial Intelligence (AI) and Internet of Things (IoT), will change the core of our every day life (Swan, 2015). They call these technologies the fifth disruptive paradigm, right after life changers as the mainframe, the computer, the internet and mobile/social media. When looking at some of the major advantages DLT offers in contrast to regular databases, Buterin (2015b) and Khan et al. (2017) mention the following:

- High honesty of intention (trust)
- 100% reliable and secure
- Runs without a host (no third party)
- Increases efficiency / reduces costs
- High level of transparency
- Immutable (trust)
- Direct peer to peer communication
- Autonomous machine interaction
- Smart contracting (if/then business logic)

Relevant insights

- DLT is a young and immature technology
- It has just passed the hype of inflated expectation and needs a solid foundation
- DLT is mostly known through the Bitcoin, but it is an autonomous data sharing protocol for distributed networks
- DLT's power lies in safe, fast and efficient data-sharing between unknown entities
- DLSs are immutable and reliable, which creates a trustworthy and honest system

2.3 DLT-development and adoption needs

As this part of the thesis, Discover, is about finding out what is already known, the following chapters will dive into the existing theory and practice. To guide this process, each chapter will follow a similar structure, starting with a sub-research question and methodology. Next, the chapter present the relevant theories and confirms the insights with a practical perspective if possible. Ultimately, based on the insights, the research question is answered

Research question and methodology

The first part of the literature research in this chapter focuses on answering the first sub-research question:

> ***SQ1:*** *What are the current needs in the adoption process of distributed ledger technology?*

As explained, the field of blockchain research in academia has exploded, with a steep exponential growth of related theories. To separate the wheat from the chaff, it was decided to use a snowballing literature review methodology (Wohlin, 2014). Using this method, a quick online search, exploration of the Delft University of Technology repository and a talk with Blocklab yielded the 2015 book from Swan, the British governmental report from Walport (2016) and some highly cited papers (Scopus) such as Christidis & Devetsikiotis (2016) and Iansiti (2017) as a tentative starting point. Next, these pieces were scouted for references that resonated well with the research question, mostly connected to blockchain "innovation", "strategy", "adoption" and "development". By repeating this process for newly found papers and reports, a saturated list of theories was gathered. This chapter will elaborate on the insights that were found.

2.3.1 DLT innovation process

To start the search towards the needs for the adoption of distributed ledger technology, it is first key to understand what the innovation and development process of DLT entails and what its current status is.

In their study of the general innovation process of DLT, Beck & Müller-Bloch (2017) found the process generally consists of three stages:

- ***Discovery:*** conceptualization and creation of ideas, recognition of possibilities and articulation of opportunities.

- ***Incubation:*** experimentation with different ideas to evolve them into viable business propositions.
- ***Acceleration:*** commercialization of actual products and services, where the business can fully stand on its own outside of the niche

These stages are also displayed in figure 13.

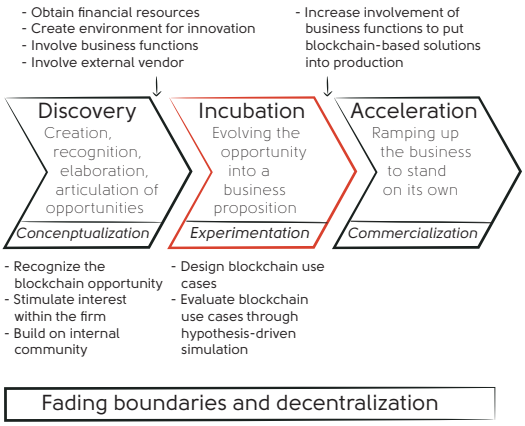


Figure 13: DLT-innovation process (Beck & Müller-Bloch, 2017)

Most companies, Beck & Müller-Bloch found, have halted in the incubation phase. This is also the case for Blocklab, the company used as a case study. Since the technique is immature and still has to overcome many boundaries, the focus is put on experimentation with the technology rather than developing business models. This in itself is not a big problem, as "the commercialization of blockchain-based solutions is also contingent on the discovery and incubation phases, because these phases play an important role in blockchain-related organizational learning" (Beck & Müller-Bloch, 2017, p. 5397).

When considering what this concretely means for the development of DLT, it was found that most projects currently settle at the proof of concept level (PoC) or at the minimal viable product (mvp) stage. Furthermore, as far as innovations go, the current DLT-applications are mostly mere alternate solutions, rather than the promised disruptive base for the future (Davidson, De Filippi, & Potts, 2016).

To understand how this works, Iansiti & Lakhani (2017) used their knowledge on technology development and applied it to DLT. Their research created a four stage model, which is shown in figure 14. Following this model, for companies to develop truly transformative products and services, they have to create concepts that are both high in novelty and that demand a high degree of coordination. The latter usually meaning extensive and intensive collaboration and sharing of knowledge.

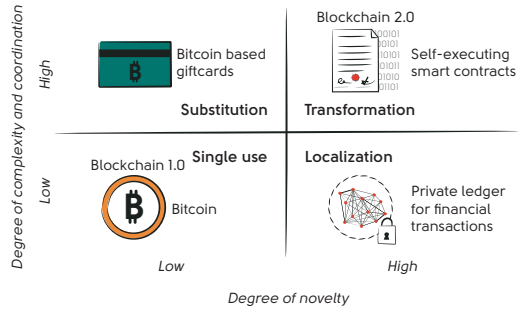


Figure 14: DLT-developmental quadrant (Iansiti & Lakhani, 2017)

As most companies are still experimenting, the current DLT-applications are either substitutions or localised products (safe niche). Sustained success, Schot & Geels (2008) say, is only achieved when the technology breaks out of the niche and becomes fully grown and established. This however, requires extensive socioeconomic change. So far, as was observed at the attended conferences, DLT is more technical talk than big breaks, as the solutions presented were all still localised or substitutions.

2.3.2 DLT software and IT- development process

The development and innovation process of distributed ledger technology seems to be quite slow-moving. It has been 10 years and there is still little known or done when it comes to creating real impact. To find out why, this chapter will explore what makes DLT software development so different from regular IT software and database projects.

Types of distributed ledger

The first consideration in DLT software development is what type of ledger is suited for processes or issues at hand. As not all networks operate in the same manner as the Bitcoin protocol, additional information is required to understand the entirety of the industry. The followings paragraphs dive into the most common forms of distributed ledger networks and how they are used.

In general, there are two defining factors: the type of permission and the openness of the network. This leads to the following types (Valenta & Sandner, 2017):

- Public permissionless
- Private permissionless
- Public permissioned
- Private permissioned

In figure 15 the difference is explained.

The choice for a type of network is based upon the use. Most companies for example will choose a private network, preferably with permissioned writing. This way they can maintain control. Within this category there are also two sorts: fully private and consortium (Buterin, 2015). In the former, one company controls the network,

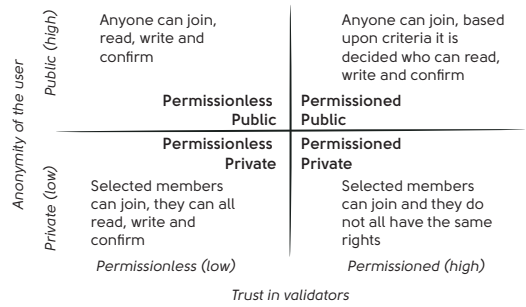


Figure 15: Types of distributed ledgers (Valenta & Sandner, 2017)

where in the latter, "the consensus process is controlled by a pre-selected set of nodes".

According to Valenta and Sandner (2007), "the mode of participation, permissionless or permissioned, has a profound impact on how consensus is reached" (p. 3). This is important, as either modes have their own advantages. The bitcoin network for example, a public permissionless network, is quite slow: it takes 10 minutes to create a block, and it is limited in scalability. However, it is open to everyone, making it rather suitable for a cryptocurrency. Other types of consensus are for example much quicker but require all nodes (parties) to trust one another.

Main platforms

When considering a type of network, one also has to consider the platform to run it on. In the industry there are numerous platforms, but a few are leading. In the next paragraphs, the main platforms are highlighted.

The three platforms that have created a standard in the industry are Hyperledger Fabric by IBM and Linux, Ethereum by Vitalik Buterin and Corda by R3. Their differences are described in figure 16 (Valenta & Sandner, 2017). In the words of Blocklab, Hyperledger is the most adult

platform, offering the most abilities in terms of different code and complexity. Ethereum is the best suited platform for creating smart contracts infused with legal code and Corda is most suitable for learning the basics skills.

Characteristic	Ethereum	Hyperledger Fabric	R3 Corda
Description of platform	– Generic blockchain platform	– Modular blockchain platform	– Specialized distrib-uted ledger platform for financial industry
Governance	– Ethereum developers	– Linux Foundation	– R3
Mode of operation	– Permissionless, public or private[4]	– Permissioned, private	– Permissioned, private
Consensus	– Mining based on proof-of-work (PoW) – Ledger level	– Broad understand-ing of consensus that allows multiple approaches – Transaction level	– Specific understand-ing of consensus (i.e., notary nodes) – Transaction level
Smart contracts	– Smart contract code (e.g., Solidity)	– Smart contract code (e.g., Go, Java)	– Smart contract code (e.g., Kotlin, Java) – Smart legal contract (legal prose)
Currency	– Ether – Tokens via smart contract	– None – Currency and tokens via chaincode	– None

Figure 16: Main DLT-platforms and considerations (Valenta, 2017)

A rapidly growing new kid on the block is IOTA. IOTA offers a new type of public distributed ledger, that no longer operates through blocks but through the Tangle (Popov, 2017). The tangle is a network of nodes, which grows when new nodes (tips) confirm two existing nodes through a hash. A node is recorded into the ledger when it has two or more connections backing it up. This is visualized in figure 17. This process is much easier to handle, as you only need access to a few tips to join.

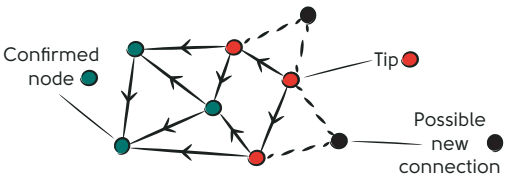


Figure 17: The tangle from IOTA

Also, as there are always nodes available on every side, there are infinite possibilities to join which creates a faster and easier network as it grows. This is promising in terms of scalability and accessibility. As no chain of blocks is used, this technology cannot be referred to as a blockchain, hence the use of the term distributed ledger technology.

When looking at the practical applications of DLT through the different platforms, the differences become clearer. Figure 18 gives a range of examples, divided by platform. When comparing this to the given information in figure 16, it can be seen that each platform was chosen for their specific strength. In WeTrade's case for example, Hyperledger allows them to connect 9 different banking systems, while IOTA allows ElaadNL to have a simple public platform that allows fast exchange.

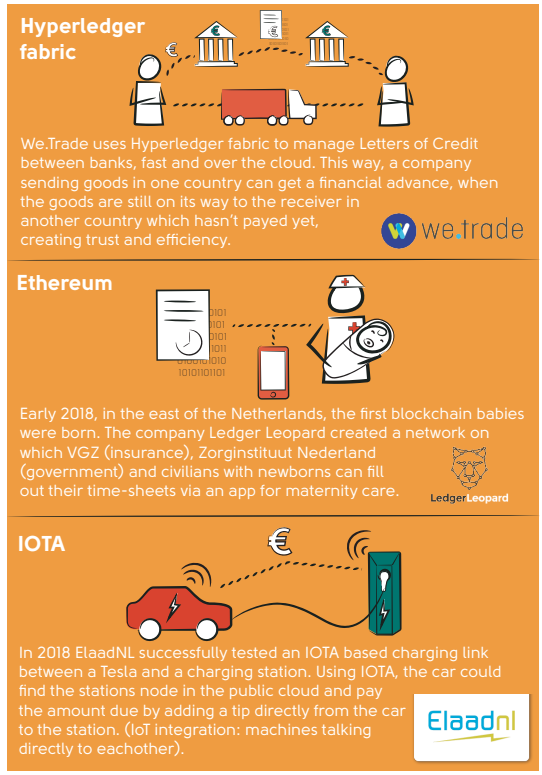


Figure 18: Applications examples per platform

Software engineering process

Another important aspect to consider in the IT-development process of DLT, is the software engineering process itself. To understand what this entails, the company Blocklab is studied. Blocklab follows a cyclical iterative framework focused on developing Proof of Concepts. Once this is done, they will develop a working minimal viable product (mvp), which is a piece of software that can handle a so-called happy flow. This means the software will maintain stability in about 80% of the usual instances.

This standard process differs from more common IT projects, since the development is done by developers from different companies at different locations. This means that Scrum meetings have to be held via skype or similar meeting software and that there is a need for planning physical meetings with clear goals like testing and feedbacking. This was also observed at the conferences, where companies elaborated on difficulties with collaborations being geographically disperse and having a different company culture. The development itself happens via online platforms like GitHub, where developers can share code and edit together. The sharing of knowledge is important as companies like Blocklab are still exploring DLT.

In figure 19 you can see clearly where the development of an inter-organizational DLS influences the regular agile process.
To get an understanding of how Blocklab experiences the different stages, we will quickly run through them. As the technology and its outcomes are new to most companies, the planning stage is a bit vague. The requirements analysis is mostly made up of assumptions. Making it hard to define clear boundaries. There is no clear vision to work towards, as the main goal is exploring. Due to its explorative nature, this phase is prone to communication problems, which can lead to misunderstandings.
Next, the design phase starts. Here the overall software architecture is discussed and developed. As the development of most distributed ledger systems is extremely technology-push focused, the user is not introduced until the coding and testing phases. With initial DLS development, the first trials are about getting the software working. In other words, 'can we let these systems communicate and exchange?'.

The late introduction of the user perspective can cause quite some problems. Late user interaction is not uncommon with technology push developments, which leads to big revelations during testing and quite possibly, large setbacks. After testing, the development team starts over, making it cyclical (figure 19).

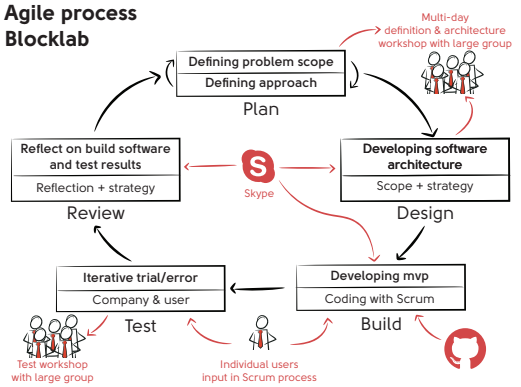


Figure 19: Applications examples per platform

Final remarks

DLT is a hype in which many started investing without knowing what it is and if it useful to them, and if it is, how to develop it. The main lesson, Groetsema (n.d.) found: in 90% of the time a regular database suffices. For the 10%: time and money is needed to explore everything.

2.3.3 Controversy of DLT

Apart from the developmental difficulties in DLT, there is also controversy regarding the ethical considerations this new technology brings to light. When looking through the diverse academic studies researching distributed ledger technology, there are generally two sides to the opiniated spectrum. There are those who see it as a radical innovation with unlimited possibilities. And there are others, who see the many problems ahead, warning to be cautious (White, 2017).

When looking at the more societal impact of DLT, sceptics warn for the ever-growing pitfalls when it comes to ethics and regulation in the digital world and in particular for technologies such as DLT. Currently, when looking at ethical considerations and other regulatory and legal legislation regarding DLT-development, these fields are completely under-defined and lacking in any form of enforceable policy (Böhme et al., 2015; Kiviat, 2015). Bitcoin for example, due to its anonymity, is the basis of almost all deep web transactions, funding drugs, fraud, murder and many more heinous crimes. Canadian researchers Ducas & Wilner (2017) were asked to look into regulation for emerging technologies like DLT. They concluded governments are at an impasse: strict regulation is needed, yet countries also want create an as open as possible climate in order to maintain and lead in innovation. In the researchers' eyes, the current DLSs and their preference amongst criminals and terrorists are, without regulation on traceability, an extreme hazard to safety and security of modern society.

In the Netherlands, the policy advisory Rathenau institute highlights another ethical issue of digital innovations like DLT: the loss of societal value in a world where the physical and digital domain become increasingly intertwined. Their key conclusion is that "the government, industry and civil society must now take action to strengthen the governance landscape, thus ensuring that public values in the digital society will continue to be properly safeguarded" (Kool et al., 2017, p. 14). In a more recent report on DLT they point to the current experimental phase as the right moment for the integration of values such as privacy, self-determination, mutual responsibility, autonomy and human contact (Peters & Kroft, 2018).

Relevant insights

- Most DLT development stuck in incubation phase: lot of experimentation, lacking viable business models
- Due to DLT's high degree of complexity and novelty, most products are localized (niche) or substitutions; no disruption
- Complexity due to many considerations:
  - Type of structure: private/public
  - Platform: established or experimental
  - Software engineering process with lots of parties involved; different locations.
- Experimentation at level of PoC or MVP
- Current development fully focused on technological development: technology push movement
- In 90% of cases regular databases suffice
- Complete lack of socioethical considerations in DLT, endangering our increasingly digital networked lives.
- Tech push has created a chasm between enthusiasts and the rest of society/ business, halting adoption of DLT.

2.4 Collaboration in DLT

The core ideology of distributed ledger technology is about sharing without limits and barriers. This ideal is exactly why DLT is so popular in the data industry. Sharing in business means trading and trading means new potential to make profit. However, as explained before, there are many hurdles in the process of creating a successful distributed ledger system. One being that a DLS itself is not useful nor profitable; it is merely a data protocol. What is needed is an additional angle, for example trading between two companies who want to cut out the middle man. Therefore, an incredibly important aspect of successful distributed ledger technology is organisations collaborating to create something that adds value only when they innovate together.

Research question and methodology

This chapter will look at how these collaborations can be set up and what lessons can be learned from the current knowledge on inter-organisational innovation. It does so by exploring the following research question:

> ***SQ2:*** *What is the role of collaboration in the adoption of distributed ledger technology?*

For this part of the research, again a snowballing methodology was used. This time, the research uses theory from the departments this thesis is written for, as a starting point. SEC: DLT-collaboration in the Dutch Blockchain Coalition (DBC) from Hillebrand et al. (2018). IDE: Bergema's research on networked innovation (2015). Next, through conversation with Blocklab, the choice was made to focus particularly on (shared) vision building, which established the focus for the snowballing. The relevant information found through the references will be discussed in this chapter.

2.4.1 Collaboration and DLT-innovation

As mentioned in the introductory pages of this thesis, the field of distributed ledger innovation is so young, that there are still many gaps in the knowledge about it. One of these gaps is the fact that there is little known about the collaborative aspects of DLT-development. However, some preliminary studies like those of Beck & Müller-Bloch, (2017) and Hillebrand et al. (2018) give some insights. The former found that "Both on an intra-organizational as well as inter-organizational level, blockchain initiatives require close collaboration since the necessary competences are scarce and widely dispersed" (p. 5397). Close collaboration however is difficult. The studied company Blocklab also showed some great insights, as they found their collaborations to suffer due to people with different goals, cultures, visions, motivations,

availability, accessibility, even literal borders and geographical difficulties.

As mentioned earlier, the study of Hillebrand et al. (2018) also gives some insights from practice. Their research focusing on the Dutch Blockchain Coaliton, a broad group of Dutch parties that want to innovate DLT together, found that the coalitions' collaborative effort is currently at an impasse. By using Sonnenwald's (2007) stages of collaboration, they found the coalition to be stuck in the formulation stage (figure 20). DBC is in need of clear communication surrounding task division, shared vision, goals and moreover, in need for a good organisational structure. When looking at these issues in others practices, it was found that both at the conferences and at Blocklab, issues such as lacking organisational structure and vision building were seen as important to solve yet difficult to achieve due to conflicting objectives, uncertainty and the risk averse nature of business.

2.4.2 Lessons from networked innovation

One of the fields studying collaborative innovation in an inter-organisational context is networked innovation. According to Bergema (2015) "networked innovation is the activity of actors from different organisations working together, on a reasonably equal footing, in order to innovate. They all have different knowledge that is needed in the joint project." (p. 38). Here, much as in DLT, the power lies in the fact that knowledge combined from different organisations can deliver results that a single organisation could not.

The lessons that can be learned from this field in relevance to DLT-innovation are as follows. Inter-organisational innovation is subject to a great many difficulties, as those involved are "often hampered in their efforts due to the difference in their professional and organisational backgrounds. These backgrounds determine people's goals, their roles and responsibilities, and their expectations and people often struggle to deal with situations where these differences affect the collaboration" (Bergema, 2015, p. 134). The four mentioned factors need to be clearly addressed in order to create successful innovation. However, the biggest finding in the research of networked innovation is that its nature is inherently complex as no collaboration is identical.

The mentioned four elements debouch into a broad range of factors that influence networked innovation, creating infinitely complex situations. As there is no one solution, the big lesson is for companies to get together, define their own personal difficulties in regard to the four themes and find their own solutions to the problems at hand.

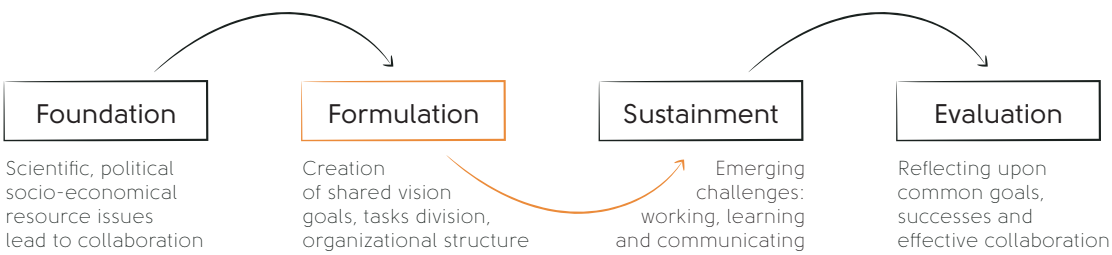


Figure 20: Stages of collaboration (Sonnenwald,2007) and the status of the Dutch Blockchain coalition in yellow (Hillebrand, 2018)

2.4.3 Collaboration in a wicked context

According to the conclusion of networked innovation, a type of collaborative environment or culture is needed that can reflect upon its own problems and learn to deal with them on the go. What complicates the situation in DLT-innovation, is its potential to impact a broad diversity of stakeholders or even entire ecosystems as a whole. With this in mind, any problem in DLT-innovation and collaboration is potentially a complex or even wicked problem. Wicked problems are defined as "unique, involving many different stakeholders, concerning issues of which the causes are uncertain, and they can only be resolved partially and temporarily since changing time and context will demand continuous adaptation of policy" (Rittel & Webber, 1973). To conclude, DLT-innovation, from both a theoretical standpoint as well as the findings from practice, needs an environment that can both reflect on its own problems as well as deal with the complexity of a wicked situation in order to reach sustainment and progress.

The learning organisation

In his study of environments who seem to be able to deal best with wicked problems, Peter Senge (1990) found something which he described as the learning organisation. This type of organisation is unique as it is "continually expanding its ability to create its future" (p. 14) and is "skilled at creating, acquiring, and transferring knowledge, and at modifying its behaviour to reflect new knowledge and insights" (Garvin, 1993). These skills are needed particularly in situations presented with wicked problems, as they require problem solving of a fairly reiterative, thus continuously evolving nature (Raadschelders & Whetsell, 2017).

According to Senge, the learning organisation is made up of five capabilities that need all be present in order for any organisation to thrive in a complex environment. These five capabilities, together with their three higher elements, are shown in figure 21.

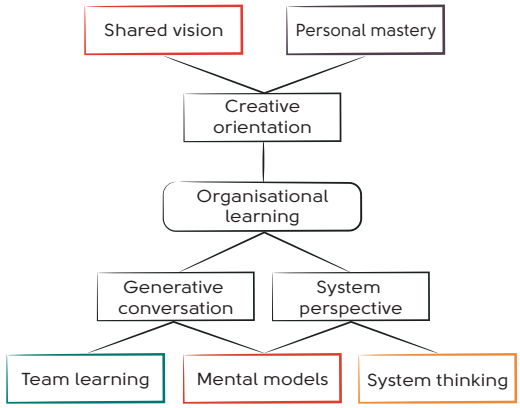


Figure 21: The five capabilities of a learning organization (Maani & Benton, 1999; Senge, 1990)

Only when all of these five capabilities are present, an environment is created that can deal with the complexity of a wicked problem. As DLT-innovation can be defined as wicked, this finding is immensely important to further its developmental needs.

In order to understand how these five capabilities can be included in design, they will be defined briefly based on the definitions by Maani & Benton (1999).

1. *Shared vision*

A common view held by a team or organisation of what to create or accomplish as an organisation. It needs to be built upon personal belief, not just the organisation's desire.

2. *Personal mastery*
The strive of the individual to do well and serve a purpose, while being able to continuously improve him or herself.

3. *Team learning*
The ability to combine and share the individual learnings of those involved in a movement of learning that grows and evolves the entire team.

4. *Mental models*
The understanding and openness to adjustment of beliefs, feelings and assumptions that shape the feeling of the individual, influenced by the personal and professional environment.

5. *System thinking*
The ability to see things holistically by understanding the interconnectedness of the parts and boundary objects of the system at large.

2.4.4 Design and collaboration

What has been established is that DLT-innovation, due to its broadness and complex collaborative setting, can be described as a wicked movement. This environment is best dealt with through organisational learning, a culture focused on five capabilities that all aim to continuously learn and improve in order to deal with an ever changing environment. What lasts for this chapter, is the question what role design can play in this. How can designers help create better collaborations.

According to Cross et al. (1975), designers are excellently equipped for vision creation, "because designers have to imagine both the future conditions that will exist when their designs actually come into use and how those conditions will be changed by the creation of their new design" (p. 02). Thus, making them rather suited to guide or facilitate the process of shared vision creation. Furthermore, communication designers in particular have the ability to study the sharing of knowledge (team learning) and to think on a systems level of abstraction. The field of design is known for finding its strength in the methodology to understand the beliefs and needs of individuals (mental models). In my opinion this shows that the combination of strategic and communication design is well fitted to operate and perhaps facilitate the creation of a learning organisation.

Relevant insights

- Collaborations in DLT have difficulties creating a vision, goals and finding a suitable organisational structure
- For inter-organisational innovation to be a succes, goal, roles, responsibilities and expectations need to be clearly defined
- DLT-innovation is a wicked process
- Wicked processes are best dealt with through an organisational learning structure, which requires a shared vision, personal mastery, team learning, mentals models and system thinking

2.5 Design and IT adoption

As this thesis looks to research what impact strategic and communication design can have on the adoption of distributed ledger technology, an IT product, this chapter aims to find out what the role of design is in current software development. For this chapter, both theory and practice were studied. The latter will be done through four case studies, which are summarized in this chapter. The full studies can be found in the appendix.

Research question and methodology

This last chapter of the Discover phase looks at the role of design in IT, by looking for answers to the following research question:

> ***SQ3:*** *In what way is design currently used to aid the adoption of software products and services?*

In order to find the relevant results for this chapter the choice was made to use a overview methodology focused on design and IT. Through quick searches on Scopus and Google Scholar, it was established that "user centred design", "human computer interaction" and "user experience design" were the best terms to start searching. Through these terms it was discovered that there are a lot of systematic literature reviews available that study this topic in combination with software development, particularly in the agile way. DLT is mostly created in an agile process. As this is in line with the found theories, the existing reviews were used to get insight in the current processes. To find how these findings could relate to practice, additionally four companies were case studied. These companies were picked based on their proven success in business, their renowned disruptive nature and their use of design and user centric methods.

2.5.1 User centred design

Software development, in particular the much preferred Agile approach, aims to create fast business value through short iterations (Schön et al., 2017). Its success comes from quickly understanding technology and learning how to use it to your advantage. It works great as a process development model, but it "lacks in defining the right kind of product, which fulfils user needs and customer expectations" (p. 79). To fill this gap, user experience (UX) methods are applied, mostly through the use of user centred design methods (UCD) (Silva da Silva et al., 2011).

User-centred design is, simply put, making sure the goals and needs of the end-user are the main focus of the product development (Brhel et al., 2015). UCD does so through "continuous end-user evaluation and the iterative refinement of design concepts and prototypes" (p. 164).

Through UCD, technological advancements become products and services people actually like to use. Especially in Technology push projects, like DLT, Bishop & Magleby (2004) found that the number one key factor to success is a focus on the customer/end-user.

Lessons from user centred design

To understand what the impact of user-centred design can be on software development, four literature studies were studied (Brhel et al., 2015; Da Silva et al., 2011; Salah et al., 2014; Schön et al., 2017). In general, the studies found a range of methods that focus mostly on integrating the user perspective in the agile process. This happens partly through (trend) research and observation, but also a lot through interpretation by using scenarios and user stories. Co-creation with the user is preferred, but this does not seem to happen fairly often.

When applying design in the software development process, there are four stages to do so, as defined by Brehl et al. (2015):

- Research
- Conceptualization
- Design
- Evaluation

The research phase sees little inclusion of design. During conceptualization, design is mostly applied in the form of interpreting user stories. During the design and evaluation phases, a lot of prototyping is done. This is where design seems to make the biggest impact.

When looking at the critical reflection on design, the four studies unanimously conclude that the methods of user centred design can be implemented quite well into the software development process. However, IT-development teams often run into problems doing so. Schön et al (2017) found that collaboration between programmers and UCD/UX teams is often an issue. The main problem "is found in sharing knowledge between stakeholders concerning user requirements and the responsibility for usability/UX" (Schön et al., 2017, p. 88). Furthermore, Da Silva et al. (2011) found that maintaining a good understanding of the big picture is also found to be difficult, as IT sprints tend to focus on short term progress. It is challenging to be user focused, the papers conclude. Issues such as time delays and availability of customers plays a large role in this as well (Sohaib & Khan, 2010). Ultimately, to successfully implement design in software development, a complete change of culture is needed, Salah (2014) concludes.

2.5.2 Case studies

To find out what the impact of design in software development practice is, four industry leading companies were studied. These companies were chosen as they are the flagships of IT-development and they often serve as an example for the IT-industry at large. These companies are Airbnb, Uber, Deliveroo and Coinbase. What makes these companies special, is that according to Verganti (2016) they have managed to create new meaning by carefully looking at their customer. Here design played a large role in understanding what the user wants and how it can revolutionize the industry. The results from the study show that these companies mainly excel by involving the user in every step of the process. Furthermore, these companies all work with multidisciplinary environments where designers, researchers and developers work together as a team.

Through their multidisciplinary and user focused way of working, these companies have created billions in revenue. However, when looking at popular media like Volkskrant, these companies seem to experience a similar problem to what is described in academic literature. In regard to the big picture, all four companies have been exposed to large amounts of scrutiny. There have been numerous run-ins with governments, from local to continental levels and all these issues come down to the same problem. To give some examples: Airbnb is blamed for overcrowding cities and Uber is accused of increase of traffic, with an increase in accidents and pollution as a result (Breebaart, 2017; Persson, 2018).

The studied companies are great at incorporating the user values, but they failed in foreseeing the impact outside of the user scope. When it comes to those societal impacts the Rathenau institute warned about, these companies are the prime example of how they can disturb entire ecosystems (Peters & Kroft, 2018). This is a incredibly important lesson for DLT-innovation. The current design methods are great at creating desire for the user by looking at user values and needs, but in regard to larger societal issues, the current design methods in software development fall short. Interventions are needed that can apply the current user focus to a larger more abstract scope.

Final remarks

When considering the insights gathered in this chapter, two things become clear. First, design and software can be a fairly effective mix. Multidisciplinary teams of developers and designers can create a lot of added value, particularly in the fields of desirability and viability. This also became clear at the visited conferences. Here the explanatory side of design, the branding and connection to user values and viability is mentioned. However, this is only the case for a few companies, who stress the need for more design in DLT especially in testing assumptions through continuous iterations.

Another finding was that the current application of design in software development is not suited to deal with larger issues on a more abstract and societal level. What is needed, especially since DLT can have a strong disruptive impact, are methods and tools that can apply the strengths of current design in software development on a level that looks at the entire ecosystem that is impacted.

Relevant insights

- User Centred Design can help agile software development to incorporate user values and needs
- UCD is mostly applied in the design and evaluation phase, through user tests
- The incorporation of user values and needs can increase adoption
- Software development benefits best from design through multi-disciplinary teams
- Current UCD is ill equipped to deal with larger socioethical aspects and considerations
- DLT requires a new design discipline focused on network/ecosystem inclusion

2.6 Conclusion discover

To conclude the first part of this thesis this chapter will reflect on the gathered insights and what their significance is in reference to the main and sub research questions. Next, this chapter will discuss the broader line that these findings have for the rest of the thesis. To start, first a reflection on the insights is given, based on the three research questions that were studied in this part of the thesis.

> ***SQ1:*** *What are the current needs in the adoption process of distributed ledger technology?*

In search of what the main needs in the adoption process of DLT are, first the process and status of current development was studied. Firstly, it was found that despite the technology celebrating it's 10th birthday in 2018, it is still a young and immature field. Both in theory and in practice it was found that current DLT development is fully focused on developing the technology, and there is little attention for viable and desirable business or societal solutions. For the enthusiasts the focus is on all the positive radical change it could bring in data sharing, yet the experiments that are being run are mostly localized niche experiments or substitute products, in which the role and efficiency of DLT is disputable. What causes and also complicates the development process, is that fact that DLT is a protocol and there are many ways to design and apply it. The large amount of choices collaborations need to face and decide upon, have created a slow moving development that cannot satisfy the demands of the hype. Lastly, as this whole development is focused on the technical aspects, a technology push movement has become visible, in which socioethical considerations are currently absent in the design process.

When summing up the insights, a typical and classic movement becomes apparent. As shown in figure 22, the development and adoption of DLT have reached the a chasm between the early adopters and the early majority (Moore, 1991). DLT adoption is stuck in the current focus on technology development

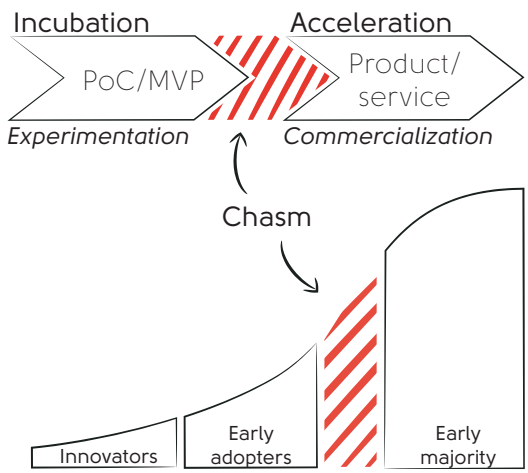


Figure 22: The DLT adoption chasm (Beck, 2017; Moore, 1991)

and the lack of focus on desirability and viability. This lack of focus, in combination with the inflated expectations of the hype, has driven a wedge between people in both business and society and the enthusiasts; where scepticism is leading and the lack of concrete results and solutions has created an adoption chasm. To answer the research question, there is a need for inclusion, proper communication and a focus on creating desire and viability.

Next, the Discover part looked into the role of collaboration in DLT development and adoption, in search for an answer to the following question:

> ***SQ2:*** *What is the role of collaboration in the adoption of distributed ledger technology?*

When looking at collaboration in DLT, studies from the Dutch Blockchain Coalition and observations from Blocklab and at conferences have found that inter-organisational collaboration on software development is quite difficult. There needs to be a good organisational structure that can develop visions and goals, and establish roles and responsibilities. Currently collaboration in DLT struggle to reach conclusions and make decisions on these aspects. What causes this struggle, is that fact that DLT-development is wicked in its nature. There is no single solution and collaborations need to establish an environment that can deal with this uncertainty. As long as this does not happen, adoption is halted by a lack of structure, which in turn influences the effectiveness of experimentation and development.

In researching what can be done to help these collaborations develop, it was found that a type of learning organisation can provide the exact structure that is needed to deal with complex and wicked situations, that is lacking currently. To do this, collaborations need to focus on creating a structure that allows the creation of a shared vision, personal mastery, team learning, mental models and system thinking.

Thus, to answer the research question, collaborations are currently stuck in the formulation stage, which slows down the process of creating structural change needed to implement DLT in society and business, which in turn slows adoption. To solve this, a new type of organisational structure is proposed, specifically suited to deal with the complexity and volatility of DLT.

Lastly, the Discover phase of this thesis looked into the impact design can have in software development. In line with the main research question, the following question was formulated:

> ***SQ3:*** *In what way is design currently used to aid the adoption of software products and services?*

In looking for an answer to this question, both practice and theory were studied. This yielded the insights that design is currently applied mostly in a user centred way, which suits well within the agile process. User centredness means the implementation of the user in the process in a such a way that adoption is improved through creating desirability and usability. This process is mainly done by involving the user in user testing and by doing user research. Being so involved with the user has caused major companies such as Uber and Airbnb to disrupt their respective industries by offering a new type of service.

However, when looking at how design in software development can deal with the larger issues DLT adresses, it was found that adoption

of DLT can only be achieved partly. The larger socioethical and economical issues that need to be addressed, as found through the first research question, cannot be tackled by the current user centred design methods. To help the adoption of DLT, a more abstract and network focused type of design is needed, that tries to include the values of not only the user, but also others who might be affected.

Conclusive outlook

The insights that were gathered in this chapter form the end of the divergent discovery phase and therefore the basis for the next chapter, Define. When looking at how the findings of this part impact the entirety of the thesis, they serve as the foundation upon which new tools, design and ultimately theories can be developed. The insights point towards a clear problem that currently causes adoption of DLT to halted. This problem, when interpreted as a designer, can be visualized as is done in figure 23. Here, the core values of design innovation (IDEO) are shown, mapped out against the findings of this part of the thesis. With this in mind, the Define phase can start to explore what the urgency of the different issues is and what current processes exist in practice that can help in solving these issues. Furthermore, the gathered insights serve as a starting point, from which this thesis can explore how design, both strategic and communicative, can offer the change that DLT requires to grow. In order to create new things, you first have to know what is already out there, what the do's and don'ts are and what the actual need is. What is shown, is that just like DLT, the domain of design also needs to grow and adjust to the great demands of these digital networked technologies.

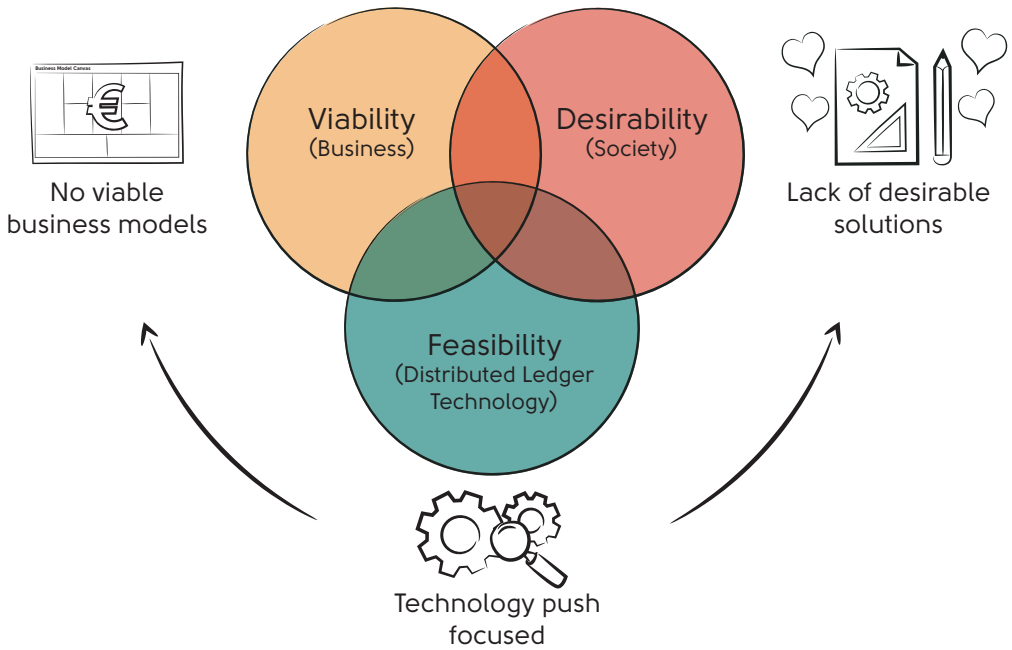


Figure 23: The two main problems of DLT-adoption, technology push causes a lack of desirable solutions and viable business models

3. Define

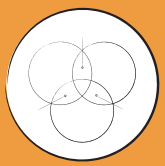
In this part:

Interview protocol

2x exploratory conversations

11x interviews

Coding



Problem model

Process model

Future of Trust Summit

Theme day digital ecosystems

Design brief

3.1 Introduction

The second chapter of this thesis, Define, looks into converging from the results of the discovery phase, toward to the conclusion of the first diamond of the double diamond model. Its aim is to process the found information and use it to generate new insights from practise. From here, a full understanding of the problems at hand can be crafted, which will form the end of this part of the thesis. To make sure the process of convergence is guided properly, the following research questions will be used as guidance:

> ***SQ4a:*** *What are the current barriers and enablers of DLS development in practice?*
>
> ***SQ4b:*** *What is the role of collaboration in DLS development in practice?*

The Define phase starts with a description of the methodology used for the research, explaining its setup and considerations. From that follows the interview protocol, which is checked with practice through two informal conversations with professionals who have experience with DLT. Through their insights a final protocol is crafted, with which 11 companies are interviewed. The results of these interviews are then analysed, coded and processed into workable models. This last step is done by comparing the findings to both the theory found earlier and additional theory sought to explain the found insights. Following the comparison, all results are translated into two models. A problem model and a model that serves to offer a direction for the possible solution. From these models, the design brief is crafted, which will be a logical build up from the first two chapters, offering a bridge between the two diamond, from research to design.

Conference visits

In this chapter, the research from theory and the interviews will be combined with a third aspect: the observations from two conferences.

The first is the Future of Trust summit, which was a co-creative gathering by Dutchchain, a government sponsored organisation aimed at bringing together a broad range of companies and organisations. The aim of this conference was to gather new insights, dive deeper into the complex problems at hand and discover how the elements of DLT can help to create new solutions. However, in the words of Dutchchain's founder Rutger Zuidam, the larger goal of summits like these is the following:

> *"What we are actually doing is hacking collaboration. We connect stories, so we can better grasp the complexity of all the stakeholders that are involved. When we use these results, everybody can make better solutions together"*

The second conference which had a big impact on the processing of the results is the Theme day Digital Ecosystems by T-Systems and Nyenrode business university. In this meeting four professionals and a professor shared their insights on the development of digital ecosystems through technologies such as DLT. The models presented at this day gave a major insights as to what is needed to increase the adoption and development of DLT.

3.2 Research methodology

The research in this chapter of the thesis aims to connect and compare the findings from the background literature on distributed ledger technology, design in software development and collaborative DLT-innovation, to the reality of DLT development in practice. This is done in order to confirm the problems as defined by literature, as well as to understand what the critical factors within these problems are. Furthermore, the focus on practice is used to find possible entries for the design of solutions. In order to get a thorough understanding of the practice of DLT development, the research goes through several steps that together generate a wide view of all present DLT-constructs, barriers and enablers. This chapter starts with an explanation of the used methodological approach per part. The entire methodological process is visualized in figure 24 and will be discussed in chronological order.

3.2.1 Literature research

As shown in figure 24, the basis for the research in this chapter is laid in the theoretical foundation of part 1: discovery. The findings from this research, in particular the models, will serve as a starting point, upon which this chapter will build, trying to achieve a broad vision based on both theory and practice, as should be within Design Based Research.

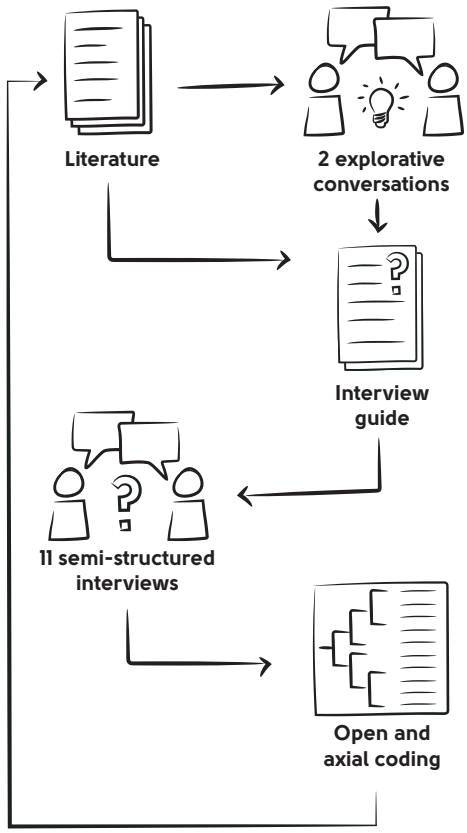


Figure 24: The DLT adoption chasm (Beck, 2017; Moore, 1991)

3.2.3 Exploratory conversations

In a first step to confirm the findings from the literature study, a translation to practice has to be made. This is done through creating an initial interview proposal. This proposal was mainly created from a combination of knowledge on DLT-development, such as type of project, type of platform, status and other relevant considerations. Furthermore it incorporated the original interview protocol from Bergema (2015) on networked innovation and collaboration, and some of the methodological lessons from design in software development in regard to the "user/network" perspective. Together, these topics formed a protocol that consisted out of three parts:

- DLT development (specific project)
- Collaboration (networked innovation)
- Stakeholder perspective

To scope the research, the energy sector was chosen as a main focus for the interviews, due to its wide and substantial experimentation with DLT (Andoni et al., 2019; Jullens et al., 2017). In order to find out if the original proposal was suited for its purpose, two exploratory conversations were held with companies currently working on DLT projects in the energy sector. During the conversations, the topics of the interview proposal were discussed in an unstructured manner. The conversations were not recorded, yet notes were taken for iterative purposes. The conversations helped to get a first practice-based view of the DLT sector.

3.2.2 Interviews

As the next step, interviews were performed to answer sub questions 4a and 4b. This was done by creating the aforementioned interview protocol. To allow continuous iteration, the notes from the explorative conversations were used to make some adjustments in the original interview proposal, which led to the final interview protocol, which can be found in appendix xx. Using this protocol, 11 interviews were performed. In the following paragraphs, the selection of the sample group, the build-up of the interview will be discussed and the coding will be discussed.

Selection of the sample group

As mentioned previously, the choice was made to focus on one sector of industry in particular, the energy sector. This sector has been quite prominent in technological experimentation with DLT and since it is relatively small, professionals from this sector might be easy to get in touch with. In order to also research generalizability, the choice was made to include projects from other sectors, as long as at least half of the total number of interviews would maintain focused on energy.

As for the parameters of the research, each participant should have experience in working with distributed ledger technology. Furthermore, participants with a managerial role were highly preferred, as they can provide a wholesome overview of the collaboration and project management.

For the selection of the sample group, initially snowball sampling was used. Using this method, the researcher finds its participants by approaching a small group, potentially

relevant to the research, and asking them to suggest potential participants (Bryman, 2012). Through the network of the researcher, relevant companies were contacted, which led to referrals to the proper departments and persons. This resulted in seven interviews, of which two companies were working in the energy sector, where the rest had experience in communication, logistics, secure track recording and insurance. As this did not meet the energy criterion, generic purposive sampling was used to search for companies operating in the energy sector. Using this method, the researchers searches and picks companies who can directly be linked to the scope of the research (Bryman, 2012). This method yielded four more companies to interview, all focused and with hands on experience on DLT development in the energy sector.

Semi-structured interviews

For the eleven interviews, a semi-structured approach was used (Bryman, 2012). The choice for this approach was based on the fact that the research questions (4a & 4b) and the literature review focused on two particular fields besides DLT itself, namely inter-organizational collaboration or networked innovation and user-centered design. The later was shaped to focus on the user as any type of stakeholder in the development process. Having a semi-structured approach, allowed for a specific list of questions on both topics. The interview guide, accordingly, consisted out of three parts: DLT-development, collaboration (networked innovation) and stakeholder perspective.

The interview would start with a general introduction by the interviewee and his role in DLT development. Following the brief introduction, next a project would be picked to structure the interview around. The project was elaborated on, both in the perspective of DLT and the necessity of the technology, as well as the general progress. In the second part, the focus was on reflecting on collaborative decision making, communication and possible barriers in collaboration. Lastly, the focus would be on stakeholder integration, with question about end-user involvement, stakeholder/participant persuasion and communication, and the level of interactions in the project.

The interviews generally took between 55 and 75 minutes, depending on the time available by the interviewee. The time constraints were factored in before the start of each interview, allowing all topics to be discussed equally. The interviews were audio recorded, after consent, to allow later analysis. These recordings were worked out into eleven anonymized transcripts.

Coding

Once all data is written out into transcripts, the building of theory asks for a detailed analysis of the interviews. This is done through coding. For this process, a mixture of open and axial coding was used. After all codes had been found and grouped, axial coding was used to look for links between the different categories that had been found. This resulted in a few important links that will be explained in the results section.

Validation of the codes

To allow an objective view, the codes were validated and, if deemed necessary, revised by having a second objective researcher critique on the coding and the connecting references. This resulted in a few changes in both naming of the codes and redistribution of some references. For example, *user friendliness* as a code was rewritten *usability* and *time constraints* was edited to *time & resource constraints*, as both were often linked and discussed together.

3.3 Results

This results-chapter will focus on the results from both the exploratory conversations as well as the interviews and the codes that followed. First the insights of the conversations are discussed, followed by the interviews.

3.3.1 Exploratory conversations

The reason for having exploratory conversations is to get familiar with the DLT in practice. For this, a Dutch power operator and a DLT-startup were interviewed. Below, the initial findings are discussed.

In general, it was found that the initial focus on DLT as an IT-concept was too narrow. The companies explained how both technical possibilities and socioeconomic constructs also played a substantial role in development of DLT and the barriers in the process. Both companies handled DLT as a construct that had effect on their ecosystem at large, for example through structural changes in infrastructure, but also in how small communities interact. In specific, the possibilities DLT offered did not match with the current possibilities in both regulation and hardware. The complex width of potential within their current ecosystem led to these companies using an incremental approach; first trying to solve minor issues.

Both companies explained they were still in a rather exploratory phase and it was observed by the researcher that involvement of the business was taken care of, however the end-user and the larger ecosystem was not considered quite elaborately. Which led the companies to experience difficulties in testing and implementation, due to a bad fit.

Lastly, the start-up admitted to using DLT partly because of the hype, which left companies eager to try this new technology. They were uncertain whether DLT itself would actually be an added value, or if a general data solution would suffice.

3.3.2 General results interviews

The interviews yielded a broad range of results. As open coding was used, a lot of additional information that did not link directly to the research question was picked up. This information will be neglected in this part. To create a general image of the different interviews, they were grouped by field of application, type of blockchain and stage of development. The results are shown on the next page in figure 25. These interviews were all transcribed, anonymised and checked by the interviewees. The open coding process yielded nine major categories, also shown in figure 26.

Of the interviewees, two had successfully implemented a distributed ledger system on a small scale (localized). The rest had successfully finished proof of concepts and some had developed working minimal viable products and pilots. The companies that were furthest, had applied a design thinking approach to define the entirety of the ecosystem, allowing them to factor in possible barriers in technological, but also socioeconomic aspects in advance. Overall, the largest general insight was the fact that all companies were mainly experimenting with DLT to explore its possibilities. Another important insight was the fact that most companies used private DLSs, which offers control and stability. A common find in niche development that defines the incubation phase.

Field of DLT application	Type of DLS	Stage of development
Energy 1	Private	Proof of concept
Energy 2	Public	Minimal viable product, successful pilot
Energy 3	Private	Minimal viable product, successful pilot
Energy 4	Private	Minimal viable product, successful pilot
Energy 5	Public	Localized working product/service
Energy 6	Private	Minimal viable product, successful pilot
Communication	Public	Proof of concept
Insurance	Private	Proof of concept
Logistics 1	Private	Proof of concept
Logistics 2	Private	Proof of concept
Secure track record	Private	Proof of concept

Figure 25: Interview description

Category	Description
Blockchain constructs	All properties that were linked to DLT directly
Business opportunities	The possible uses and use-cases of DLT in practice
Collaborative constructs	All properties relating to collaboration
Communication	Communicative forms and methods
Development process	All properties relating to developmental process
Lego workshop properties	Specific workshop on use of Lego as explanatory tool
Motives blockchain use	All motives for the use of DLT technology
Reactions to blockchain	The general reactions on the use of DLT (internal/external)
Rules and regulation	All information related to regulatory aspects and law

Figure 26: Code categories at the highest level

3.3.3 Barriers and enablers in DLT

In order to answer the fourth research questions (4a), the list of codes was scouted for possible barriers and enablers in regard to DLT-development. To create an overview, the choice was made to separate the DLT specific issues from additional barriers and enablers related to collaboration, communication and development. The table in figure 27 presents the first list, which specifically focuses on DLT-related discussion topics, sorted by aggerated number of mentions. This is done due to the codes *trust* and *ownership* having subcategories.

Nodes on issues	No. times aggregated mentioned	No. times mentioned	No. aggregated participants
Generalizable issues			
Trust	34	18	7
Scaling up	17	17	8
Trust\Identity	16	16	5
Risk management	15	15	6
Ownership	14	3	5
Time & resource constraints	13	13	6
Maturity	12	12	6
No added value	9	9	6
Safety & security	9	9	6
Business negotiations	7	7	4
Hype	6	6	4
Supervisor	5	5	3
Own.\Third party ownership	4	4	4
Technology push	4	4	3
Need for business model	3	3	3
Own.\Effort based share division	3	3	2
Reliability	3	3	3
Own.\Consortium	2	2	2
Own.\Founder led network	2	2	2
Shift of power	2	2	1
Transaction speed	2	2	2
Energy specific issues			
Usability	7	7	3
Should not discriminate	3	3	2
Business-case focus	2	2	1
Incentive design	2	2	2
Stakeholder autonomy	2	2	2
Heavy computing	1	1	1

Type of issue	Technological	Both	Socioeconomical

Figure 27: Barriers and enablers for DLT-innovation

As can be seen in figure 27, the table is grouped by generalizable issues and energy specific issues. In comparing the nodes from the different transcripts, energy versus the others, it was found that most issues are generalizable. Only the ones regarding a specific end user, usually a citizen using energy from the grid, were mentioned in the energy sector companies alone. Especially usability, autonomy and equality (discrimination) of all users can be seen as a clear link toward user centred thinking.

After axial coding and looking for new links, it was found that a large part of the factors regarded more socioeconomical aspects than it did on the technological basis of the technology. These socioeconomical issues were barriers or enablers that appeared during the exploratory phase of development and had to be discussed and sorted out in order to create viable solutions.

Next, all barriers with seven or more mentions were studied in detail. In the following paragraphs, a brief overview of the biggest factors will be given. The full study can be found in appendix xx.

Brief insight in the major factors

1. Trust

The most mentioned factor from the interviews is trust. As described in Discover, DLT is famed for creating environments in which trust between two parties is not an issue, which is also shown by the naming of the conferences: *Future of Trust* and *Rethink Trust*. However according to the interviewees' experiences, trust and DLT still do not mix very well. As the technology is still young, the interviewees feel not everyone thinks the technology is trustworthy. This creates an adoption barrier as a lack of trust is one of the biggest issues in business world. Due to the lack of trust, business and society have build in an incredible amount of fail safes in the form of third parties who control, oversee and manage processes. And it is a lack of trust that causes companies to experience difficulties in collaborating and shared decision making.

2. Trust/identity

Linked to trust, is the problem of identity. The interviewees point out that they feel DLT can be 100% reliable, negating the need for trust in the network. However, when it comes to how information is processed and provided to the network, trust becomes a big issue in the form of identity. Identity in DLT regards a discussion surrounding the following. Once the data is on the DLT, it cannot be corrupted due to immutability, however, who is to say the initial data wasn't faulty or corrupt to begin with. To do so, there needs to be a check of "identity", for example a unique code that is physically attached to a good and that can be tracked autonomously. The link between the physical world and the digital world of DLT is extremely fragile and prone to corruption. Which brings the discussion right back at the issue of trust. As identity and trust are inherently linked, they both came up so much during the interviews and it is also why it was the central topic of the conferences.

3. Scaling up

The third big problem in DLT is scaling. This problem is rather technical in nature and it refers to the issues DLT-platforms experience when they go from a safe controlled (niche) environment, to a larger public environment. As everybody is still experimenting, nobody knows what will happen when DLT's are scaled. In the case of Bitcoin, scaling has caused the system to consume tons of energy and it has made the transaction speed slow, as a huge network needs

to bring confirmation. Related to this are also the scaling of infrastructure and of acceptance, which is costly and time consuming. In the end, scaling means giving away control to the system and letting it be autonomous, while convincing those who should join that it is completely safe. Which is something that stands perpendicular to the current way the business world operates and why it has been branded the biggest issue in the growth of DLT.

4. Risk management

Why giving away control to a system outside of a company is so difficult, is because it increases risk. Large companies tend to focus on minimizing risk. With the lack of trust in others, risk avoidance is a big priority. This is why the whole business is governed by contracts. When two or more parties intend to share through DLT, the division of risk becomes an issue. Who is to blame if there is a failure? Risk avoidance is guaranteed to cause problems in adoption of new and uncertain innovations such as DLT.

5. Ownership

Related to risk management, as mentioned, is ownership. If the system is at least partially private, which all observed systems are currently, who gets to have ownership and thus control? This is a discussion that was mentioned a lot in the interviews and also something that pops up in any conversation with both DLT-sceptics and enthusiasts.

3.3.4 Collaborative and developmental factors

In order to find an answer to sub research question 4b, all coding regarding collaboration and the developmental process must be examined. To do so, a list was compiled of the relevant fields, from which all codes with ten or more mentions were grouped in the table seen in figure 28 on the next page. The codes are ranked from high to low mentions per category. All codes were mentioned by both energy related companies as well as the rest, allowing them to be generalizable. Each category will be discussed separately.

1. Collaborative constructs

What must be said beforehand, is that all codes from this category are enablers. The barriers mentioned, appeared in only five interviews and were mentioned seven times or less. They will be mentioned at the end of the paragraph. As far as the six codes that appear, there are three clear distinctions, each explained below.

The right, open minded mentality

The first enabler of networked collaboration considering innovations like DLT exploration with no clear outcome, is the mindset or mentality of those involved. Open minded people with a *let's do it* mentality and an open source infrastructure mindset. In short, you need people with a "*can do attitude*", "*total strangers but with an eagerness like 'this is amazing and really cool', making collaboration incredibly easy*", "*people who say 'I think I get it, let's make something', to see if it works*". Furthermore, "*everybody should be able to work together in an open market*", one interviewee explained. The willingness to share and open source the idea's furthermore helps collaboration and accelerates ease of use and distribution or growth.

Showing the possibilities

Another important factor is convincing people through showing and establishing common ground. Showing others the power of DLT through clear examples, prototypes and finding a common ground, enables new ideas and new

ecosystems to be generated. As different views combined can create new and stronger ideas. It is the "*art of putting your blind spots aside ... put experts together ... and let them overlap to avoid the blind spots*". "*You can't do innovation alone*", another adds. This factor links closely to the communication factors of discussion helps advancement and creating support.

Proper tooling

Six out of the participants specifically mentioned proper tooling to be of the essence in a networked collaboration. "*Tooling helps excellently, you can really work independent of location*", one participant said. He was supported by the others, who mentioned the use of Slack, Skype, Trello, GitHub, etc.

Nodes	No. times mentioned	No. partici-pants
Collaborative constructs		
Let's try it mentality	15	8
Convincing by showing	15	9
Open source infrastructure (mentality)	13	7
Proper tooling	12	6
Open minded people	10	6
Establishing common ground	10	6
Communication		
Create support (change management)	21	11
Discussion helps advancement	20	11
Stakeholder involvement	14	11
Matching content to audience	14	8
User should not notice	10	5
Development process		
Defining ecosystem	18	9
Workshop	16	7
Validating technology	15	11
Working agile	14	7
Iterations	13	6
Expert knowledge	13	7
Digital prototype	10	6
Front end development	10	7
Motives to use blockchain		
Exploring to gain knowledge	18	10
Learning by doing	16	9
Let's try it mentality	15	8
Exploring	12	11
Generating new opportunities - ideas	10	4
Higher efficiency	10	6
Reactions to blockchain		
Maintaining status quo	18	7
Enthusiastic to try	15	8

Figure 28: Barriers and enablers for collaboration and development

1. Communication

Communication in and on itself can both be a huge barrier or a subtle enabler. In the context of distributed ledger technology and collaboration, communication is mostly used to discuss possibilities with the aim of advancement. In this creating support by involving the all stakeholders and taking them along, preferably through storytelling and the constructs of change management, is key. Here it is important to match the content to the audience, as mentioned in collaborative constructs, to create common ground. The most important thing in discussion, is questioning everything, multiple participants found: "*Why do we do it this way? What don't we know? What do we want to know?*". Or like another says: "*What do I want? What do I get in return? Tightly organized discussions about what a system looks like, which roles are present*".

All eleven participants mentioned the factors of discussion, creating support and involving all stakeholders in this process. "*From the moment you forget to involve people you get resistance, that is killing for a project*", one participant reasons as to the importance of these factors. The only remark that has to be placed is that, when looking at the end-user, sometimes it is wise not to involve them. The user should not notice the background protocol called DLT is quite a common factor in all but one interview.

2. Development process

When looking at the barriers and enablers that link to the developmental processes, a few clusters become apparent. As mentioned before, distributed ledger technology is more than just IT. Therefore, nine participants mentioned they started with defining their ecosystem and the players in it. Seven did so through a so-called workshop. "*Imagine, a large meeting room, two whiteboards*" and people asking "*What are the pains? What are hick-ups?*"". It creates a common understanding, one participant adds: "*A we-feeling ... mainly to get a buy-in*".

The workshops generally work towards a minimal viable product. Those who are most successful, did so in a lean-mvp way, as described in figure 29 (Ries, 2011). This allows all factors to be taken in, albeit in a niche, but still maintaining "*minimal viable ecosystem*". This minimal viable product, always served as a first validation of the technology. From this, programmers can start designing in an agile way. This meant "*fast creation and validation to see if we're on track*", over and over until a viable product was reached. An added value, according to one participant, is that working agile "*creates a common language we all speak*", even across borders. That helps collaboration immensely.

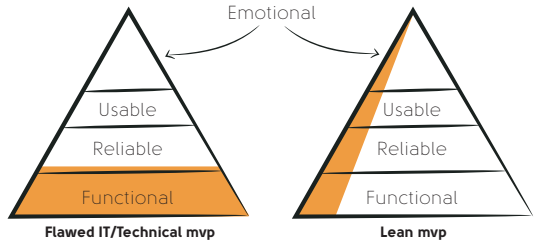


Figure 29: Flawed IT/technical mvp versus a lean mvp (Ries, 2011)

3. Motives to use DLT

When looking at what drove all these companies to start developing distributed ledger systems, there is one clear factor present in all companies: exploration. Exploring to gain knowledge of DLT as a concept and a technology. Everyone started not from a clear goal, but from an exploratory point of view, getting to know this development and willing to learn simply by starting to use it. The earlier mentioned let's try it mentality plays a rather important role in this. All participants wanted

to try it out as fast as possible, without long conversations first. "*We did it mainly to explore, to find out what this technology can do*", multiple participants mentioned. This willingness to explore and to learn is a must and a clear enabler. When questioned about the possibility of finding out the technology wouldn't work, one participant replied: "*sometimes your goal is simply to learn, I think that is very important these days*".

Additionally, the promise of higher efficiency and the generation of new opportunities and ideas were mentioned as stimulating motivations as well. But in the end, exploring the technology was the highest goal for all, which suits the exploratory incubation phase they are in (Beck & Müller-Bloch, 2017)

4. Reactions to DLT

Lastly, the reactions to distributed ledger technology need to be considered. They are not directly barriers or enablers, but they show the motivation of those who struggle and those who succeed. The two most present opinions were *maintaining the status quo*, mentioned 18 times and *enthusiastic to try*, mentioned 15 times. They show the clear gap in how distributed ledger technology is perceived.

On the one hand, people are fairly willing to try this new and exciting technology. "*A board member saying 'I want this because I know it might lead to great things'* ", an interviewee explains. A clear enabling mindset. A bit of boldness is key, another explains, "*let's get in and we'll see where it takes us*".

However, an even larger amount of references deals with a rather negative welcome. The general fear of change. The "*focus on keeping the business running is dominant*", large companies want "*stability and risk-aversion*". When one company invited all the established names in one room and said the future would change a lot, it ended in a "h*arsh discussion, people were mad at us*". The need for people to avoid risk and change was highly present in the interviewees' stories. Therefore, this fear has to be considered when looking for successful collaborations.

3.3.5 Interpretation of the results

To analyse the potential needs of distributed ledger technology and its development, this sub-chapter looks at the results from 11 practise-based interviews. What follows in the next paragraphs is an interpretative conclusion that tries to look for broader meaning in the found results. The interpretation is structured in the same way as the results, based upon research questions 4a&b, starting with a reflection on the barriers and enablers in DLT-development (4a). This is followed by the analysis of the collaborative and developmental factors (4b).

To work towards a conclusion that can be compared easily to the findings from part 1 of this thesis, a three-part model as created by

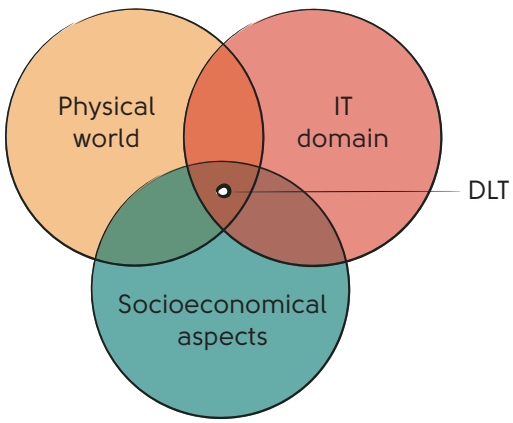


Figure 30: DLT as defined by one of the participants

one of the interview participants will be used to explain the important aspects of DLT-practice. This model, as shown in figure 30, assumes that DLT development always regards three contexts: the IT, the connection to the physical world and the socioeconomic aspects it influences. As this is in line with the researcher's conclusion on the relevant aspects, this structure was deemed appropriate for the analysis and interpretation.

Barriers and enablers in DLT

As is to be expected from companies in the incubation phase (Beck & Müller-Bloch, 2017), mainly barriers were found when discussing DLT throughout the interviews. This is due to the experimental nature of the incubation phase, which mainly focuses on finding barriers and solving them in an iterative way. However, when asked, all 11 professionals also saw ample opportunities for DLT, with a total of 23 separate business propositions mentioned. What can be concluded from this is that current DLT-development is characterized by both a lot of struggle and equal optimism.

Most valuable insights

As a list of determining factors itself is not extremely valuable input for the design process, a second step of more explanatory research is performed. The goal of this step is to find patterns between the most mentioned factors. This resulted in the systematic overview as seen in figure 31, in which the barriers are marked red. In this scheme, the arrows indicate the order of influence. This means for example that an increased feeling of safety and security has an impact on how much trust is needed. The first observation that can be made from this model, is that almost all factors are socioeconomic, which is interesting, as development focuses mainly on the technological aspects.

Risk aversion

When taking a closer look at the scheme, two main clusters can be found. The first regards trust, identity, risk management, ownership, supervisor and safety & security. This cluster is best described as risk aversion, the nemesis of radical innovation (Alon et al., 2018). As sharing valuables like company data is inherent in DLT, most companies take a cautious stand. This resulting cluster from the interviews is a direct confirmation of the found literature and observations of the conferences, with trust and risk aversion dominating the discussions around DLT, as the insecurity of outcome is one of the biggest DLT-innovation adoption problems.

Maturity of DLT

The other cluster is gathered around maturity. As the technology is still young, maturity issues such as scaling and time delays are mentioned a lot. As there is no precedent and all companies

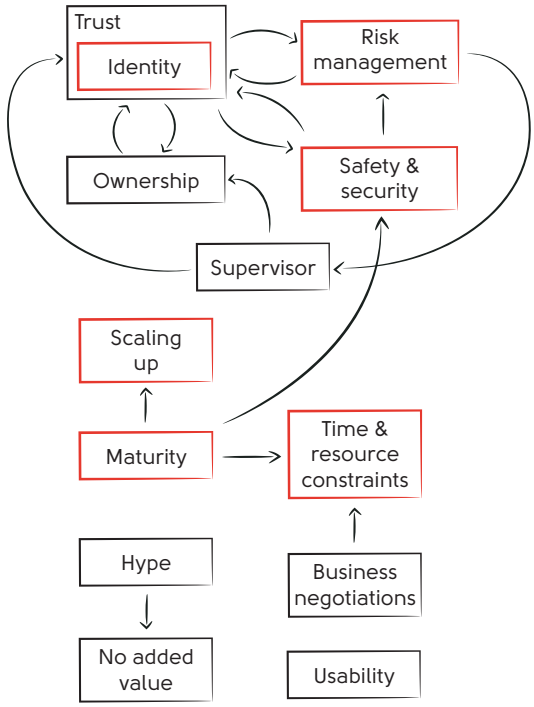


Figure 31: Barriers (red) and enablers relations of DLT

are still exploring, this issue causes the process of innovation to be time consuming and costly in resources. Especially knowing the amount of possible platforms and choices regarding type of ledger, DLT-innovation is prone to a lot of negotiation beforehand. This also explains why most solutions are not disruptive but simply substitutions or localized experiments, both steps that attract less discussion and gain confidence faster.

The fact that there is no single answer or solution, the wickedness of DLT in combination with its immaturity and the hype, make it easy for people to be sceptical, as was witnessed during the recap of the Digital Ecosystems day, where mainly CIOs and IT-seniors reflected on the things the technology couldn't do yet and finding reasons not to invest too heavily. In the end, the main barriers in DLT for its adoption house in the creation of trust and confidence, especially in the current risk averse climate.

Collaborative and developmental factors

As mentioned, with the codes that did not relate directly to DLT itself, a second analysis was done. This resulted in five categories that have been explored in the previous sub-chapter. To analyse these categories further, an additional step of coding was performed to find if and how they could be linked to each other. This resulted in a model of the most influential factors and their respective links (figure 32), as shown on the next page. In this figure, the arrows indicate the order in which factors influence one another.

The way the model is build up, it shows the entire process (yellow) of conception, ideation, creation through agile development and the presentation of the results. From there on, the process repeats by finding new opportunities, spreading the word, aligning new partners and ultimately conceiving new ideas. Additionally, in red the model shows which factors need to be present in order for the system to succeed or fail.

When interpreting the process and the enabling factors, there are two interesting finds. First, almost all enablers have to do with mentality and motivation. An environment where open-mindedness and the will to try, learn, share and cooperate are present, is deemed to be critical to success. Second, there is a critical point, the if/then connection, that can make or break the spread and growth of DLT-development. This point is critical, as a negative reaction to DLT was found to be a major burden in DLT-adoption. Those wanting to maintain the status quo, the risk averse, have to power to kill the innovative climate needed. Thus, what is needed is a way to influence or steer the mindsets of the sceptics, towards confidence and trust, preferably through open minded enthusiasm.

Apart from the model, another major insight needs to be mentioned. In the interviews, all participants stressed that DLT lives by its ability to support collaboration on a new level. As distributed ledger technology allows companies to see each other as peers looking for new opportunities. In many cases, DLT might not be the final solution, but it is a way to get companies around the table; into a conversation about the future. A conversation about commonization and sharing, being open to change together.

Based upon the observation of the researcher, conversations with professionals and the interview data, the biggest result of this research is that DLT can be used as a vessel for change. It acts as a catalyst for open thinking. Defining an ecosystem together and looking for connections to other ecosystems, is perhaps the biggest

promise of distributed ledger technology. It can be used to promote network thinking, a development that, in the words of one of the speakers at the Future or Trust summit, is not about "eliminating the competition, it is about eliminating competition all together". DLT at its best allows people to invent a newer and better wheel together, instead of every organisation inventing the same wheel over and over again in private. However, as was observed, this requires a shift in mentality for most companies, which takes time and preparation. Adoption, in many ways, is about anticipation and as the interviews and the model show, there are a lot of factors and moments that can influence the perception of new stakeholders, making DLT, complex as it already is, extremely prone to misunderstanding and misjudgement. Killing the innovation.

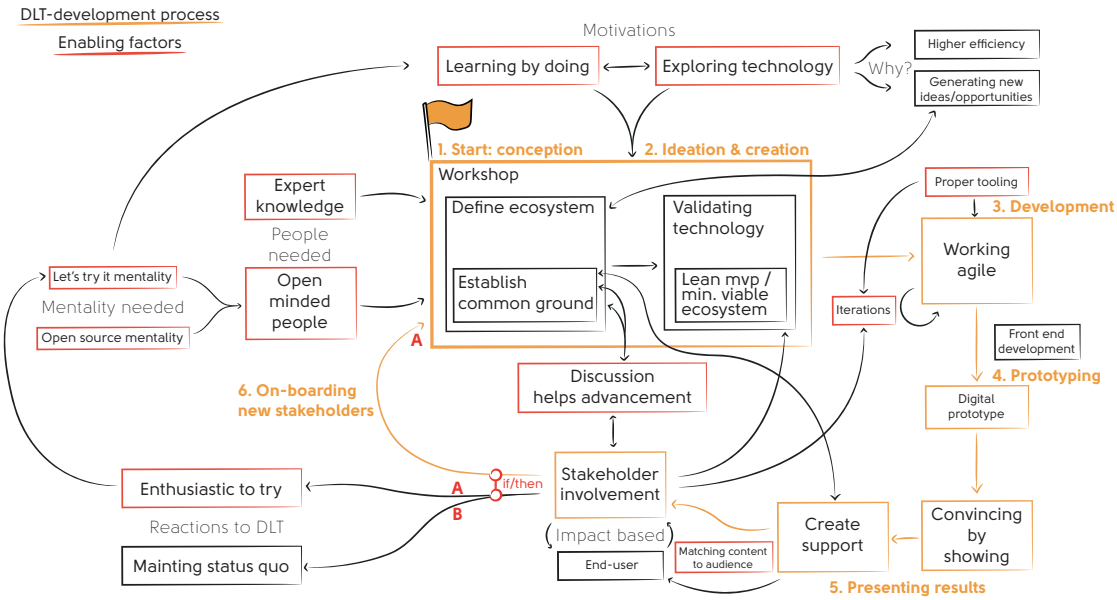


Figure 32: Overview of collaborative and developmental facts

Relevant insights

- The main barriers in DLT-development are the aspects regarding risk (aversion), trust (identity) and maturity (scaling)
- Trust and confidence are needed, as DLT-innovation is uncertain in nature.
- Experimentation mainly focuses on technology, where the barriers mostly rise in the socioeconomical domain
- Innovative mentality and open-mindset play a crucial role in DLT-development
- The critical point for adoption is in how DLT is presented and how people react to it; negative reactions, breaks the cycle
- DLT's core strength lies in bringing companies together and innovating collaboratively; causing true disruption

3.4 Discussion of the interview results

As the results have been processed and interpreted, it is time to go back to theory. Here, scoping and converging is used to determine how they offer new insights. This chapter does so by again looking at the two models, barriers/enabler of DLT and collaborative/developmental factors and comparing this to theory.

3.4.1 Barriers and enablers DLT

This chapter starts with comparing the model, shown again in figure 33, with the theories on DLT-development and its barriers. As found, the majority of the insights from research focus the on socioeconomic challenges rather than technical limitations.

When comparing these findings to literature, a clear distinction becomes evident. A lot of research still focuses mainly on the technical challenges of distributed ledger technology, mainly on its maturity and scalability. However, in the last two years, the socioeconomic factors like trust and risk aversion seem to gather more and more attention. Batubara & Janssen find "the need for new governance models and acceptability of this technology are the major challenges from the organizational perspective" (2018, p.8). These challenges, they found, mainly derive from issues relating to trust, risk management and supervision or auditability. Likewise, Schaffers (2018) and Mendling (2018) find that beside the technical limitations of maturity and scalability, adoption and acceptation are major factors in

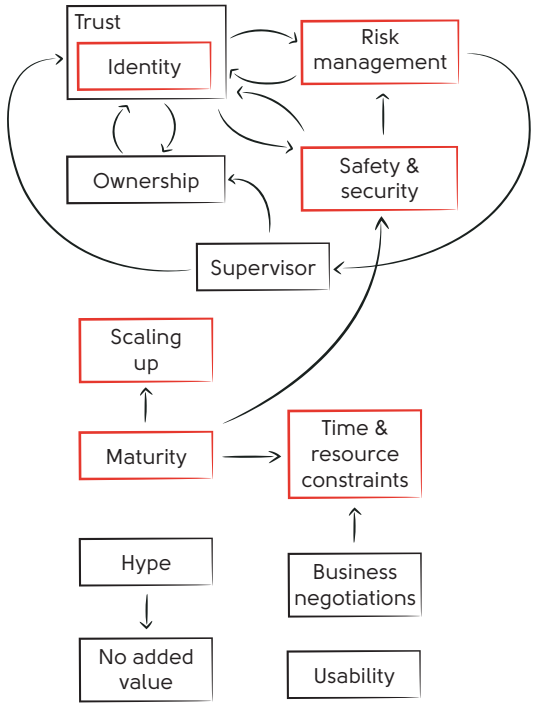


Figure 33: Barriers (red) and enablers relations of DLT

the advancement of DLT. Furthermore, they urge research into the evolution and change in corporate culture needed to sustain DLT development.

In summary, the found factors as shown in figure 33, both technical and socioeconomical, link closely to the aforementioned research. Especially trust and its effects on company culture and collaboration pose a big challenge. The factors derived from practice confirm the existing knowledge about challenges in DLT development. In the last two years research has started to look more into the socioeconomic challenges and impact of DLT. So far however, no concrete solution is in sight. More research and tests are needed to reach the plateau of productivity and acceptance (Panetta, 2018).

Strategic niche management

The question that rises from the gathered insights is, whether the technological development of DLT follows a unique path. When connecting the findings and the theory from Beck & Müller-Bloch (2017) of distributed ledger technology being in an experimental stage (incubation), a link with another model becomes apparent. The current development process of DLT is in many ways similar to the strategic niche management model by Geels (2002) and Schot & Geels (2008).

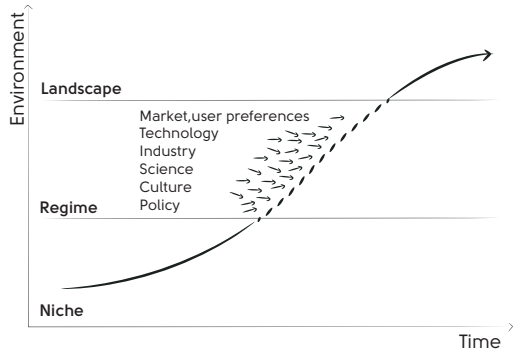


Figure 34: Strategic niche management in technology transition (Geels, 2002)

As seen in figure 34, technological transition requires new developments to break away from to niche through the regime and toward the landscape by tackling a range of socioeconomic or as they call it, sociotechnical barriers.

Dilemmas	Approach A	Approach B
Vision	Be flexible, engage in iterative visioning exercises and adjust to circumstances.	Be persistent, stick to vision even when it gets tough.
Learning	Create variety to facilitate broad learning.	Too much variety dilutes precious resources and prevents accumulation.
Strategy	Upscaling through bricolage strategy and stepwise learning. Incremental steps.	Upscaling through breakthrough strategy and big leaps to achieve success rapidly.
Network	Work with incumbent actors, who have many resources, competence and 'mass'. Change their vision.	For radical innovation it is better to work with outsiders who think out of the box and have new ideas.
Protection	Protection is needed to enable nurturing of the niche-innovations.	Do not protect too long and too much, this can lead to limited exposure.
Niche-regime interaction	Wait for 'cracks' to appear in the regime and then vigorously stimulate niche-innovations.	Use niche experiences to influence perceptions of the regime actors and actively create cracks in the regime.

Figure 35: Table of dilemmas in niche management, derived from Schot & Geels (2008). DLT preferred approaches are highlighted.

As found, DLT faces a much similar path, where most factors link to culture, policy and the market, rather than just technology. The model helps us to understand DLT's development in relation to other transformative technologies, perhaps allowing for similar solutions to tackle these challenges.

In his later research, Geels mentions a list of dilemmas that need to be taken into account when breaking through the regime (Schot & Geels, 2008). This list, as shown in figure 35 on the previous page, creates an insight into which dilemmas are most important and what steps can be taken to absolve them. When comparing this list to the findings from practice, the highlighted approaches were found to be preferable in DLT development.

In conclusion, when comparing the findings of recent literature to the outcomes of practice, a clear need for socioeconomic change becomes clear. In this, the development of distributed ledger technology follows the technology transition model by Geels (2002 & 2008). Geels advices a closer look at the dilemmas surrounding vision, strategy and network involvement in order to further develop the technology.

3.4.2 Collaborative and developmental factors

When it comes to collaboration and development, the insights derived from practice generated a model of relevant factors, shown in figure 36. The model shows a combination of the general process and the factors that enable this process. This chapter looks into comparing these results to literature and finding out what

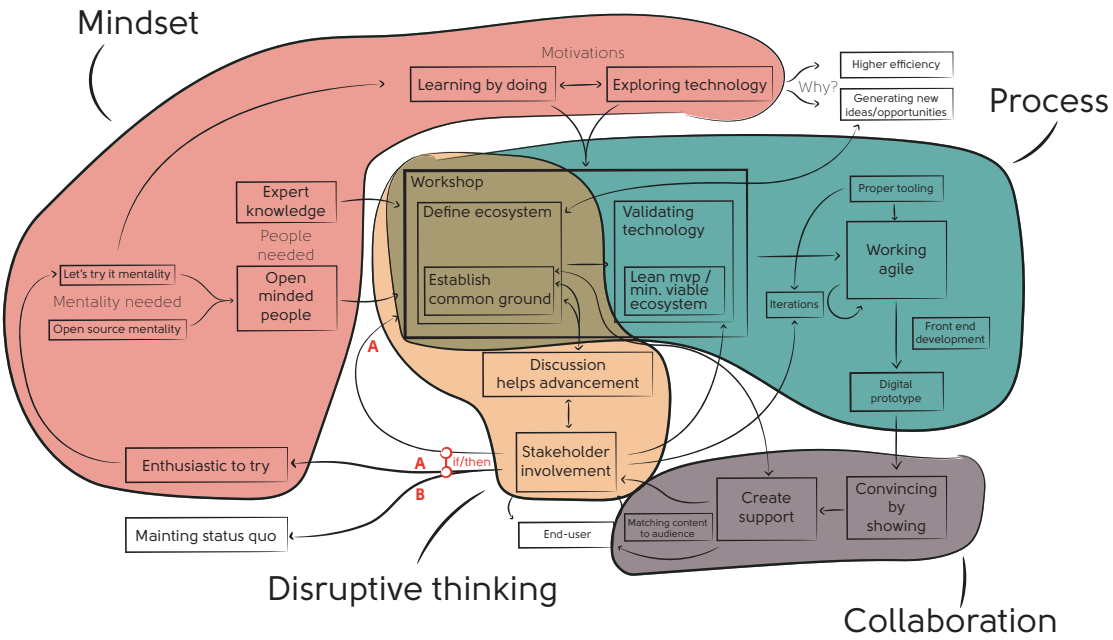


Figure 36: Model representing the factors of the collaborative and developmental processes in DLT, divided into four scopes.

is ambiguous and what is unique. As the model is quite complex, a choice was made to divide it into four sections by looking at the relation between factors. Each section will be discussed individually and compared to literature, after which a general conclusion is drawn.

Process

When looking at the general development process, highlighted in green, the current conception of a distributed ledger system does not vary much from regular software development. First a workshop is used to get everyone on board and to define the architecture. The outcome is usually a minimal viable product or a set of user stories. This can then be used to develop prototypes, which can be tested or used to spread acceptance, all through an agile way of working. These factors link closely to the methods and processes found by Schön, Thomaschewski, & Escalona (2017) in their review of agile development in relation to design. They found the development of use cases and scenarios in workshops to create user stories and prototypes were amongst the most common design elements in software development.

Collaboration

The second area of interest is the stimulation of collaboration through creating support and by showing the power of DLT. When looking at theory, this part of the model links best to lessons of change management (Mashapa et al., 2013; Sato & Panton, 2003). The participants actively sought to create a guiding coalition, to communicate their vision and to empower others to act. Here especially desirability and awareness are big topics of interest. The processes that are gone through, are of crucial importance to the sustainment of the model. When DLT development stays within a group, a closed environment is created. This halts development and harms the original idea of DLT: a public, open platforms with no need for trust or third party monitoring (Nakamoto, 2008).

Mindset and motivation

The third area of interest, is the mindset and motivation required to venture into the abyss of insecurity that is inherent to DLT's immature stage of development. What became clear throughout the interviews is that a special type of people is needed. A type of people that works hands on and dares to experiment, regardless of the outcome.

The need for expert knowledge and an open or creative mindset is key in developing any type of new insight into the ecosystem or the network at hand. What became apparent in interpretation of the results, is that the most vulnerable point in the model is the on-boarding of new stakeholders, partners or clients. They either react enthusiastic or they go into fight or flight mode trying to maintain the status quo. Creating the right mindset in a larger public, is key in continuation and scaling of any project related to DLT. One mistake in this area, as one interviewee described, can deal a devastating blow to the development of a technological innovation without clear outcome.

The effects of having the right mindset present in a company are further explored by Van Dijk, who lectured at the theme day Digital Ecosystems (Van Dijk, 2016; Van Dijk & Peters, 2011). Her analysis of organizations from an ecological perspective, have led to the life-cycle as shown in figure 37 on the next page. According to Van Dijk most established companies reside in the 3rd and 4th quadrant, leaving them at a loss

in an ever-changing environment as they are less adaptable. An ecosystem, in her words, is defined by circular causality. Meaning there is no direct control from whomever at any time, thus there being a need for people in the 1st and 2nd quadrant to innovate.

When comparing Van Dijk's work to the model from practice, there is a clear link between the motivation and mindset needed to create opportunities in new ecosystems, and the lifecycle of organizations. As Van Dijk pleads, there is a need for people to get back into the upper quadrants, a mindset that is willing to try, wild and entrepreneurial. Stimulating intuition and creating exception are necessary in order to create the mindset needed to survive in a networked ecosystem.

Disruptive thinking

The last remaining area in the model of figure 37 is disruptive thinking. How the current process of DLT development as shown by practice is different from other IT projects, or innovation projects in general, is the fact that the disruptive thinking present allows for a so-called networked environment or ecosystem to define and develop itself. The companies that have created successful pilots, all had in common that they managed to get together the relevant stakeholders and allowed them to think together of new ways to tackle the future. The reason many sectors are experimenting with distributed ledger technology, is that it allows collaboration without the need for intensive trust. The core finding of this research is that DLT has allowed collaboration in a way not seen

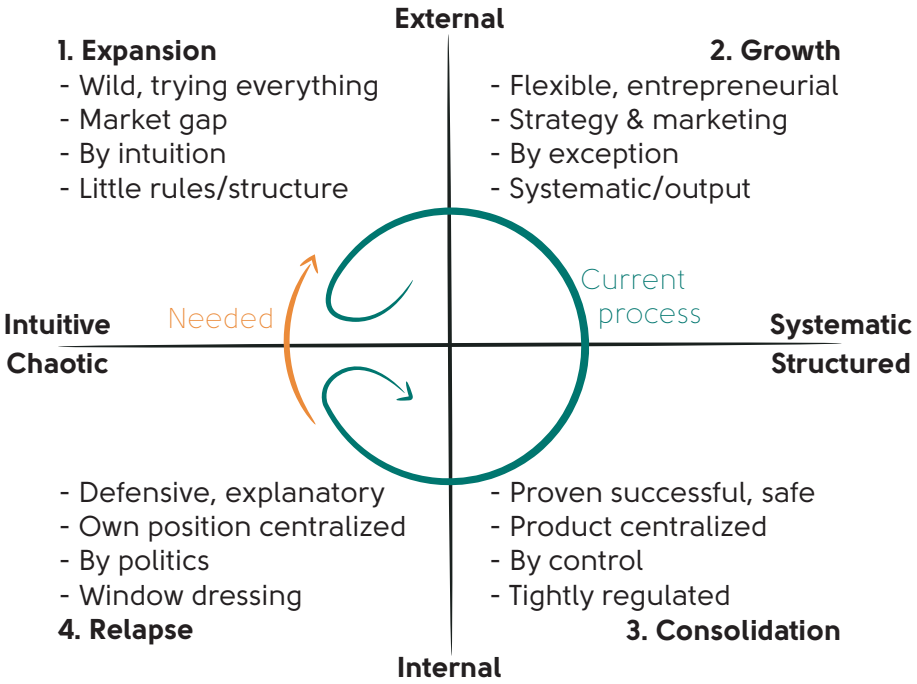


Figure 37: Lifecycle of organizations (Van Dijk, 2016)

before on this scale. Competitors have joined in ventures and consortia to create environments that are bigger than their individual landscapes.

When comparing this find to literature, it is easy to make the link to open innovation (Chesbrough, 2006) and networked innovation (Bergema, 2015). Both look at inter-organisational collaboration, where networked innovation even goes as far as peer to peer co-creation. Both fields have studied the social factors and methods that are necessary to constitute a healthy innovative environment and created elaborate lists of influential factors. So far, however, the technology or innovation itself has always been an outcome, whereas this research has found the technology to be the enabler of the innovative process. The unique constructs of DLT, as explained in the paragraph below, allow the technology to be a vessel for disruptive thinking. It creates network thinking, along the lines of circular causality, rather than the linear thinking seen in companies today. The writer of this thesis would argue that DLT as a means is more powerful than DLT as a solution.

3.4.3 The power of DLT

Lastly, a link to theory is sought to the specific aspects of power of distributed ledger technology. When trying to define its true power, the systematic literature review by Seebacher & Schüritz (2017) provides a good overview of the current perception in academia. Their research, as shown in figure 38, found that trust and reliability are the core of DLT. What attracts organisations to come together and innovate, are the promises these two factors take away by solving the largest barriers of current trading such as reliability, integrity and transparency. Making DLT all about collaborative exploration of what is possible in a decentralized, trustworthy environment.

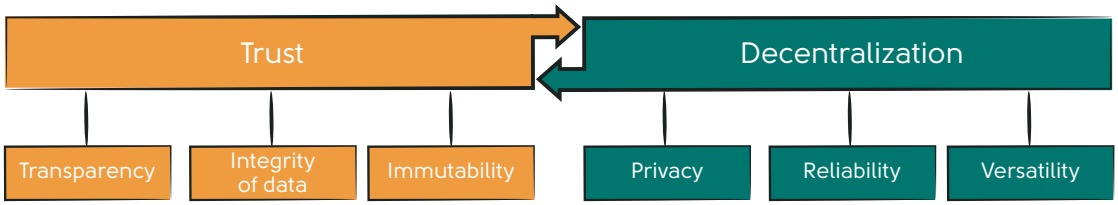


Figure 38: Characteristics of distributed ledger technology (Seebacher & Schüritz, 2017)

Relevant insights

- Academia finds solving socioeconomic barriers to be crucial to DLT-adoption
- Strategic niche management can help in solving DLT's socioeconomic issues regarding trust, growth and adoption
- SNM names six dilemmas to focus on: vision, learning, strategy, network, protection and niche/regime interaction.
- DLT needs a combination of disruptive thinking and mindset innovation makes to create adoptable innovations
- The right mindset for DLT should be focused externally, be entrepreneurial, wild, exploratory and flexible. However, most company are focused internally, risk averse, controlled and defensive

3.5 Design brief

To end the define phase of this thesis, a design brief was created. In a regular design brief, all requirements for the upcoming design project are discussed in order for the project team and the designer to reach an agreement. However, as this thesis is not commissioned by a client, certain issues such as budgeting and planning will not be discussed. What does follow in this chapter is a problem statement, the goals of the design and the design challenge that is to be solved. These aspects will be based upon the information gathered in both the discover and define phase. By looking at the gathered insights from both a communication design and strategic design perspective, the final scoping of the first part of this thesis will be done.

3.5.1 Problem statement

When the insights of the first and the second part of this thesis are gathered, a broad picture of DLT-development and adoption comes to light. To allow a problem statement to be deduced from this, a combination is sought between strategic and communication design.

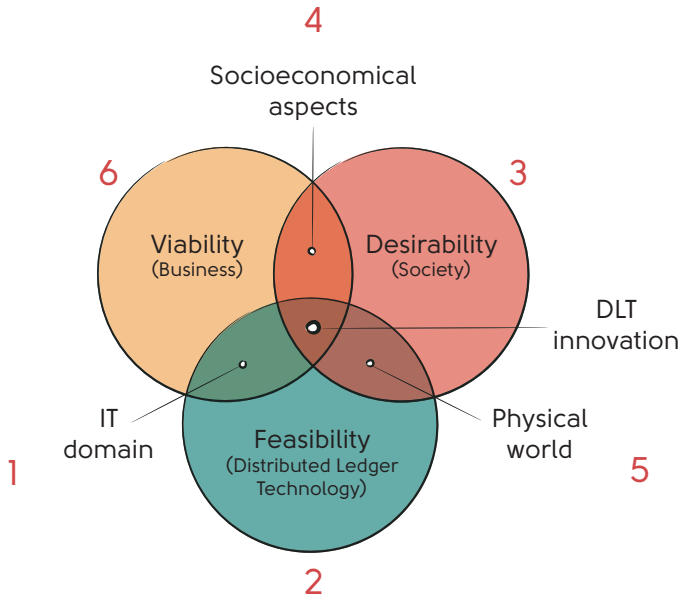


Figure 39: The model of DLT-innovation incorporating the aspects of DLT-development and design innovation

According to IDEO, design-innovation is the sum of viability, feasibility and desirability. When these three lenses come together, true innovation can be created that works, is wanted and fulfils a need. From one of the interviewees it was learned that DLT-development can also be seen as the sum of three parts, namely: IT, the physical world and the socioeconomic domain.

When looked at this from a communication designer's perspective, who wants to see the bigger picture by combining the knowledge available, the urge exists to create a new, better model. This new model should incorporate both the lenses of design innovation from a strategic design perspective and the defining lenses of DLT-development from a practical perspective. Thus, the model in figure 39 was created. What can be seen in this model, is that DLT-innovation is actually the sum of six parts, that are all interconnected. Only when all parts are addressed, true desirable and feasible DLT-innovation can be created, which is needed to increase its adoption.

With use of the model combined with the gathered insights, the main problems of DLT-adoption were found. As shown on the left, all elements turned out to have a problematic aspect, creating a total of six problem areas that all link together. They are as follows:

1. *Experimentation*
DLT is in its nature an IT solution. The technology field is still immature and has just passed the hype (Panetta, 2018)Currently, there is little knowledge on how to program DLSs and how to use them. Time is needed to experiment, causing most companies to hang around in the incubation phase (Beck & Müller-Bloch, 2017).

2. *Technology push focused*
Due to most companies being in the experimental phase, their focus is mostly on the technology itself. Almost all projects are driven by technology push innovation, to understand its technological potential.

3. *Desirability is neglected*
There is little focus on the (end)users and other influenced stakeholders in DLT innovation, due to its technology push nature. Desirability is neglected and projects run into problems as they don't address a need or create desire.

4. *Discussion on socioeconomic issues*
As desirability is largely neglected in DLT-development, most discussions and barriers in the studied projects arose in the socioeconomic domain.

5. *Problems with link physical world*
Directly related to 4a, the largest barriers are found in the link with DLT to the physical world. Digital identity confirmation (digital twin) is one of the biggest discussions on DLT and it's far from developed.

6. *Viability is the biggest obstacle*
As there are no direct needs to address or desires to fulfil, companies and societies at large find themselves wondering of what value DLT is to them. Currently, the naysayers and sceptics have the overhand and adoption is slowed by their influence on the early majority both in business and society. This has created a chasm in the development and adoption of DLT.

As the development of technology needs time, the choice is made to focus the rest of this thesis on the underexposed aspects of desirability (3), the socioeconomic aspects within this (4) and the effect this has on viability and acceptance of DLT (6). From these three areas

This statement, which is the result of scoping the first five research questions (1, 2, 3, 4a &4b), is formulated in the following way:

DLT-adoption is halted by those who cannot see past its current lack of viability. As the values and needs of society and business are largely neglected, a chasm has appeared which halts DLT's adoption. What is needed is an outside perspective in order to help and look past the current boundaries and to create true desirability.

3.5.2 Goals of the design

As mentioned in the problem statement, the goal of the design should be to bring in an outside perspective to help fulfil the needs of DLT-adoption. These needs are categorized by the respective field of strategic design and communication design and are as follows:

Strategic design:

- DLT-development needs to address desirability and viability.
- DLT is best applied when its disruptive characteristics are used as a vessel for change. Disruptive thinking needs to be stimulated.
- DLT-development needs network centred design, which means a focus on values and needs of everyone in the ecosystem.
- As DLT-development is volatile, a continuous iterative approach is needed.

Communication design:

- DLT is wicked in nature, it needs solutions applicable to a wicked context.
- The abstract socioeconomic context of DLT-adoption needs to be addressed, e.g. through strategic niche management.
- It is the mindset that determines the success of a DLT-adoption. A climate stimulating an open mindset is needed for development to succeed.
- Collaborations using DLT require a proper inter-organisational structure, such as organisational learning.
- DLT flourishes only in collaborative form.

As mentioned above, from the research in this thesis, two promising theories were deduced that on paper prove to be quite promising to deal with these needs. These theories are the organisational learning theory by Peter Senge (1990) and the strategic niche management theory by Geels (2002). Organisational learning helps in dealing with wicked problems and strategic niche management helps technology to develop and grow out of its niche. From these theories, the following model, shown in figure 40, can be made. On the top side, this model shows the SNM dilemmas that need to be addressed in order to break through the regime. On the bottom, the organisational learning capabilities are shown. Their overlap is coloured in red (learning) and yellow (visioning).
What DLT-adoption needs, is a combination of

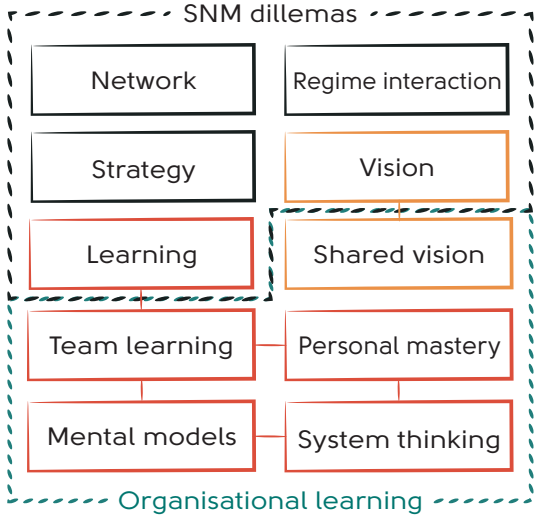


Figure 40: Combined aspects of organisational learning and SNM

strategic design and communication design, to combine the field of disruptive thinking with open collaborative mindset innovation. With the list of needs and the theories in mind, a list of goals can be made that the upcoming design should achieve. As applying the whole model into one design might prove quite complex, the choice is made to focus only on the visioning and the learning aspects of both theories. The goal developed from the needs are as follows. As a goal, the design should:

- Allow users of the design to get into an open mindset that stimulates disruptive thinking.
- Incorporate a network centred design focus that addresses all needs and values within the ecosystem.
- Encourage an environment based on organisational learning, as the context of DLT is wicked.
- Focus on creating a vision, to provide clarity and common understanding.
- The design should be suited for a professional and collaborative environment (e.g. consortia).

3.5.3 Design challenge

In order to kick off the design process, a design challenge is formulated from the goals:

Use frame innovation to create a design that uses the constructs of DLT to create a more open mindset, which enables companies to create disruptive yet desirable future visions that are both workable (IT) and communicable (internal/external)

This design challenge will serve as the starting point of the design, incorporating the needs and goals. To create a design challenge, IDEO's approach is used ("Design Kit: Frame …," n.d.); the full process is explained in appendix xx.

This design challenged is based upon a few choices, made during its development. To understand this, they will be discussed briefly. A more elaborate explanation is given in the next phase, develop. In the process of the challenge development, it was found that it might be wise to choose an existing methodology as the basis for the design, as then the full focus could be on achieving the goals and solving the problems, rather than having to build a tool from scratch. This was advised, as the case in this thesis is rather complex and elaborate. The method that was chosen is frame innovation by Kees Dorst (2015). This method fits well to the proposed problem as it steers a designer led team to deal with "the emergence of a radically new species of problem: problems that are so open, complex, dynamic, and networked that they seem impervious to solution" (p.1). What makes it particularly suitable, is that is uses framing, which is "universal human ability" (p.2), making it easier for non-designers to comprehend.

Additionally, during the development of the design challenge, the choice was made to focus on a central outcome. In this case, a future vision was chosen as this outcome. To make it fit to the context of DLT-development, the choice is made to challenge the vision to be workable for IT and communicable internally and externally in a professional collaborative environment.

To conclude, this design brief aims at creating the foundation for the Develop phase, in which the first design will be created. As the changing of a mindset towards a disruptive setting is quite difficult, it was chosen to guide this process by using frame innovation, a proven method to change a frame of reference.

3.6 Conclusion define

The aim of the second part of this thesis was to scope the findings from the discovery phase in a convergent way towards the design brief. To structure this process, two research questions were formulated. Each question will be answered below with the found insights. Next, there will be a reflection on what the findings and models from this part of the thesis mean for the rest of the report and for distributed ledger technology and its development at large. The following question kicks off this conclusion:

> ***SQ4a:*** *What are the current barriers and enablers of DLS development in practice?*

In the first part of this thesis it was found that there currently is a chasm between the enthusiasts and the majority of society and business, caused by the immaturity of the technology and the technology focused, experimental phase DLT is in. The study of practice revealed similar results, confirming the most advanced project are still only at a experimental or localized level. When diving more into depth to find out the specific barriers and enablers, it was found that mainly the socioeconomic aspects of DLT bring a burden. Lengthy discussions about trust, identity and risk, dominate the field of mentioned barriers. Where the technology offers solutions that should solve these exact problems, the connection and collaboration within the real world proves difficult. The overall lack of confidence and trust in others that dominates the business world and the inexperience of those working in DLT to create the needed comfort, has caused adoption to be slow moving. Additionally, as was found in the discover phase, the scaling of DLT remains another big barrier. There is little known about scaling. The needs and requirements, both digitally and physically (infrastructure), cause problems for any DLT that wants to break out of its safe niche, towards big adoption and implementation. This is partly caused by the slow on-boarding of new partners and struggles in the collaborations that follow.

After the barriers and enablers for DLT itself were analysed, the focus shifted on information regarding collaboration in DLT-development, as was researched by the following question:

> ***SQ4b:*** *What is the role of collaboration in DLS development in practice?*

As was just mentioned, on-boarding and sustaining good collaborations is a problem in a inter-organisational development process that characterizes DLT. In answering the research question, it was found that collaboration is crucial to the success of DLT. Only when multiple parties share data and knowledge, DLT can function as optimally as it was meant to do. From the gathered insights, the model shown below on the left was created. What this model shows is that in order to stimulate

the disruptive thinking that can be achieved through and with DLT, the right open mindset and motivation can make or break the project. The critical point in this model is the on-boarding of new stakeholders and partners. A negative and cautious reaction can halt adoption and innovation immensely, while the true strength of DLT lies precisely in its power to bring companies together to start innovation collaboratively. This paradoxical movement, where the technological promises bring people together, but poor presentation of the technology can scare people away, is what makes DLT-innovation so complex.

Conclusive outlook

When the insights from the research were analysed, it became apparent the biggest possibilities for design to aid DLT lay in the combination of creating the right mindset that allows disruptive thinking to happen. Here, the focus should be on the on-boarding through the creation of an enthusiastic and open mindset. This mindset, according to the found research, should focus be externally oriented, wild, exploratory and flexible. Thus, the design brief focuses on the following design challenge:

Use frame innovation to create a design that uses the constructs of DLT to create a more open mindset, which enables companies to create disruptive yet desirable future visions that are both workable (IT) and communicable (internal/external)

The challenge focuses on creating desirability through the change of frames through we see the future. As shown in figure 41 on the right, the bigger idea is to get those who don't see viability, to let go for a second and consider all the possibilities. To create a sense of desire for DLT, in order to speed up its adoption. The design challenge, together with the found insights, will now form the basis on which a design can be build. A design that aids the adoption of DLT.

In the long run, however, DLT needs a more rigorous approach, focused on strategy and organisational structure. Here the theories of strategic niche management and organisational learning come in. This will however not be the focus of this thesis, but these findings will be reflected upon at the end of this thesis.

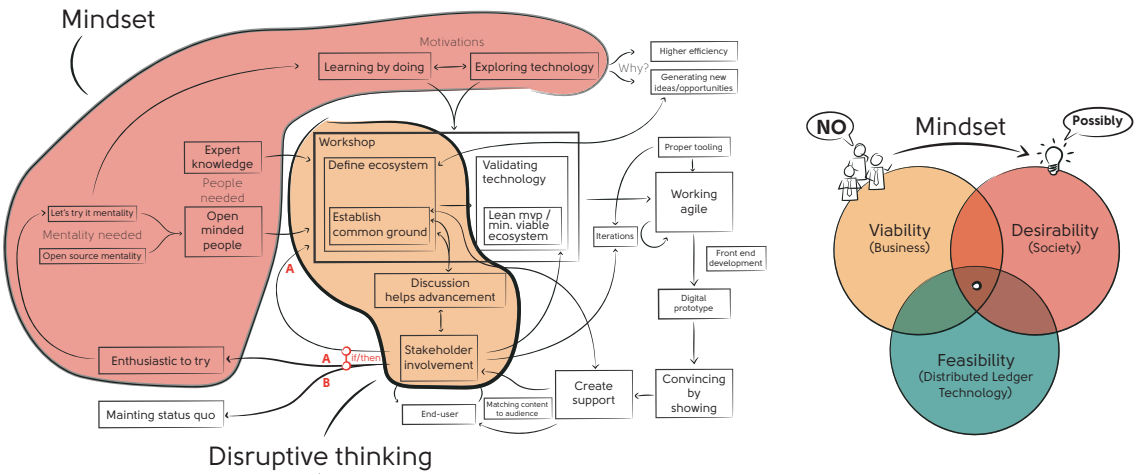


Figure 41: The conclusive models this part of the thesis. On the left the factors regarding mindset and on the right the needed shift of focus.

4. Develop

In this part:

Additional literature study

Hypothesis framework

Ideation

Legal deepdive

4.1 Introduction

The third part of this thesis focuses on developing a feasible design feasible for testing what the impact of design can be for the adoption process of distributed ledger technology. This will be done through combining theory and the practical skills of design.

First, the design brief will be broken down, to understand where its value lies. Through this process a format is chosen that will be based on a mix of insights and available methodologies. The chosen methodology is then again broken down, to understand what its power is. From this broken down method, in combination with the earlier gathered insights, a theoretical hypothesis framework is build. Having a theory based hypothesis is important, as Design Based Research seeks to generate new knowledge and insights. Through the theoretical foundation, the researcher can test and hypothesize whether the earlier found models can be used to help DLT-adoption. What follows after this elaborate preparation, is a phase of divergent ideation, in which the design process will be discussed. In the end, this chapter leads up to the first testable prototype.

To guide this process, a research question was developed for the two final parts of the thesis. This question is as follows:

> ***SQ4c:*** *How can design tools be used to aid the needs for the adoption of distributed ledger technology?*

Having this question helps with keeping focus. The design should at all times be in the interest of adoption of the technology. Thus, a direct and clear link with DLT needs to be present and the design should always present DLT in a clear and understanding way, leaving no room for misinterpretation.

Conference visits

As part of the Design Based Research approach, another conference was visited during the development phase. This conference, which was focused on the legal aspects of DLT-development, was used to create an insight in what structural issues play on the background. This conference was held at the Dutch National Bank and although it focused mainly on the financial world, the aspects of risk aversion and collaboration to create development were widely discussed.

4.2 Design preparation

As mentioned, this chapter starts with a look back at the deliverable of the first diamond of the double diamond model: the design brief. In the next paragraphs, the design brief will be broken down to find its raison d'être, the core of what it aims to achieve. From there, the process will form itself.

4.2.1 Recap design brief

The design brief that outlines the foundation of the further design process, is build up of three parts. First, a problem analysis was given. DLT mainly faces three large problems that interrelate. First, the technology is immature, which causes companies to focus on developing it further. Due to this, the desirability and viability of the technology are neglected. This has created a chasm between the current enthusiasts and the larger majority of business and society, where the latter two are rather sceptical and see no direct need for DLT.

As it was found, the development of the technology itself simply needs time and devotion. What can help is more engagement, as exposure can help to get problems solved faster. Thus, to aid the adoption of DLT, the lack of desirability and viability was chosen as a starting point. To solve this problem in adoption, a shift of mindset is proposed, where the focus will lie on creating desire for DLT, away from the scepticism from a viability point of view, as shown in figure 42.

In order to make this more concrete, a set of goals and the following design challenge was formulated:

> *Use frame innovation to create a design that uses the constructs of DLT to create a more open mindset, which enables companies to create disruptive yet desirable future visions that are both workable (IT) and communicable (internal/external)*

Breaking down the design challenge

In order to find what the core philosophy behind the design challenge is, the method of the golden circle by Simon Sinek is used (TED, 2010). The theory of this circle, as displayed in figure 43, is that if you want to create something truly desirable, you need to reason not from "what" you want to create, but you need to look deeper into the "why" you want to create something.

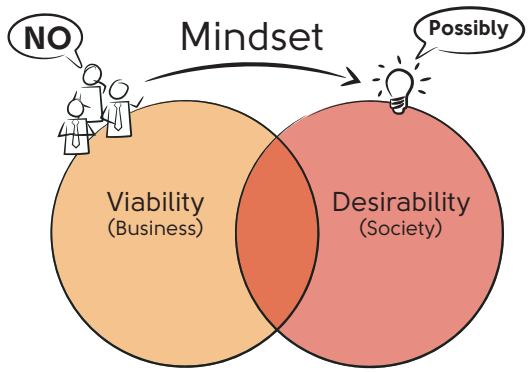


Figure 42: The focus of the design brief: create a desirable mindset

Using the "why" as a starting point, better and more disruptive ideas can be formed.
Through using the "why" as a starting point, the design brief can be broken down. After doing so, the "how" and the "what" can be determined. The process, which is visualized in figure 44, consists of the following reasoning.

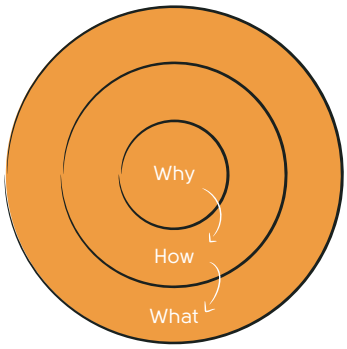


Figure 43: Golden circle of reasoning, by Simon Sinek (TED, 2010)

Why?

The core of the design brief is the combination of two things. First it was found that DLT is really only viable in a collaborative context where multiply parties share something and its complexity demands a variety of expert coming together. However, apart from the enthusiasts, the majority hesitates to engage, as they cannot see the possibilities. Thus, adoption and acceptance are needed. Which also brings us at the "who is it for?" question. The design challenge is focused on on-boarding skeptics and lay-man who can help speed up the development of DLT

How?

Through the interviews and the observations it was learned that simply sharing a story about what DLT can do and showing a pilot, is not enough to convince people. Especially, for the parts where collaboration is stressed, companies seem to want to solve it themselves internally first. After deliberation of the observations and a conversation with the Red Cross, who are doing DLS pilots, it was decided that an immersive experience in a collaborative setting was needed for people to truly understand and feel the power of collaborative problem solving through DLT. As one of the interviewees said, "*you need to experience it, in order to understand and trust it as a new possibility*". Thus, an immersive experience should help to form an new mindset.

What?

As there are still little examples know of products with DLT that can be tested and experienced, DLT requires a different approach

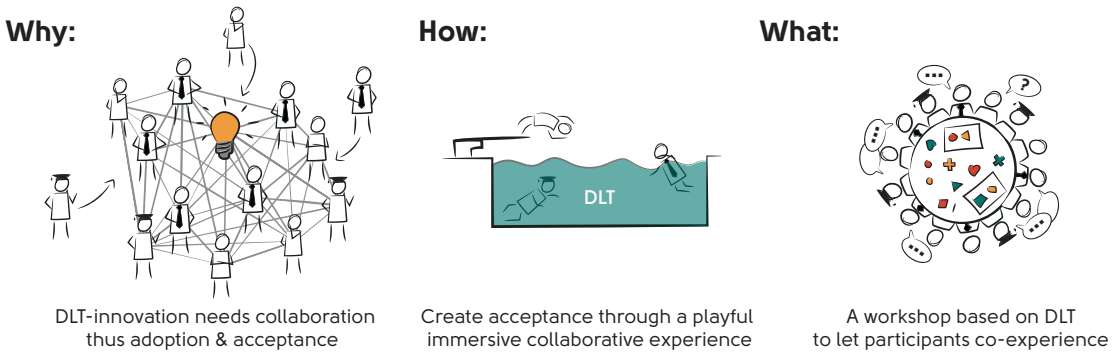


Figure 44: Break down of the design brief in order to go from "why" to "what"; the outcome of the design process

than a regular "test and try" product sampling. DLT currently lives mainly through the bold thinking of those who see the possibilities. What is needed is a change of mindset for those who cannot see it, created through an immersive experience where people get a first understanding of what DLT is. Again, as a "try it at home" kind of experience is not realistic, a format better fitting to the current DLT-development process was chosen: a workshop. Currently, when DLT-developers sit down with stakeholders, they do so in a workshop settings, where they either define, discuss or test software in a collaborative setting. The aim of the workshop should be to let participants get a first experience with DLT and create a desirable mindset that beliefs in possibilities, rather than seeing non-viability.

4.2.2 Opportunity areas

Now the "what" has been determined, a set of opportunity areas was created to explore what content of the workshop could be. The idea of these opportunity areas, which are visualised on the next page, is that you as a designer force yourself to find a way to express what the importance of the design should be. Furthermore, having different areas allows the designer to explore different direction. In total four areas were created, which can be found in appendix xx. The two areas shown on the right were chosen as leading, as they express both the strategic side (top) and the communication side (bottom) of design.

To create an opportunity area, first a field of focus is chosen. This field is then accompanied with insights from the research. These insights are displayed in the white boxes. After this process, an image is sought out that accurately describes the field of importance. Next, the methods and theories from communication and strategic design were explored, to seek if there is already existing knowledge on how the opportunity areas can be engaged. These theories are shown in the bottom right of the area. When all areas are finished, they can be used as a discussion tool, in order to iterate towards a viable design underground.

4.2.3 Frame innovation

As mentioned, the opportunity areas were used to find suiting methods and to discuss these, in order to make a choice for the basis of the design. As the design challenge already mentioned, for this thesis, the choice was made to use frame innovation by Kees Dorst (2015) as a foundation for the design to build on. This choice made for the fact that frame innovation is based on using design to change the frame through which people see a problem. This theory therefore forms a perfect bridge between strategic and communication design. Furthermore, the target group of the design is universal. On-boarding a diverse group of people is crucial to DLT-development. Thus, frame innovation is chosen, since it relies on the "universal human ability" of re-framing (Dorst, 2015, p. 2). Meaning, everyone can do it.

Originally, the frame innovation method by Kees Dorst (2015) consists out of nine steps. However, a quick online search found that it is also possible to slim the method down to six or seven steps, where the initial analysis is less broad. The smaller format fits better to a workshop setting. Thus, the foundation of the design will be based upon the following six steps of frame innovation:

1. Context

Define the context surrounding the problem, including all stakeholders and their relations.

Using DLT to challenge the status quo

- Discussion helps
- Changing meaning and roles
- Establishing new common ground
- Radical and provocative statements

Design driven innovation
Change management
Design thinking

Getting stakeholders into the right mindset

- The right message
- Open minded mentality
- Motivated to learn and do

Change management
Frame innovation
Storytelling

2. *Field*
Map all interactions (currency) of the playing field, finding the deeper, universal values that bind all parties. Think of cultural, economic, social, and symbolic aspects.

3. *Themes*
Find the motivations and experiences that link the players.

4. *Frame*
Re-frame the problem. 'If the problem is approached as if it is ..., then ...'.

5. *Futures*
Generate realistic and viable solution within the frame.

6. *Transformation*
Find the most workable frames, weed out the bad and create a business plan to reach the newly proposed future.

What makes this method particularly suited, is that it also fits to the current process of DLT-development, which was translated into the research interpretation model (p. 63). Currently, DLT-development starts off with a workshop in which the context and ecosystem is defined. Thisis also the start of frame innovation.

Furthermore, frame innovation fits with the requirements to incorporate organizational learning and the creation of a vision, as was stated in the design goals. When compared to organizational learning, frame innovation seeks to find the deeper mental models in interactions, to enable participants to collectively find new frames (team learning). The outcome of frame innovation is usually a set of frames that serve as a vision for change.

Creating a suitable foundation

As frame innovation itself is a method with a certain amount of steps, it cannot directly be made into a design fit for DLT. Therefore, the methodology of frame innovation was broken down into pieces that could serve as separate bases for the design. When looked at frame innovation more closely, three categories can be found. They are shown in figure 45. The first focuses on analysing the current situation. The second aims to disrupt this situation through re-framing. Lastly, the third goes back to reality through the creation of a solution that is new, yet fits to the current context. When visualizing these three steps, a kind of arc can be created, as shown in figure 45. This arc demonstrates that frame innovation goes from concrete, to abstract and back. The outcome being a viable solution.

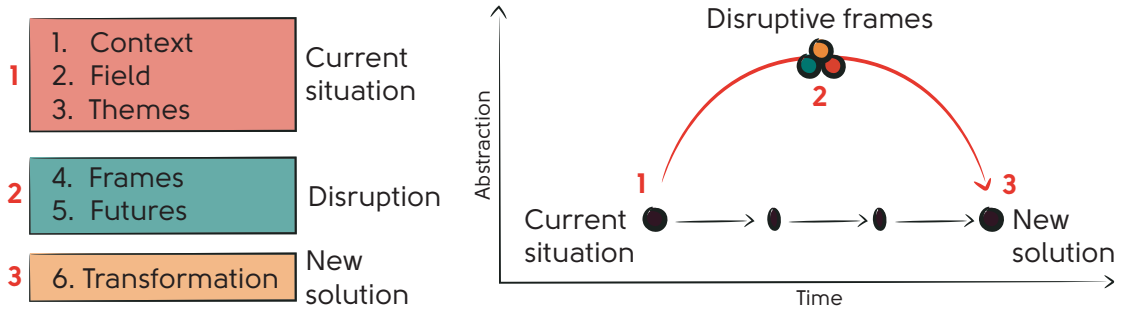


Figure 45: Frame innovation broken down in elements and placed in a three step model

4.2.4 The addition of new theories

Frame innovation is a very suitable method for re-framing current problems by looking at it from a different context. It is however less suited when the new context is unknown or in a distant future. Therefore, an additional search in literature was done to find methods better suited for defining a future context based upon abstract possibilities rather than concrete outcomes, as is the case for DLT-innovation.

Incorporating DLT

To find out how frame innovation could be made suitable for the context of DLT, first the aspects of DLT are revisited. When looking at the aspects of power of DLT, Seebacher & Schüritz (2017) defined that the promises of trust and decentralization drive its current impact. Their theory consists of a model containing these two aspects and their defining characteristics of transparency, integrity of data, immutability, privacy, reliability and versatility. The model is shown in figure 46. To allow participants of the design to be submersed, these topics of DLT should be integrated in such a way that a playful experience is created. When looking at the model of figure 45, DLT integration would fit best to the creation of disruptive frames, as they do not belong to the current context, but should belong to the new solution space.

Vision creation and prospecting

As the design challenge looks at creating a vision for the future as a final outcome, and the current process of frame innovation is not suited for future prospecting, the research of Voros (2001) was used to guide this process. Voros found that when creating a future vision, it is important to consider the different extremes that are possible. His research found that visions can generally be placed in one of four categories. These can be found in figure 47. These categories are ordered as follows: *possible futures*, including the broadest possible outcomes; *plausible futures*, which look at the most viable outcomes; *the probable future*, which is the most likely outcome given current development without intervention and *preferable future*, which is a mix of different bold ideas. A preferable future aims to find new directions into the realm of possible and plausible futures, allowing a change of focus. According to Voros, this is what a good vision should do. In case of the design in this thesis, the aim should be to create disruption. The focus of this thesis is the *possible futures* domain.

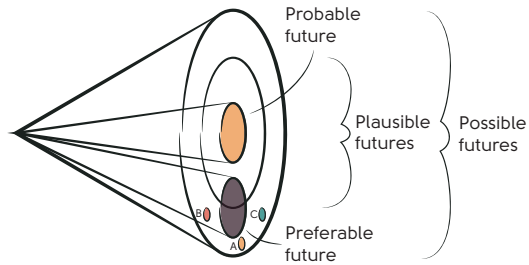


Figure 47: The different futures by Voros future cone (2001)

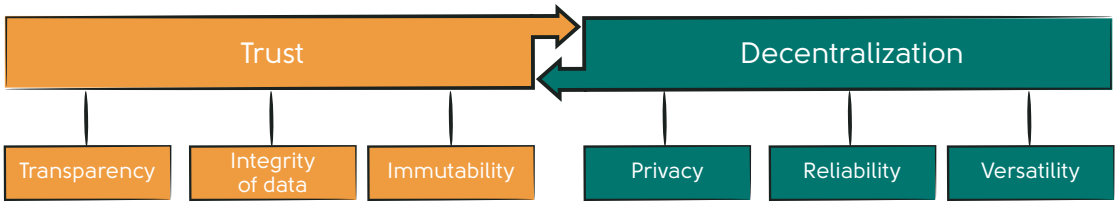


Figure 46: The most important aspects of DLT; the strength of its existence

Causal layered analysis

To create ideas that fit in the preferable futures cone, Voros suggests the use of causal layered analysis (Inayatullah, 1998). Causal layered analysis (CLA) is a method of four steps that aims to transform perception through challenging the core myths of society. The method is shown in figure 48. When comparing this method to frame innovation, it shows quite some overlap. The process of finding deep needs and values fits well with frame innovation's steps of finding *field* (2) and *themes* (3). When looking to apply frame innovation in a prospecting context, with the outcome being ideas on the daring regions of Voros' scope, causal layered analysis can bridge the gap between frame innovation and Voros, as it overlaps both methods.

As mentioned, CLA consists of four steps or levels to be defined (see figure 48):

1. *Litany:* Trends, events, problems (current context)
2. *Social causes:* Economical, cultural, political and historic interrelations.
3. *Discourse/worldview:* underlying values and cultural dynamics.
4. *Metaphor/myth:* Collective archetypes, (gut) emotions and societal frames.

Once the level of metaphor and myth is reached, Inayatullah proposes the creation of new metaphors and myths to challenge the current way business is performed. New metaphors can be radically different and completely new, or they can be opposites of current frames. From here, people participating in a causal layered workshop are asked to go back up the iceberg to find a new worldview with new relationships. In going up and down in these levels, participants become able to create new meaning.

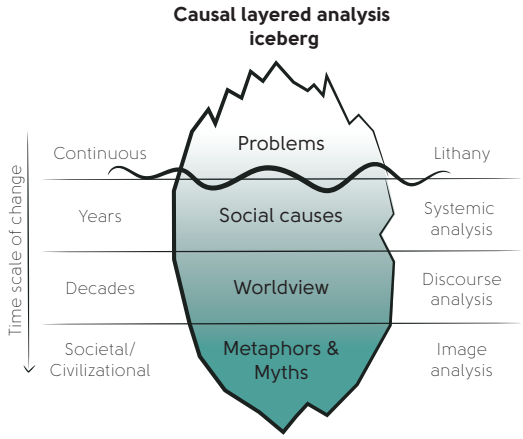


Figure 48: Causal layered iceberg (Inayatullah, 1998)

Shared vision building

In order to create a vision, one has to understand its fundamentals. A vision, according to (Simonse, 2017), has four distinguished properties.

1. *Clarity:* a vision needs to be clear and understandable.
2. *Value drivers:* There needs to be a clear and compelling benefit; solving a need or wish.
3. *Artefact:* a strong vision needs to be materialized through imagery in 2D or 3D.
4. *Magnetism:* How desirable and attractive the given vision is.

When building a vision is put into practice, Simone defines there are four leadership skills a vision creator should master:

1. *Imagining* a desired state
2. *Sharing* through established bonds
3. *Championing* through ideation
4. *Securing* commitment

Both lists of criteria from Simonse can be used to test if the outcomes of the final design are suitable for communication (internal/external).

4.2.5 The theory hypothesis framework

In the past few pages, the initial process of translating the design brief is shown. Through a process of consideration and iteration, the choice was made to pick a proven method as the basis for the design: frame innovation. What makes frame innovation suitable, is that it is based on a universal human ability, meaning everyone can partake in it. Furthermore, it is well suited for use in a wicked context, due to its elaborate steps of defining the deeper context.

However, as it turned out, frame innovation in its current state is not fully applicable to the context of DLT-innovation. Where frame-innovation focuses a lot on re-framing a current problem to a new different context, DLT needs a future visioning approach. This is because the disruptive power of DLT lies in domains not yet present, thus in a context outside of our current scope. With this in mind, frame innovation was broken down in order to find what parts need fine tuning and to make it ready to be turned into a workshop. For this an additional theory search was performed. Through this search, the theories of Voros (2001) and Inayatullah (1998) were found, that could fill the gap between frame innovation and operating in a future uncertain context. Next, these theories were added to the broken down frame innovation method and put into the framework as shown below in figure 49. Here the choice was made to use CLA in the current context stage, DLT and metaphor re-framing in the middle phase and Voros shared vision making in the final phase.

The framework that was created from the combination of theories serves two purposes. First, it will be used as a blueprint upon which the different steps of the design can be build. Next, as it is a theory based model, it has not been proven in practice. Therefore, the framework itself is also a hypothesis. This hypothesis is based on the assumption that a combination of frame innovation, future prospecting, DLT and CLA can be used to help sceptics experience the power and possibilities of DLT. Which in turn allows a change of mind. To find out if this model actually works as assumed, a series of tests will be performed. The tests are followed by a critical reflection on the design and the iterations, which can be found in the end of the final part of this thesis, deliver.

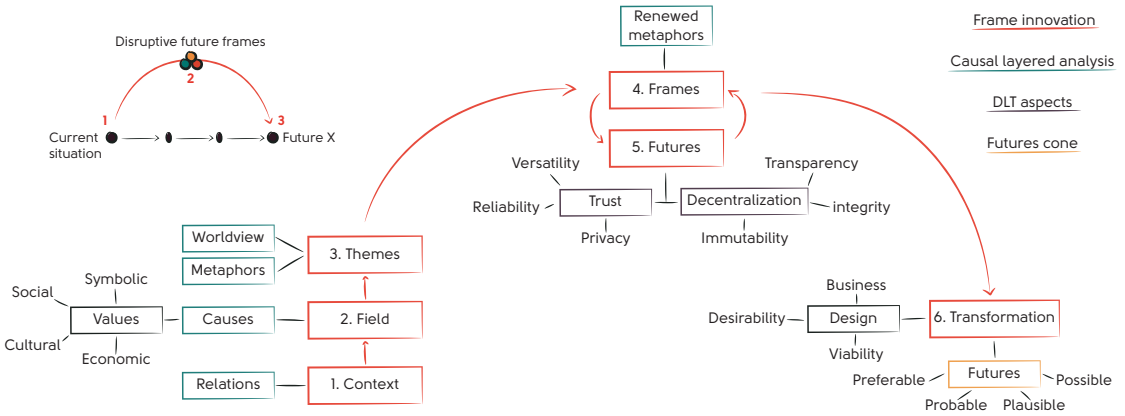


Figure 49: The framework with all theories combined, which will serve as both a basis and an hypothesis for building and testing the design

4.3 Design process

The previous chapter led to a methodological framework that can be used to change perspectives and create a vision accordingly. From here, a design can be created. This will be done using the design challenge, the methodological framework and several steps of ideation. However, the final goal of this thesis is not to create an optimal tool. The design process will be a continuous process of reflection, focused on creating new insights in line with the design-based research approach. For the structure of this chapter, this means only the steps leading up to the first design will be discussed. This will be done through explaining the process and showing how the ideation led up to the first prototype.

4.3.1 The development process

To go from a framework to a usable design, a design process is needed. In order to do so, the earlier established design challenge is used as a starting point:

Use frame innovation to create a design that uses the constructs of DLT to create a more open mindset, which enables companies to create disruptive yet desirable future visions that are both workable (IT) and communicable (internal/external)

The challenge formulates four goals, that need to be kept in mind:

- Use frame innovation
- Use the constructs of DLT
- Create an open mindset that can allows disruptive yet desirable future vision to be created
- The vision should be workable and communicable

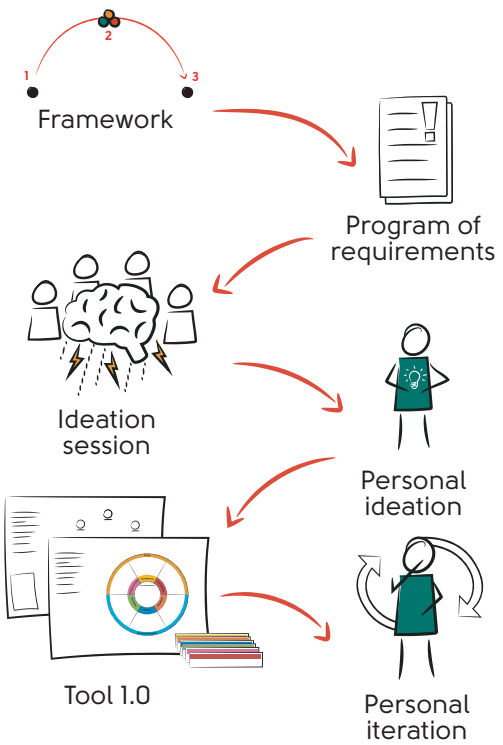


Figure 50: Steps of the iterative design development process

As was mentioned before, the choice was made to base the design challenge upon an established methodology, that of frame innovation. Next, frame innovation was broken down and tailor made to suit the DLT-innovation process, which resulted in a framework. This framework will be the start of the creative process, which is shown in the figure 50. The process shown is similar to a regular design process, but performed in a quicker and simpler way known as the lean start-up method (Ries, 2011). This means, instead of elaborately iterating and developing towards a final design, it ends with a simple prototype that is ready to be tested. This prototype should incorporate all the aspects of the design brief, but in the most simple and minimalistic way. From there, the deliver phase can continue on the lean path with quick iterations and reflective sessions. Here the aim is to accept potential failure in order to learn a lot in a minimal amount of time.

In the following paragraphs, each step will be discussed briefly, mainly focusing on the results of each stage.

4.3.2 Program of requirements

In order to bring structure to the ideation process, which can be quite messy, a program of requirements is created. Having a program of requirements helps to later make choices in choosing the best ideas. The program of requirements is largely based upon the goals and needs, but it is set up to be more practical in nature. To understand where all aspects come from, it is divided into sub-categories. Per category the relevant requirements are mentioned.

The design should:

1. *General:*
   - Create an understanding of DLT
   - Be usable in a professional and collaborative environment

2. *Design challenge:*
   - Be based on frame innovation
   - Use DLT to facilitate an open mindset
   - Allow the creation of disruptive yet desirable future visions
   - Create an outcome that is workable and communicable

3. *Organizational learning:*
   - Facilitate learning as a team
   - Address a deeper understand of values and needs (mental model)
   - Create a shared vision
   - Allow personal mastery to developed
   - Evoke system thinking

4. *Shared vision:*
   - Create a vision that is clear and understandable
   - Create a vision that creates compelling benefits for either needs or wishes
   - Create a vision that can be materialized (2D or 3D)
   - Create a vision that is magnetic, meaning desirable and attractive

4.3.3 Ideation session

As now there is a clear design brief, framework and program of requirements, an ideation session with designer peers is performed. This step kicks of the creative process and lets go of the initial structure. In this session, which is

similar to a brainstorm, ideas are thought up and discussed critically, with the aim to find out-of-the-box ideas to approach DLT.

Understandability of DLT

The session yielded several results relevant for the design. In general, as DLT is an IT-concept, quite some explaining of the technology was needed to translate the framework and the design brief in to viable concepts. Participant had a hard time with this. Second, the complexity of all the possible directions DLT could go in, created quite some discussion on what to include and what not. Here, a comment was made that good guidance and process logic should be leading in the design.

Type of workshop

The second part of the creative discussion focused on how the insights from the previous parts is best applied in a workshop. This resulted in four concrete suggestions for the format, as shown in figure 51. All of the four formats can be considered immersive in their own sense, but each suits a different purpose. Playfulness is aimed at fun interaction, creative sessions are focused on generating new insights, discussion is about creating mutual understanding and designing is about applying knowledge to design a pre-determined outcome. Next, out of the four areas, a choice needed to be made fro the design.

As was found through the research, the observations and yet again in the first part of the ideation, the understandability of DLT is low. It is a complex technology, thus it is hard to take the a set of gathered insights and start designing. Thus, a design workshop was ruled out. Furthermore, a few of the interviewed experts had expressed disinterest in playful tools, as they found it too childish and not fit to their "serious" context. This does not mean playfulness and DLT can't work; one of the participants actually hosted a successful series of Lego serious play DLT workshops. However, with the critique in mind, the playful domain was put to the side for now. What remains are the fields of *creative session* and *discussion*. From experience, the designer of this project knows that people might be a bit averse to creative session, but when engaged properly, it always yields adequate results. However, a discussion based workshop also has benefits. The need of DLT is to cross the chasm between enthusiasts and sceptics, something which can be achieved through active discussion, as was learned from the interviews. Furthermore, Verganti (2016) found that critique in discussion can help to create disruptive innovation of meaning. Thus, a mix of *creativity* and *discussion* was suggested.

Figure 51: Choices for workshop format generated from the group ideation session

Workshop development

With the *creative* and *discussion* field as the established focus for the workshop and with good understanding of DLT, the group session now focused on analysing the theoretical hypothesis framework. Their main conclusion was that a single tool or canvas, translating the entire model, would be too lengthy and complex. The model itself perceived as elaborate, thus a tool that simplifies it would probably be highly complex to make. Thus, the choice was made to split the design into different parts, which fits with the already established approach of the framework. This resulted in a two-way split. The first part would focus on the current context definition through discussion, followed by a second more creative part, focused on immersing the group in the DLT-experience through re-framing metaphors.

4.3.4 Personal ideation

The outcome from the group ideation was mostly that DLT remains difficult to explain and incorporate, and that the workshop format should consists of a minimal of two parts, that takes a creative and discussion base approach. To start the personal ideation, the two focus fields were taken as a starting point:

- Discussion based exploration of current context through frame innovation/CLA
- Creative exploration of DLT through re-framing metaphors and vision building

Next the six parts of the frame innovation method and framework were divided among these two categories. This resulted in the division as shown in figure 53, on the next page To find a workable format for the workshops, examples of workshops were researched through the internet and in design related books. From this process, the idea for a set of guide-along canvasses came up. Canvasses, like the value proposition canvas by Strategyzer (2018) as shown in figure 52, can help designers and others alike to go through a process of certain steps. Furthermore, the insights a canvas creates are displayed in a visually clean and overview-like manner, which makes them easy to communicate. As this fits with the design requirements, the choice was made to start iterating within the boundaries of a canvas.

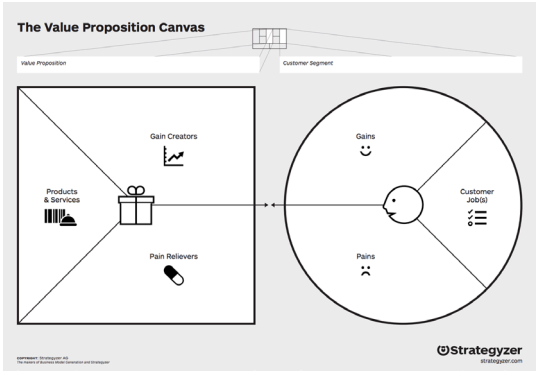


Figure 52: Guide-along value proposition canvas (Strategyzer, 2018)

Next, each of the six steps of frame innovation had to be thought out in the form of a canvas element. As the process is still lean, the design reasoning process is rather short and simple. This is because the idea is to just start testing as soon as possible. The following reasoning led to the first canvas elements:

1. Context

There are a few different ways to explore a DLT context, usually in the form of a network or ecosystem. Generally, when companies explore their environment, they create a stakeholder map. Here, the company is usually placed in the middle. As DLT is a technology based on peer sharing, the choice was made to go for a circle

of equals, on which participants have to map their ecosystem. Having a circle forces a natural perspective of equality and there is no player more important than the other. Furthermore, it allows for a group in a workshop to sit around and participate from every side.

2. *Field*

To define the interactions of the different players, the same network circle can be used to draw lines between the players. With the addition of a legend, the interaction are defined.

3. *Themes*

In this part, participants have to find underlying themes and overlapping deeper causes. This element is best suited for a critical reflection, thus a space for discussion had to be created. Next, this phase also requires the creation of a metaphor: the deepest layer of social cause. As this it might be difficult to reach the required depth, it was decided this step needed proper guidance through the use of easy examples.

4. *Frames*

As *frames* is the first part of the second canvas, this is where DLT is introduced. As the initial six aspects of DLT felt a bit too abstract for creative immersion, the elements were each explored in depth through a quick literature search, as can be found in appendix xx. The search yielded a list of ways to explain and define the different elements, thus they were clustered. As this step of the workshop should feel creative yet suiting to the DLT context, the choice was made to use the format of provocative questioning. This method was described by one of the interviewees as asking "what if" questions that create discomfort, thus demanding a reaction of the participants. This resulted in the choice to use a set of "what if" cards that could aide the canvas. Each card aims to let participants re-frame the issue through the use of a DLT-aspect.

5. *Futures*

Next, the aspect of *futures* was explored. Here, the provocative discussion results would be used to create future directions. These directions where then used to create new metaphors, that would help to transform the current context into a new future context.

6. *Transformation*

In the transformation phase, participants have to get back to reality, thus filtering their wild ideas to a more realistic scenario. To do this, a space is needed where the new metaphors can be worked out into concrete ideas. To help this process, it was chosen to include a set of examples to guide this process.

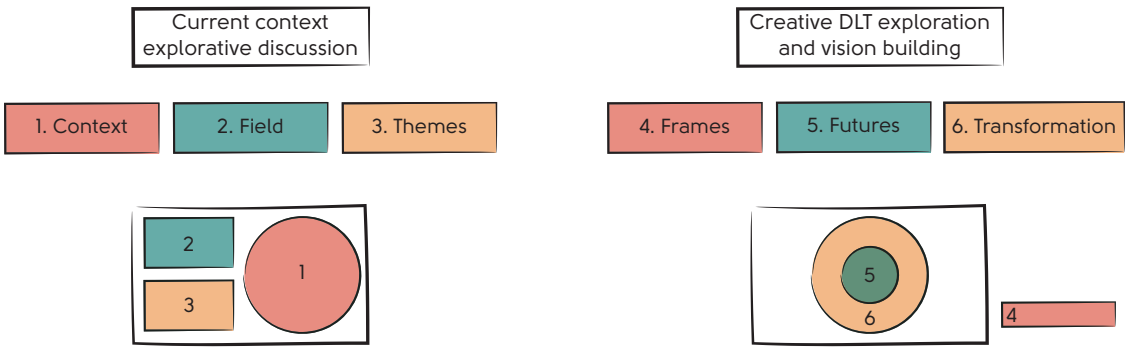


Figure 53: The build up of the two first canvasses

Concluding remarks

As can be seen in the reasoning above, a lot of choices and assumptions were made. The reason such a messy creative process is used, is that the designer wanted to make quick iterations. Thus, not using elaborative brainstorms, but working out the first idea that comes to mind.

When looking back at figure 53, the last part of the process is also displayed. This part consisted of taking a set of blank canvasses (A3-format) and drawing out multiple ways of placing the different elements. Through this process, the elements were played around with and the best fit was chosen. For the second canvas again the format of a circle was chosen, as this was assumed to work well in a group setting. Here the reasoning is to start in the middle with the metaphor of the current context, and work towards the outside of being creative and ultimately, more concrete. After a brief session of sketching, the format, as shown in figure 53, was chosen as a starting point for the design.

4.3.5 The first prototype

The first prototype, which is the deliverable of this chapter, consists out of two canvasses that can be tested in a workshop format. The first canvas, which can be seen in figure 54, allows participants to go through three steps: *context*, *field* and *themes*. Here, the participants are asked to define their current ecosystem, by drawing out the players and their connections on the circle. Next, they go into discussing the underlying values behind each connection or interaction. From there, a set of frames or myths is created that describe the current system. The aim is to define a couple of interactions between two stakeholders, in order to create a deep understanding of the system.

After the first canvas has been filled out, the second canvas is introduced. This canvas, as shown in figure 55, consists of the steps of *frames*, *futures* and *transition*. The goal of this canvas is to use the different aspects of DLT (six colours) to challenge the current metaphors and to create new metaphors. From there, concrete ideas and a future vision could be created by the group. To integrate the "What-ifs" in the canvas, a separate set of cards was made that could be used alongside the canvas. An example of these cards is shown in figure 56 on the next page. In the next and final phase, deliver, the canvasses will be discussed in more detail.

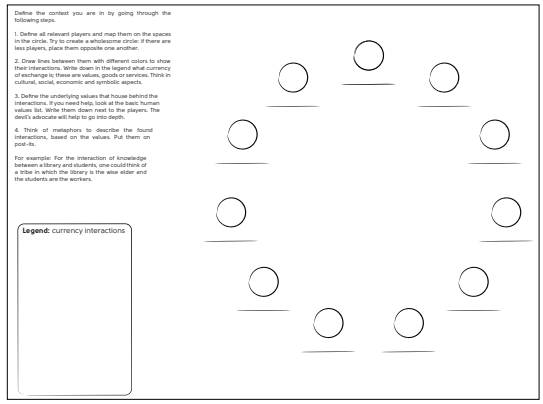


Figure 54: The first canvas of the prototype

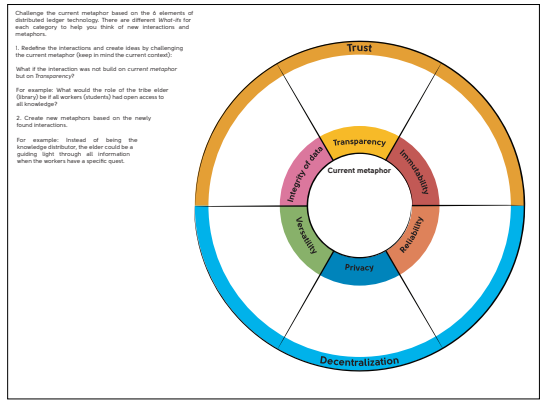


Figure 55: The second canvas of the prototype

Figure 56: Two examples of the provocative "what-if" cards

4.3.6 Personal iteration

After the first prototype was created, a final step of personal iteration was done in order to prepare for the first round of testing. In going through the canvasses by using a fictional case, it was discovered that perhaps it would be useful to offer some extra guidance in the finding of values and the re-framing of metaphors.

To help participants along, for the first canvas, a sheet with basic human values was added. This sheet was created by the Public Interest Research Centre (2011) in order to help people understand the different types of human values and what aspects belong to them. The sheet is shown in figure 57. The idea is that this map can help participants to engage in a discussion more constructively.

To help the participants go through the process of metaphor building and re-framing, an example is given of a current situation metaphor: the library as a wise elder that spreads knowledge to the tribe (students). Nex an example is given of a transformative metaphor in the digital age: the library as a guiding light instead of a knowledge distributor, to help students find the right information and help them filter the needed knowledge.

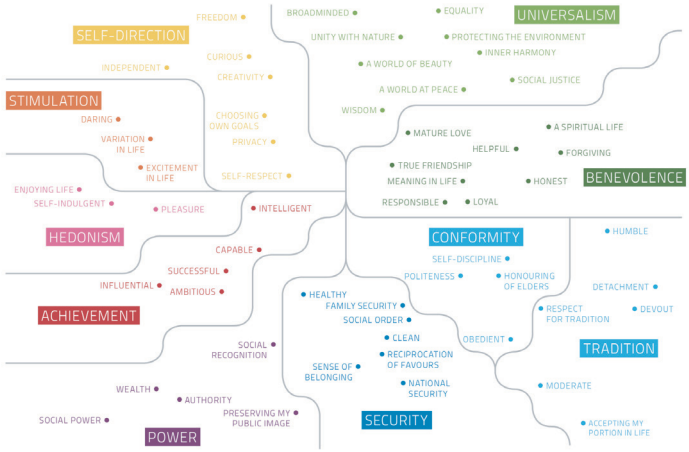


Figure 57: The map of basic human values

4.4 Conclusion develop

In this final part of the development phase, the conclusions from this chapter will be drawn up. This concluding process will start with a recap of the processes discussed in this chapter, followed by a more abstract outlook as to what the significance of this chapter has been in the entirety of this thesis.

The basis of this chapter has been a combination of two things, the design brief and design challenge, that have come forth out of the earlier two parts of this thesis, and the following research question, that is the focus of the second diamond of the double diamond model:

> ***SQ4c:*** *How can design tools be used to aid the needs for the adoption of distributed ledger technology?*

Translating the design brief

The first part of develop has been focused on translating the design brief. This was done using the methodology of the golden circle. Here the why, how and what of the design were defined. The direct aim of the design is to change the mindset of the sceptics of distributed ledger technology, through engagement in an open and experiential way. However, the core "why" is to aid the adoption process of DLT. As was learned from observation and the interviews, simply sharing knowledge and examples is not enough to convince people to start accepting DLT. Adoption is about knowing what to expect and fulfilling that need. In order for DLT to be adopted, the topics of anticipation and appropriation need to be addressed. Thus, an experience is needed where people can create an understanding of what DLT is and how it can be useful to those who currently do not see its possibilities.

With the above in mind, the choice was made to pick a setting that could guide participants through an immersive experience, while still being applicable to a company environment. This resulted in the choice to focus the design on facilitating a workshop.

As frame innovation had been chosen as the method to guide this process, it had to be dissected and re-designed to fit within the context of distributed ledger technology. This was done by adding additional theories that would make frame innovation fit to DLT. Furthermore, the theories make frame innovation useful for the anticipation of future technologies, where it originally looks at re-framing the here and now.

Through this process of dissecting frame innovation and adding additional technologies and information, a theoretical hypothesis framework was created. This framework, which is shown on the next page in figure 59, serves two purposes. First, it will be the basis for the design process. As design-based research aims to develop new theory, it is wise to build upon

a combination of existing theories. Second, the framework will also serve as an hypothesis to test whether or not such an elaborate model is actually suited for the context of vision creation in distributed ledger technology.

With this process is mind, a preliminary conclusion can be drawn. The combination of strategic and communication design has proven quite suitable to combine theory into a model for the basis of design. However, whether this type of model works as the basis for design and if it can aid the adoption of DLT, is still to be seen.

Developing a first prototype

To answer the still open part of the research question; how can design tools be used to aid the adoption of DLT, an actual tool needs to be created. The second part of develop is completely devoted to the creation of a first rough tool.

As might have become apparent in this thesis, it does not follow a regular design process. As design based research aims to create now insights through the application of design, a process more suited for learning was used. To ensure however that the processed is still structured towards an outcome, the lean mvp development process is used as shown in figure 58 (Ries, 2011).

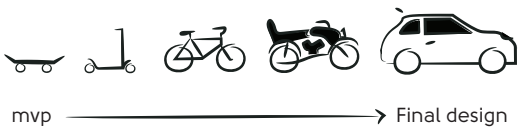


Figure 58: Lean mvp to design development (Ries, 2011)

Using lean development means the outcome of the develop phase will not be a proper design, but simply a "quick and dirty" prototype; based largely on the assumptions of the theoretical hypothesis model. As is shown in figure 58, the prototype should still address all the needs of the pre-defined "why". In case of a car design, every prototype should get you from A to B. In case of this thesis, it should be a format usable to test immersion in DLT. What this means for the design process is that it is much less elaborate and divergent as one would expect from a project focused on delivering a design.

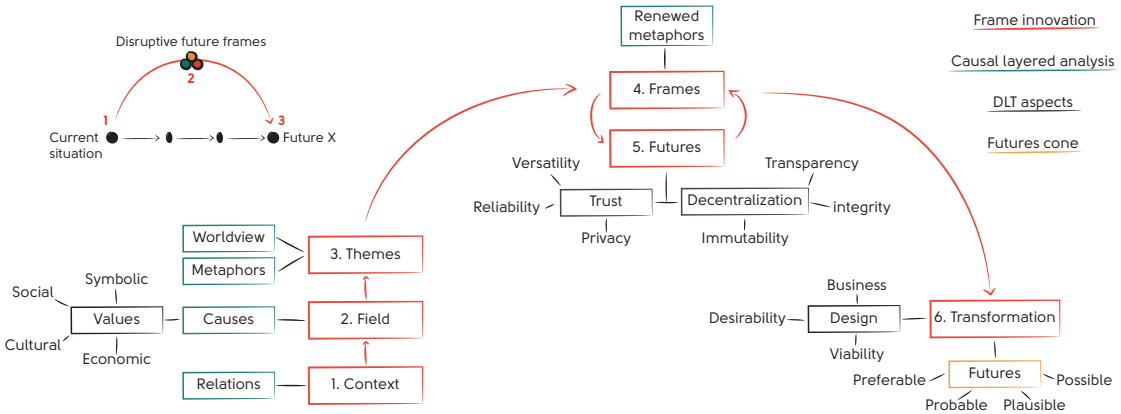


Figure 59: The theoretical hypothesis framework, which will be used to test if these theories can be used to aid the adoption of DLT

In the end, the following two canvasses as shown in figures 60 and 61 were created. They will be used for the first round of testing. The first canvas focuses on developing a shared understanding of the current ecosystem or context. This canvas will focus mostly on the power of discussion, in order to establish common ground. The second canvas focuses more on using a creative and provocative approach to trigger participants to think of and engage in the aspects of distributed ledger technology.

Conclusive outlook

The developmental part of this thesis focuses on translating the results from the first diamond model into a workable design. This means the results, which are theoretical insights, have to be translated into a basis upon which design can be build. There are many ways to do this. For this thesis, it was chosen to use the six lens problem model as a basis for understanding the needs of DLT adoption. From there, a process model is created to understand how these problems could be addressed in of DLT-development.

What the develop part of this thesis does, is to guide the reader through the process of going from results, through the use of a design brief, to a theoretical model and a first prototype. This interconnection of theory and practice is a deliberate choice. By basing the design not on a free creative divergent process, but on a theoretical model, a more academic approach is sought in order to understand how design can be applied to aide distributed ledger technology adoption. With a theoretical hypothesis, the design will not be as bold or out of the box as is perhaps possible, but it will help to reflect upon the process later.

To conclude, what this chapter has done is go through the process of development of both a theoretical model and a simple first design that can follow from this model. Its final deliverable is a "quick and dirty" prototype, that is far from finished, but should be able to test the proposed solution. In the following chapter, deliver, this model will be put to the test. It is expected there will be quite some short-comings, which is not a bad thing. The outcomes will be the start of a cycle of iterative testing, focused on gathering insight for the final reflective conclusion.

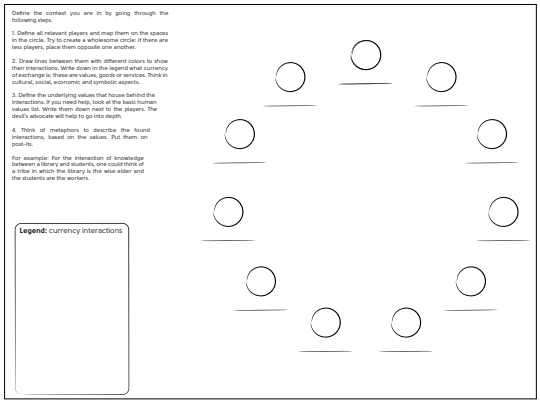


Figure 60: First canvas of tool 1.0, focused on context development

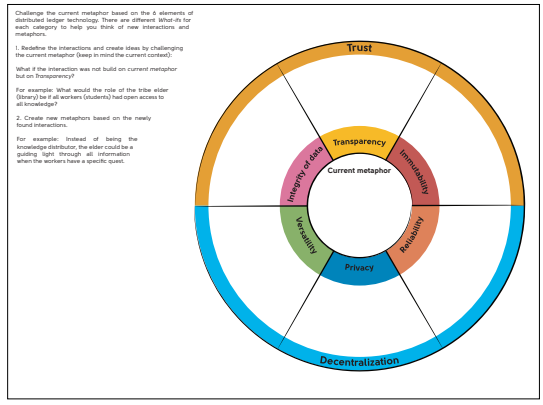
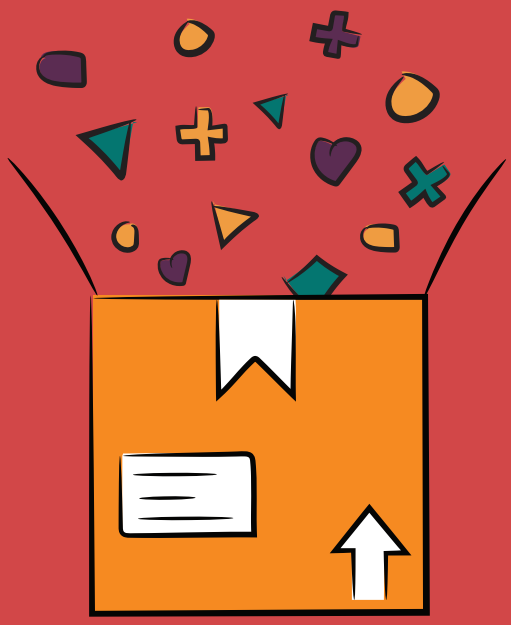


Figure 61: Second canvas of tool 1.0, focused on DLT transformation

5. Deliver



In this part:

Prototyping tools 1.0, 2.0, 3.0

3x testing prototypes

Insights

Iteration prototypes

2x confirmative conversations

Evaluation

5.1 Introduction

The final phase of this thesis is all about going through a cycle of iterative tests in order to deliver valuable insights and create the basis for new theories. At the core of this phase is the following research question:

> ***SQ4c:*** *How can design tools be used to aid the needs for the adoption of distributed ledger technology?*

As the symbols on the left suggest, the build-up of this final stage of this thesis is quite simple. In the previous phase, a first prototype was created. This prototype will be discussed thoroughly in the next chapters, after which a first round of testing will be done. From this round, a batch of relevant insights is created that will form the basis of both new theories in confirming or refuting the hypothetical theoretical framework, as well as provide the basis for changes in the following prototypes. Ultimately, this phase ends with a critical reflection on the design, the results of the testing and the process at large.

5.2 The iterative testing process

In this final part of the thesis, the prototype as proposed in the previous part is put to the test. What follows as an iterative cycle of testing, in which every time small changes will be made, in line with the insight and observations from the previous test. This way, a lean development process is followed, in which a very basic prototype is put to the test, iterated upon and tested again. Every time valuable insights are collected. As the thesis follows the Design Based Research approach, the final outcome will focus primarily on these insights and not on the final design itself. The goal of this process is to understand if the tools as proposed can help to create a more open mindset, that helps companies to create a more positive attitude towards DLT and spread adoption.

To start this chapter off, the prototype as proposed in the previous chapter will be discussed in more detail. Next, the first test will be described, after which the insights will be summed up. From the insights, changes will be made in order to create a new prototype 2.0. This process is repeated two more times.

5.2.1 Prototype 1.0

To understand the value of the first prototype, the next few paragraphs will describe its working in detail. Thereafter, the test setting and focus point will be discussed.

The first prototype consists out of two canvasses, shown on the next pages and, a value map and a set of cards, of which an example is shown in figure 64. When all three elements are put together, a workshop of about an hour is created. To understand each canvas, they will be discussed in more detail below.

Canvas 1

The first canvas is focused on going through the first three aspects of frame innovation, using the steps of causal layered analysis. The goal of this canvas is to allow participants to understand the complexity of their network and to test if they can define the depth of values that are housed within. These are the steps:

1. Define all relevant players within the ecosystem.
2. Draw up all underlying interactions and define what is exchanged.

3. With use of the value map (appendix xx), define the underlying values of the exchanges.
4. Think of metaphors that describe the relationships and underlying values.

Canvas 2

The second canvas aims to go from the current situation to new situations, using the aspects of DLT to create new metaphors and ultimately, new ideas and visions. The goal is to let participants create new meaning together and create a shared vision of change. The steps are as follows:

1. Challenge the current metaphors by using the what-if cards to gather new insights.
2. Create new metaphors from the insights, after which new ideas can be created.

In the end there will be a discussion on whether or a vision can be created and if so, what this vision would be.

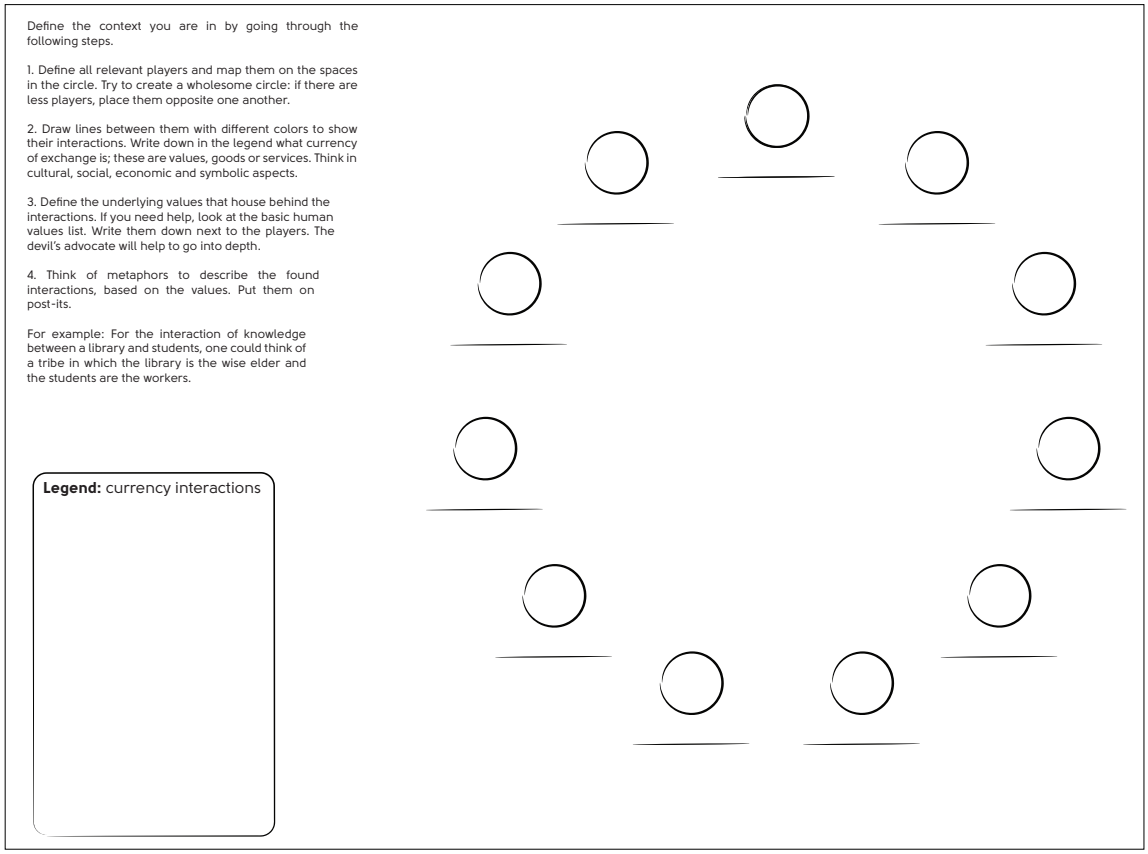


Figure 62: The first canvas of prototype 1.0

Challenge the current metaphor based on the 6 elements of distributed ledger technology. There are different *What-ifs* for each category to help you think of new interactions and metaphors.

1. Redefine the interactions and create ideas by challenging the current metaphor (keep in mind the current context):

What if the interaction was not build on *current metaphor* but on *Transparency*?

For example: What would the role of the tribe elder (library) be if all workers (students) had open access to all knowledge?

2. Create new metaphors based on the newly found interactions.

For example: Instead of being the knowledge distributor, the elder could be a guiding light through all information when the workers have a specific quest.

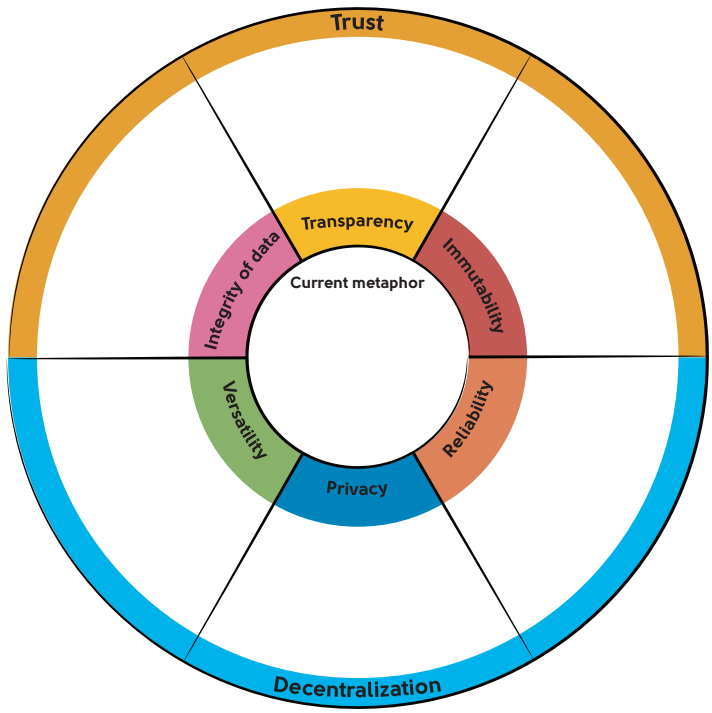


Figure 63: The second canvas of prototype 1.0

Transparency

What if you could real time follow all processes and statuses around you?

What would you do with it and how would it change your current position?

Figure 64: Example of a provocative "what-if" card

5.2.2 Test 1.0

For the first test, a group of students was asked to participate in a one-hour workshop. The canvasses and additional information were handed to them and the test started by explaining the test case. What will be discussed in the next paragraphs are the goals of the test and the test-case that was used.

Goals

The first test was set up to test a number of assumptions. In this first test the goal was mainly to see if the model worked on an abstract level. Assumptions:

1. Participants can define all relevant relationships and values within a complex ecosystem.
2. Metaphors can be made to describe these relationships.
3. The What-if cards make DLT aspects more understandable.
4. New metaphors can be created through the aspects of DLT.
5. Ideas and ultimately a vision can be produced from new metaphors.
6. The canvasses need no additional guidance.

The test case

On the 5th of January of 2011, Chemie-Pack, a chemical storage company in Moerdijk burned down. The fire was recognized as a major incident and the Onderzoeksraad voor Veiligheid conducted a thorough research of what went wrong before and during the incident. With their insights, a test case was made where four parties would try and use DLT to establish how similar incidents can be handled differently in the future. The four parties were: 1) the fire department, 2) society at large, 3) the company Chemie-Pack and 4) the government (local/national). As this is a test-case, the participants were role-played by students. To prepare them, the information and the incident investigation report shown in appendix xx were used. This case was deemed appropriate as at the Future of Trust summit this had been one of the test-cases for DLT use.

Figure 65: A still of the first test

5.2.3 Insights test 1.0

After the test was done, a group reflection was held to evaluate both the gathered content as well as the canvasses itself. The insights from this reflection combined with the observations from the test, will serve as the content of this sub-chapter.

Through a quick analysis, it was found that the observations and comments could be clustered into five general categories: *complexity*, *format*, *guidance*, *continuity* and *urgency/goal*. The results are summarized per category in the following paragraphs, after which a general reflection on the goals will follow. The filled in canvasses are shown in figures 66 and 67 and can be found in appendix xx for more detail.

Complexity

- The case chosen turned out to be incredibly complex. Even though four major parties were selected, a lot more parties were needed to correctly display the context.
- Overall, the participants appreciated first defining a complex ecosystem to create an understanding of complexity, and then diving into a few connections more deeply.
- There were too many what-if cards and their use was not clear.

Format/setting

- The two steps included too many sub steps and required quite some steering.
- As there were eleven spots on the circle, the group only stopped defining stakeholders after all spots were filled.
- Defining all interaction takes up too much time, four were highlighted.
- The metaphors were only used for one on one interactions, not for the system.
- The process, the timeliness was messy, a clearer definition of time is needed.

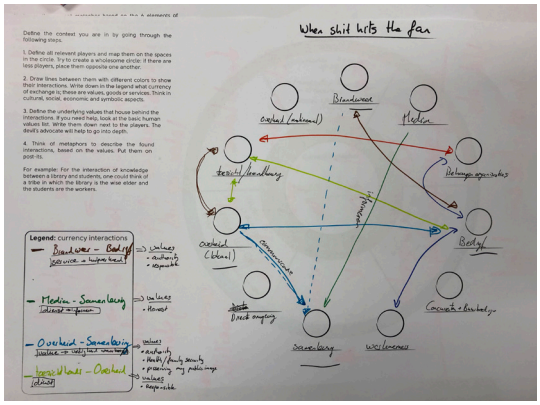


Figure 66: Results of the first canvas (larger in appendix xx)

- The role-playing aspect did not work.
- The metaphors were adequate and appropriate. I.e. from father-child relationship to co-pilots in an airplane.
- There is a lot of negative discussion: "this will never work", which kills the ideation.

Urgency/goal

- The goal of the second canvas was unclear. This caused a loss of focus and a messy discussion

Guidance

- DLT was not adequately explained, leaving many questions on feasibility and viability of the ideas.
- The group anchored to the example metaphors, where they only created discussion on human interactions, rather than looking at nature for example.

Continuity

- The poor link between the canvasses required quite some intervention from the facilitator

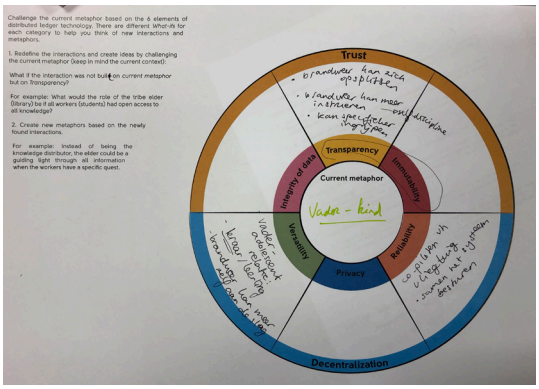


Figure 67: Results of the second canvas (larger in appendix xx)

Reflection on goals

Overall, the first test yielded a lot of interesting results. When reflecting on the goals, the following can be said. The participants were able to dissect a complex ecosystem into relationship and they were able to define appropriate metaphors, both in the first and second canvas. However, the understanding and the role of DLT was unclear, and a lot of additional guidance was needed. Furthermore, due to time constraints and the unclarity of the second canvas, a good vision was not created. These points will need to be improved in the next prototype.

Conclusion

When summarizing the results of the first test, a clear overview of the first prototype appears. In general, the aspects of using canvasses seems to work, however the role of the facilitator in the workshops needs to be reconfigured. Furthermore, there still is a lot of unclarity in regard to DLT and its use. Also, the goals of the canvasses were not clear. Lastly, whether it is due to the complex case or due to DLT, the participants anchored to every bit of help they got, which influenced the process. During the process and in reflection they mentioned they would have like more example and shows of outcome. With this in mind, a new prototype will be created.

5.2.4 Prototype 2.0

From the results from the first prototype, a new prototype is created. This prototype will be described in the next paragraphs in the same manner as the previous one, after which the next test will be described. From there new insights and results are gathered with the aim to create a third prototype.

The main feedback from the first prototype was that there was a lot of unclarity mainly in the second canvas. This vagueness regarded both the process, as well as DLT and its aspects. Furthermore, there goal of creating a vision was not met. With this in mind, a new set of canvasses was created. These new canvasses still follow the original steps of frame innovation, causal layered analysis, DLT and future prospecting. The canvasses will be discussed below and are shown on the next two pages.

Canvas 1

As the development of the canvases regards an iterative process, the first canvas of the second prototype will be largely based on the previous one. Additions are made to minimize anchoring, create more guidance and allow more input from the participants themselves. For example, instead of preassigned number or players, an empty circle is given.

Canvas 2

The initial second canvas is split in two by the addition of a third canvas. The second canvas aims to create new metaphors by using several DLT aspects and lining them up for a brainstorm. To add clarity, a step was added and instead of what-if statements, a set of symbols was created, which corresponded with a set of cards that explained each category and give directions for the sub-aspects of DLT.

Canvas 3

As it turned the second canvas was not suited for creating a vision. Thus an additional canvas was created. This canvas uses future scoping and ideation to create a daring, yet realistic vision.

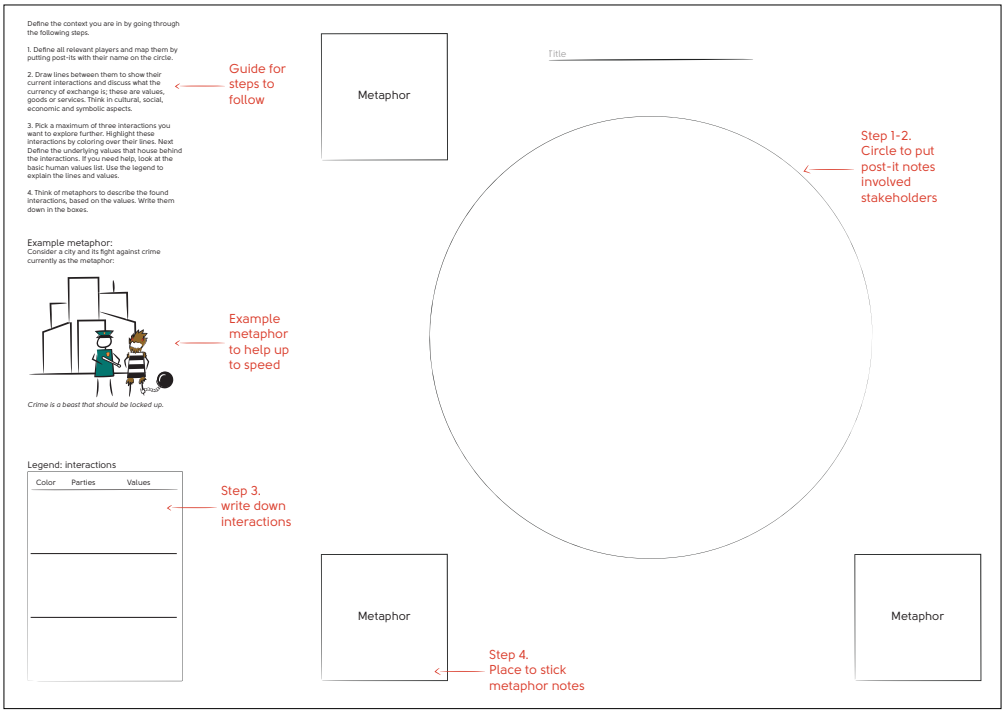


Figure 68: The first canvas of prototype 2.0

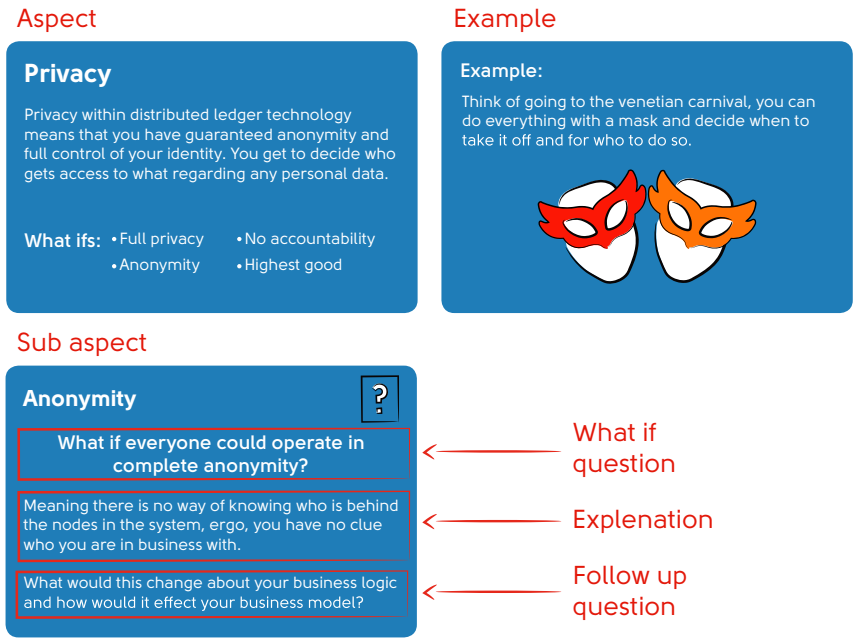


Figure 69: The renewed more visual "what-if" cards of the second canvas

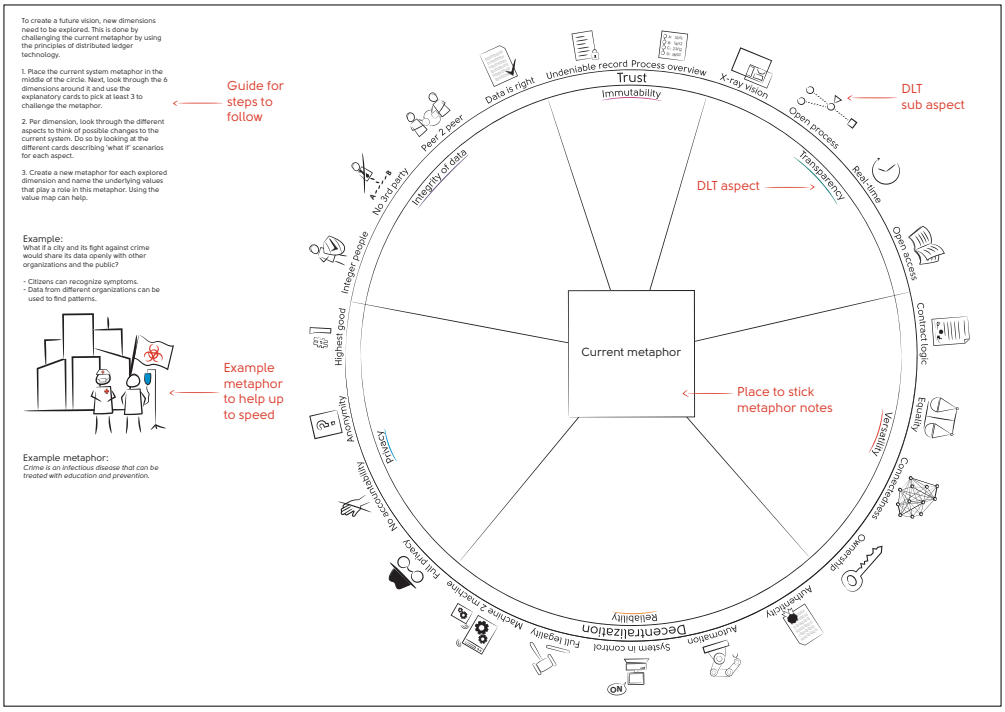


Figure 70: The second canvas of prototype 2.0

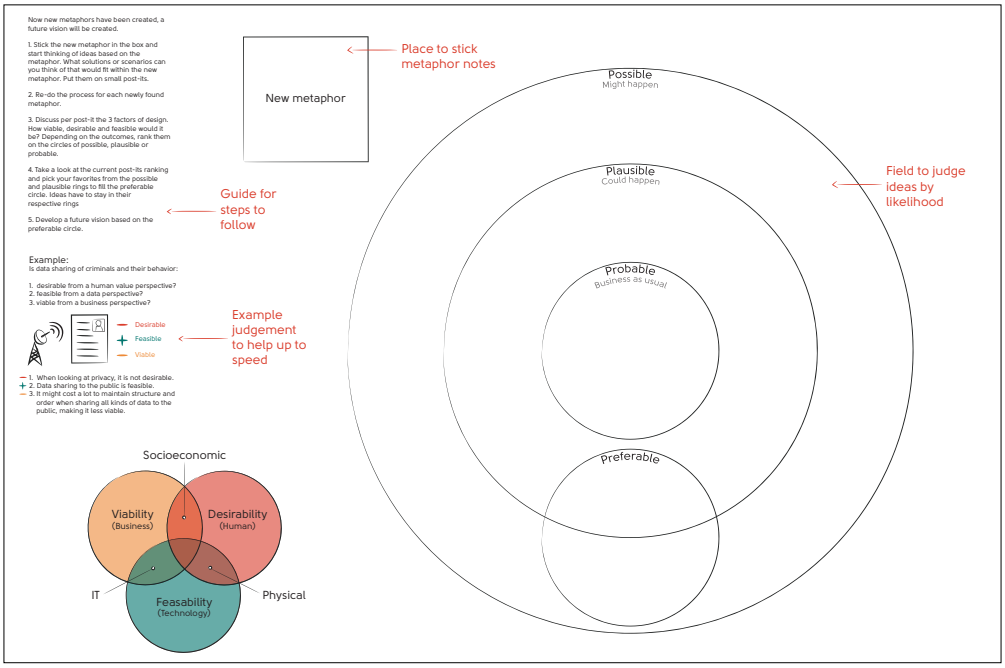


Figure 71: The third canvas of prototype 2.0

5.2.5 Test 2.0

In the next paragraphs, the second test will be discussed. This test, which was performed by a mixture of students and working adults, focused on a different, more DLT oriented test case. This case will be explained below.

Goals

As this process of testing and gathering insights is iterative, the goals for this test will also be adjusted. This time, the focus will be more on the process than on the inner context. The assumptions:

1. Time will be monitored closely by the facilitator, which should lead to faster conclusions & decisions.
2. More steering from the facilitator will not influence the perception of choice and personal mindset.
3. The new symbols and cards will help guide the participants and create a better understanding of what DLT is and how it can help.
4. The addition of the third canvas will help in generating ideas and ultimately a vision.
5. The focus on system wide metaphors will help in creating a broader vision.

The test case

For the second test, a case with a more self-explanatory context was chosen. This was done to leave more time for the prototype itself, as it requires less interpretation. With this in mind, the case of the Elektronisch Patienten Dossier (EPD: electronic patient record) was taken. As two of the chosen participants have a background in the medical field and one other was involved as a program developer with the first EPD-tests, this case spoke much more to the imagination. Furthermore, one other participant had recently been involved with the system as a patient, which made the need for role-playing irrelevant. Only a basic group introduction was given into the topic, after which the goal of the workshop was explained: create an alternate future for the EPD by using DLT.

5.2.6 Insights test 2.0

After the second test was performed, the group reflected on both the gathered content as well as the canvasses itself. As it was found that not all results fitted within the five earlier defined factors, two new factors were added: *freedom* and *aesthetics*. The results are summarized below.

Complexity

- DLT is still not comprehended very well.
- Single system metaphors are difficult to create and do not create more understanding in the end.
- The abundance of DLT perspectives and the misunderstanding of meaning creates confusion and time delays.
- Discussion on feasibility, desirability and viability in this stage is too much to ask, in terms of energy and focus.
- It is difficult to reach agreement on what ideas or possible, probable or preferable.

Format/setting

- There is a lot of discussion, which is good in perspective of team learning, but it does cost a lot of time.
- The facilitator is too much present and was noted to steer the process, which caused frustration among participants.

- A lot of the discussion is not written down, valuable insights are lost.
- Due to time constraints, the steps of the third canvas had to be rushed and the focus was mainly on ideation.
- Ideation is halted by questions on viability; no open no critique environment.
- Ideation is halted by questions on viability; an open no-critique environment is needed.

Urgency/goal

- The goal of each canvas needs to be clearer and its place in the workshop needs to be addressed more properly.
- A sense of urgency is needed: a clear end-goal or problem to be solved.
- The need of the second canvas is unclear, which also hinders the right application of DLT-aspects

Guidance

- The facilitator is too much present and was noted to steer the process, which caused frustration among participants.
- Help from the facilitator is needed in making decision/choices.

Continuity

- The link between the canvases is vague; leap too big.
- As the link between the second and the first canvas is unclear, participant redefine the metaphor but neglect the underlying system.

Freedom

- The facilitator is too much present and was noted to steer the process, which caused frustration among participants who felt they could not make their own choices.

Aesthetics

- The canvasses were perceived as attractive, due to the visuals.
- The large amount of visual stimulation caused participants to be distracted and it caused a lot of discussion on interpretation; visually overstimulated.

Reflection on goals

When reflecting on the goals of this test, close monitoring of time proved a necessity, but too much interference of the facilitator was perceived an annoying. A better balance is needed, perhaps with a visible clock; letting the participants monitor it themselves. Although the cards were perceived as clear, there were too many aspects and it confused participants. Next, the addition of the third canvas is currently perceived as too much, as the link with the second canvas was unclear. It took a lot of energy and focus in a stage which aims to create a satisfying ending. Lastly, the metaphor was too vague and didn't link well to the values.

The second prototype proved to be too elaborate and not clear in function. This caused confusion and a lack of urgency, which created annoyance and too much interference from the facilitator. In conclusion, a simpler, more comprehensible canvas is needed that explain clearly what the value of DLT is and what the goal of the workshop is.

5.2.7 Prototype 3.0: Consider the impossible

From the results of the second test, a third and final prototype will be created. The main finding of the second prototype test was that the complexity of the different canvasses was too high. The amount of steps required and the difference in tasks, together with the large stack of cards, caused participants to get lost and only being focused partly on the canvasses. For this reason, a new format was chosen. The new format consists out of an individual elements, and a set of simpler group activities. This format will be briefly explained below.

Individual booklet

The new format kicks off with a personal booklet that serves two purposes. First, it lets participant get sensitized by going through an individual thinking experiment (Sanders & Stappers, 2012). Second, the booklet serves as a reference between the group's thoughts and their own ideals. The booklet consists out of a front page, where participants define their values and goals. Inside is a circle where they can draw out their idea of their current ecosystem. Lastly, the booklet also contains a simple explanation of the six aspects of DLT.

Canvas 1

The first canvas is a simple and clean copy of the earlier canvas. The examples have been left out and the steps focus on repeating the individual exercise of creating an ecosystem. The step that has been added is the focus on a critical point.

Canvas 2

Between the first and the second canvas, an additional canvas has been added, that focusses on going through the causal layered analysis process towards the creation of a set of metaphors. This step is low in visual noise, creating a simple and easy to understand flow.

Canvas 3

The third canvas is the same as the previously second canvas, only lower in visual complexity. The goal is create a discussion. The first two canvasses are high in freedom, but due to the complexity of DLT, the third focuses on going through DLT together, guided by the facilitator.

Canvas 4

To end the process in a concrete way, the choice was made to add a final canvas. This canvas takes a fun and creative approach towards the conclusion, by letting participants draw up a headline for the future. This very simplified vision forces participants to think of the goals they want to reach and how they want to reach it.

The canvasses are all displayed on the next pages.

5.2.8 Test 3.0

In the next few paragraphs the third and final test is discussed. This test, which went through all the four canvasses in 1,5 hours was performed with four young professionals, of which one works at an insurance company experimenting with DLT. As the test-case of the second canvas test turned out to be well-suited for DLT-innovation, both in understandability and in context, it was chosen for this test as well. Roles were divided corresponding with the participants experience as insurer or patient.

Figure 72: The outside of the individual booklet, page 4 and 1 (front)

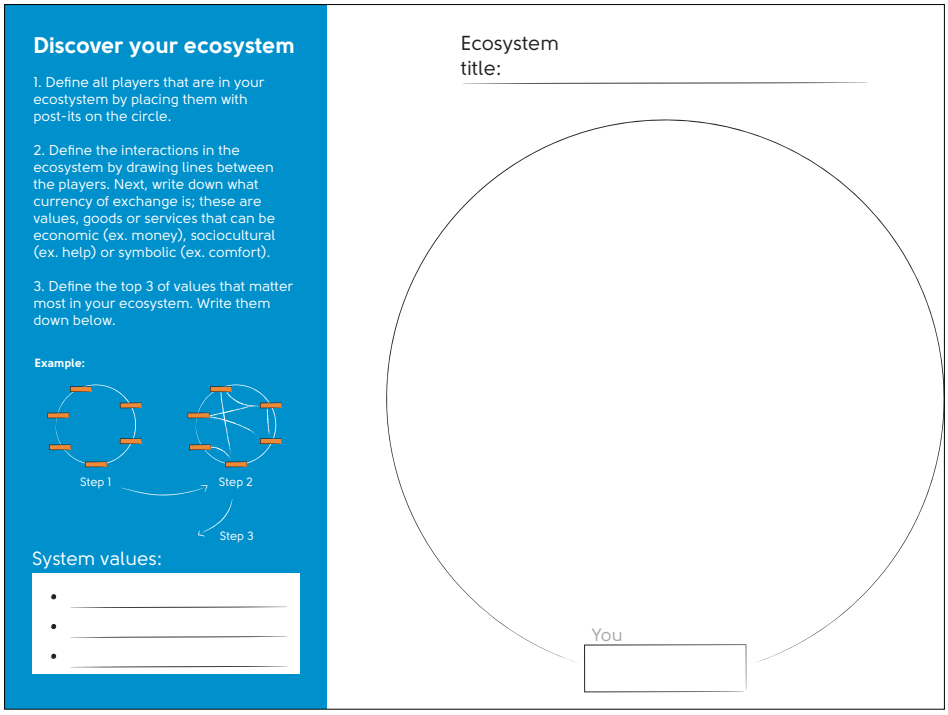


Figure 73: The inside of the booklet, page 2 and 3

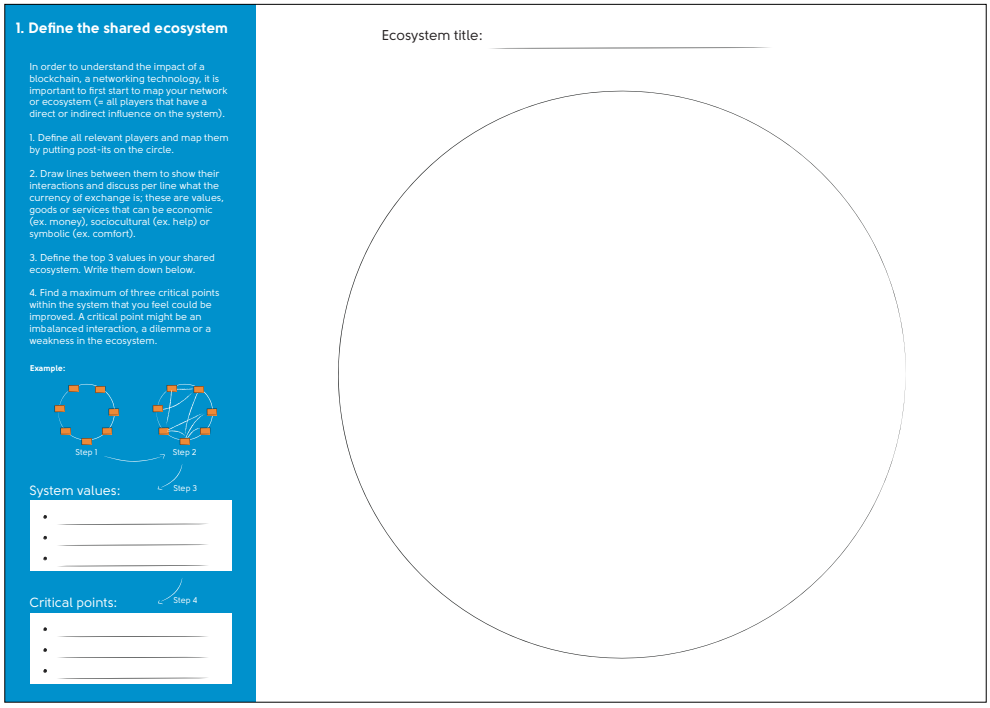


Figure 74: The first canvas

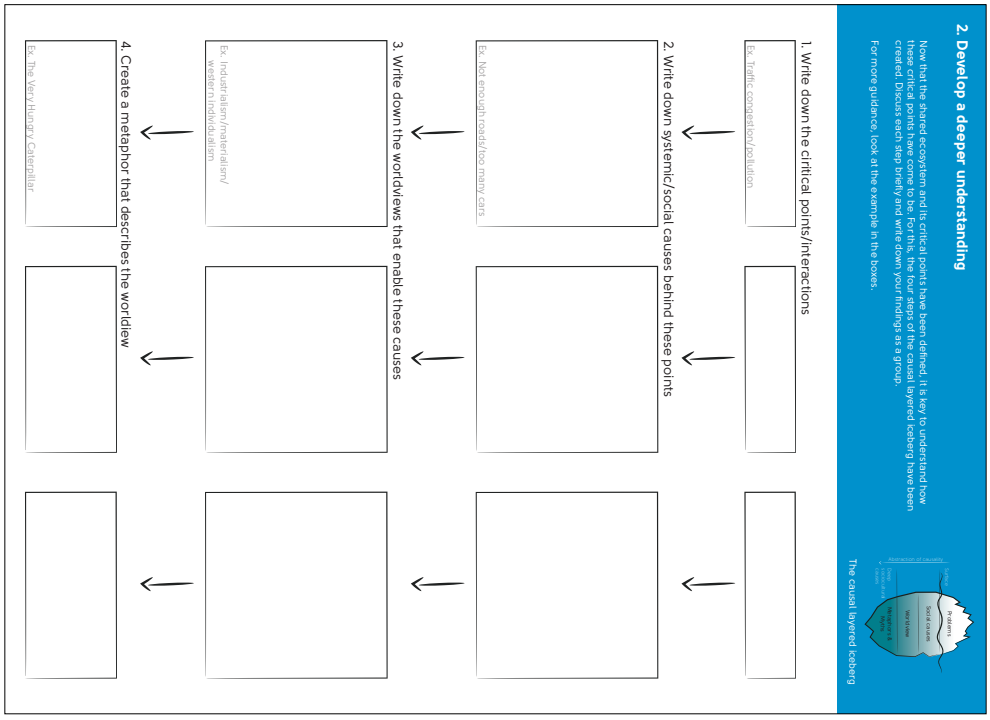


Figure 75: The second canvas

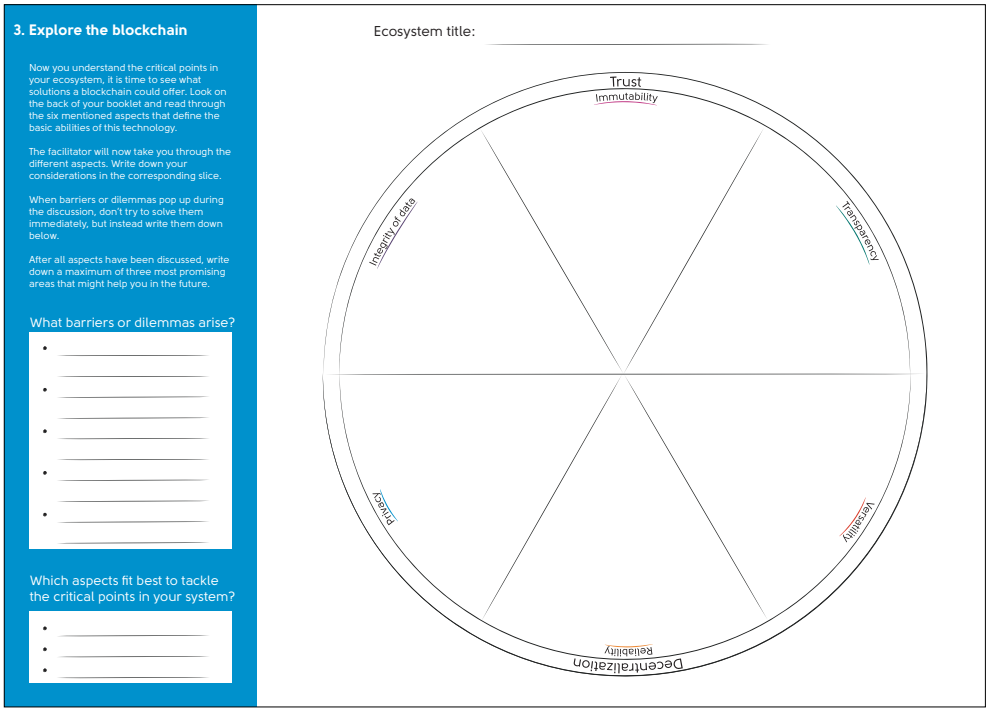


Figure 76: The third canvas

Figure 77: The fourth canvas

Goals

As this final part of testing and iteration, a final adjustment to the goals is made. This time, the focus is on creating understandability, simplicity, continuity and satisfaction. The latter will be tested through discussion of the experience with the participants afterwards. The assumptions:

1. More canvasses with simpler steps will make the continuity better.
2. Low visual stimuli should make the focus clearer.
3. The goal of the canvasses is clear. Participants understand the different canvasses and their links.
4. The individual start will help to let participants form their own image and use this to defend their position in the group.
5. The simplified aspects of DLT are clearly understood.
6. The concluding canvas will help to wrap up the process in a fun and concrete way.

5.2.9 Insights test 2.0

As mentioned, the final test ended with a broad discussion on the experiences of the group with the four canvasses and the booklet. As now there was an individual aspect, one last factor for reflection was added: *team dynamic*. What follows is a reflection on all eight factors.

Complexity

- The low visual complexity of the booklet and the first two canvasses is experienced as pleasant.
- The complex images created by the participants in their booklets and on canvas 1 are perceived as valuable: a simple visualization of a complex system.
- The complexity of DLT still causes some discussion, as from the back of the booklets different understandings were created.

Format/setting

- The four canvasses are well explained and easily understood. The addition of an individual part helps to let every participants experience their own value.
- Timing is not as much an issue anymore, however the understanding of time needs some tweaking. It is advised to add time indicators to the canvasses.

Freedom

- In the beginning there is a lot of freedom, this is welcomed as participants can create their own atmosphere.
- Having an individual part helps to let participants experience their own worth.
- Too much freedom in the last two canvasses leads to a lot of discussion on interpretation.

Team dynamic

- The separation of individual elements and group elements is perceived as a good addition.
- The separation should be clearly defined per canvas, now participants started asking is this for my own gain or for the group in the first canvas.
- A good balance between group and individual needs to be thought out, as now it lead to unclarity on role and tasks.
- There is a lot of discussion, but a lot of valid points are not written down. Perhaps a minutes-secretary is needed.

Aesthetics

- The lack of symbols and figures is not a problem, there is less distraction.
- The clean look is described as visually appealing. However, there is still a lot of text participants mention.

Guidance

- During the decision making of value definition and critical point definition, participants needed help to come to conclusions.
- The overall low facilitator involvement was perceived as nice.
- The increased guidance during the DLT explanation was not seen as counterproductive.
- The explanation of DLT can still be done better, now there was a discussion on interpretation.

Continuity

- Despite their being four canvasses, the link between the canvasses is mostly clear. Only the second canvas needs a better link.

Urgency/goal

- The goal of the second canvas was unclear without the intervention of the facilitator.
- Overall, participants understand the goals of the canvasses, especially after the critical points are analysed, a sense of urgency is created.

Reflection on goals

When looking at the formulated goals, the first thing that becomes clear is that in the last test, the continuity and understandability of the canvasses was drastically improved. With some minor comments, the general understanding of the ideas behind the canvas was clear. The decrease of visual stimuli also helped in this, as there were less distractions and more eye for what needed to be done. For the largest part, the goals of the canvasses were also clear. Only the second canvas needed some improvements in the way it could be linked between the first and the third canvas. The second canvas itself was perceived as a fun exercise.

Another point that got positive attention was the individual booklet. Having an individual element helped participants to immerse themselves and it also led to them having a valid say at the table. Participants were noted looking back at their personal values and reflecting upon them in the group.

What must be noted is that inclusion of distributed ledger technology still causes a lot of discussion and sometimes confusion. As one participant noted: “I have yet to find someone who can explain blockchain to me in a single phrase”. For this, additional research is recommended.

Lastly, the addition of a fun vision creation element was concluded to be successful. The exercise helped the group to wrap up and process and after it was created, the group noted a sense of closure. It must be noted that the atmosphere was focused on fun during the last canvas. Thus a very serious discussion should not be expected. However, the right facilitator can help the group to come to a good conclusion through the use of laddering (asking why).

5.3 Validation of the found insights

To make sure the design is not only based on the perception of the people who joined the tests, none of whom where experts in distributed ledger technology, two experts were consulted. What must be noted is that these experts were interviewed during the testing and did not comment on the final canvas. Their insights play on a more general level.

The Red Cross: 510 global

As the Dutch Red Cross realised that distributed ledger technology is offering a large set of opportunities for global trading, they set up a range of pilots for refugee aid in a diverse set of countries. Their projects focus mainly on resource allocations and personal registration.

When asked what a tool for collaborative DLT exploration should do, they reasoned it should mainly bring together parties in order to start a conversation on collaboration. However, they felt before they could engage in such a conversation, they would first need to understand the technology properly. When asked if a tool could help, they found themselves wondering if such a complex technology can be understood without actually using it. This is the reason they are testing their products on site in foreign countries, to get a true experience. They imagine it will take another 5-10 years before DLT-collaborations can truly exists sustainably. When asked what would really help them, the on-boarding process of new clients was mentioned, alongside with creating enthusiasm and facilitating a discussion around the barriers. In that sense, they found the canvasses where these are discussed the most interesting.

Achmea

Another company that has been heavily investing in DLT is Achmea. This Dutch insurance company is using DLT to facilitate the exchange of data between insurance companies. When discussing the tool with them over the phone, they expressed great interest in the part where it should on-board new partners, as they found collaboration to be difficult. According to them the greatest value of a tool would be facilitating and solving the discussions around the physical barriers of DLT. However, they expressed worries as to what the exact goal and outcome of the tool would be. They found it still sounded quite abstract and were hesitant to its nature. Furthermore, they actively wondered how the tool could help with adoption, if it is a small workshop. According to Achmea, DLT needs adoption to spread like an oil stain. In that sense, they feel scaling of the tool is critical.

5.4 Reflection on the design

5.4.1 Introduction

Now that the canvasses have been evaluated and the insights of the tests have been gathered, the final part of the double diamond process can commence. In this chapter, the finale stage of convergence, the design process from beginning to end will be reflected upon. Furthermore, the place of the developed canvasses in the process of distributed ledger development will be discussed. Ultimately, this chapter ends with a set of recommendations that should offer guidance and prospect to those who want to develop design for DLT-development further.

5.4.2 Reflection on the design and testing process

Design goals and hypothesis

To reflect on the design process from beginning to end, first the design goals and the hypothesis are briefly discussed. The process started with the following design challenge:

Use frame innovation to create a design that uses the constructs of DLT to create a more open mindset, which enables companies to create disruptive yet desirable future visions that are both workable (IT) and communicable (internal/external)

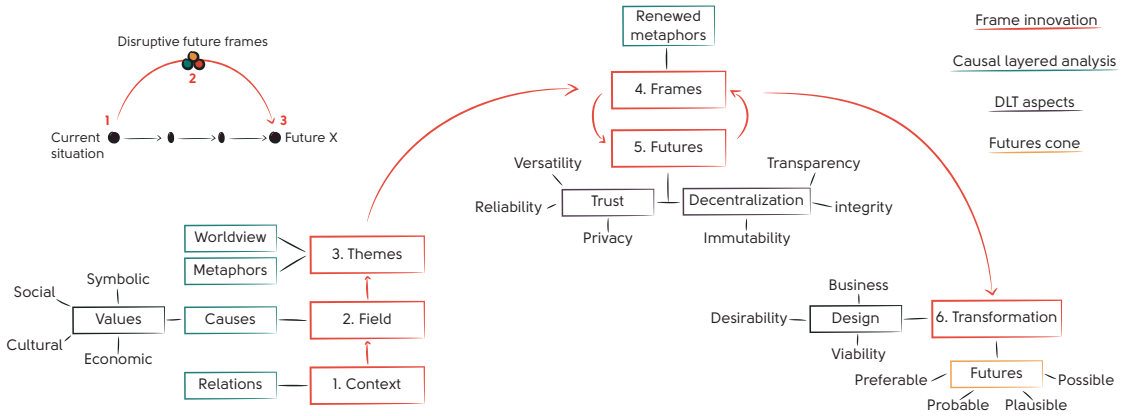


Figure 78: The hypothesis of the theoretical framework.

From this design challenge, the following goals and requirements were distilled:

- Use frame innovation
- Use and create an understanding of DLT
- Create an open mindset that is open to a disruptive yet desirable future vision
- The future vision should be workable and communicable
- Be usable in a professional and collaborative environment.

Additionally, the list of requirements mentions organisational learning and strategic niche management, but these will be excluded for now and reflected upon later.

From these goals and requirements, an hypothesis consisting of a theoretical framework was created. This framework, as shown in figure 78, serves as the theoretical translations of the design goals. As this framework is then put to the test through the design of the canvasses, it can best be seen as a hypothetical model that explores whether or not a change in mindset can be created using these steps based on frame innovation. With this hypothesis in mind, the iterative design process, the testing and the gathered insights can be reflected upon.

Design process and iterative testing

In figure 79, the iterative process of development is shown. First a simple 1.0 tool was created; simply through designing two canvasses. One to explore network or ecosystem thinking and one to introduce and explore distributed ledger technology. This tool was put to the test, and from the insights, which will be discussed in the next paragraphs, a tool 2.0 was created. The same process was repeated twice, until tool 3.0 had been tested as well.

When reflecting on the process, the first test was messy and unstructured. There were too many aspects in the canvasses and a lot of guidance was needed. This is however not necessarily a bad thing. Following the lean methodology (Ries, 2011), not much time was wasted creating the first tool and a lot of valuable insights were gathered. With this logic in mind, the initially flawed test can be seen as a success. Using this process of making changes and putting them to the test, helped to create not only a better set of canvasses (tool 3.0), but also created a list of insights that can be used for other tools in the field of DLT-development as well. When doing exploratory research in a rapidly developing field such as DLT, it is wise to pick an iterative method like the lean start-up methodology, in order to quickly test assumptions and grow your process alongside the technology.

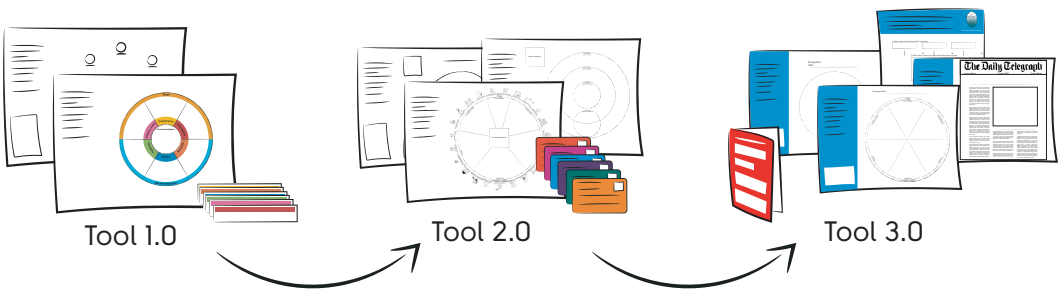


Figure 79: The developmental stages of the design canvasses.

Insights from the design tool tests

By testing the various canvasses, gathering insights and adjusting the them accordingly, a list of relevant developmental factors for designing tools for DLT is gathered. Through the testing, an optimum per factor was created, as shown in figure 80 below. Each factor which will be discussed below.

Complexity

Through testing the canvasses, it was learned that there are two sides to complexity. Participants liked the experience of grasping how complex their ecosystem is, yet get easily lost when too much or too complex information is fed to them. Thus, a design for DLT-adoption needs to be low in visual and contextual complexity. Sometimes, restrictions in terms of a maximum amount of parties or discussion time can help avoid unwanted complexity.

Format/setting

When designing for DLT, it was found advisable to use a guided workshop setting, facilitated by someone who understand the technology and can offer guidance when matters get too complex. It was found that it helps to have multiple canvasses and spread out the complex matter over different steps and stages.

Freedom

The freedom the participants experience during the workshop should be high. Having them feel autonomy in developing their own ideas is crucial for their motivation into wanting to understand and explore the technology.

Team dynamic

In regards to team dynamic, there should be a 33/66% balance. It is good to let the individual develop his or her own vision first, but what matters most is applying the individuals perspective in the group. Therefore, it is suggested to focus mostly on the group, but leave room for individual development of ideas and vision. The balance stimulates both group learning, a key aspect, and individual learning. What is rather important in the group dynamic, is that there is alignment as to what certain aspects mean to the group. This needs to be established and monitored continuously.

Aesthetics

During the tests, different types of aesthetic and visual tricks were used to test if it could help in simplifying complexity. It was found that simple and clean canvasses create ample guidance, while complex visuals and the use of too many examples can over-stimulate and create confusion and distraction. Furthermore, visuals tend to create anchoring, where participants get stuck on a certain meaning or image.

Guidance

In order to let participants experience complexity, the freedom of exploration is

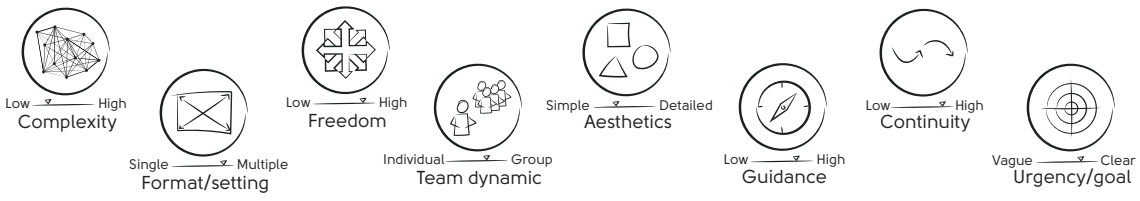


Figure 80: The developmental factors of the design canvasses.

needed, however, when the more complex aspects of DLT come to the table, proper guidance is needed. Guidance should therefore be balanced, from low in the exploratory stage to high in the explanatory stage. Overall, with DLT high guidance in needed on steering the process, however during the content development in the workshop, guidance should be at a low point.

Continuity

It was found that the continuity, when using multiple canvasses addressing different types of complexity, needs to be extremely high. A good link between different elements is essential for the group to stay alert and to avoid confusion.

Urgency/goal

Overall, when doing anything with DLT, a clear goal is needed. This can be "exploring for the sake of learning" or something more concrete. In any circumstance, having some type of urgency or goal that is shared in the group, is crucial to creating proper bonding, avoiding wild goose chases and creating the needed continuity.

Final remarks

What remains to be done, is a reflection on the eight factors as a whole. As might have become apparent in the explanation of the insights, these factors cannot be tweaked individually without consequence. In that sense, the factors are a tiny ecosystem themselves, in which a change in one factor, potentially changes the entire system. For example, when complexity is raised, more guidance is needed, which decreases the amount of freedom experienced. When reflecting upon this, the current setting is a mere suggestion that works in case of this thesis, but for any other given situation, with or without DLT, the simplest change might be needed, creating an entirely new setting.

Reflection on goals and hypothesis

After all the relevant test insights had been gathered, the final reflection on the design could be written. Below, the different parts of the theoretical hypothesis and the design goals are reflected upon, using insights from the tests, knowledge from literature and experience from practice.

1. Theoretical hypothesis framework

During the first iterative tests of the tool, it became apparent that the initial hypothetical framework was too elaborate and complex. In the second test, it was tried to use aesthetics and visuals to create understandability and take away some complexity. This however, did not have the desired outcome, after which the choice was made to refute the initial hypothesis, and create a simpler, less complex model, as seen in figure 81. The model is still based on the design goals regarding frame innovation, but it stops at the part of imagining futures, rather than creating a solid workable vision. This choice was made is due to the fact that vision making turned out to be unnecessary for changing the mindset and it created a highly complex and endless discussion. In the end, just the discussion on the barriers was found to be more valuable, rather than creating solutions

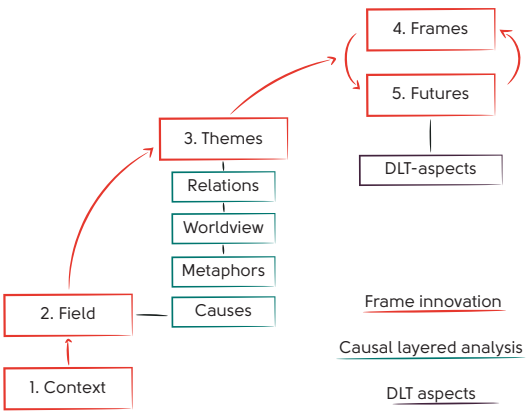


Figure 81: The new and final theoretical framework for the design

in the form of a vision. What was added in the last stage, is a simple newspaper exercise, that allows the group to come to a conclusion in the form of a simplified headline-vision.

2. Use and create understanding of DLT

During the first test of the design, it was found out that explaining DLT to a group of people who has never been in touch with it is incredibly difficult. The technology and its possibilities are incredibly complex and a lack of continuity and urgency led to a lot of confusion. Ultimately, the tool succeeded in this goal, but only by touching upon DLT in a highly abstract way and assuring proper guidance throughout the exploratory process. Apparently, even the basis of DLT can create ample and adequate discussion.

3. Create an open mindset that is open to a disruptive yet desirable future vision

The goal mentioned here is two-fold. First an open mindset needs to be created and second, a vision needs to be created. As discussed, the latter turned out not to be desirable or feasible in the current format. The former however, has been the main aim of the design. Having proven methods such as frame innovation and causal layered analysis incorporated in the design, the participants engaged in a discussion that allowed them to open their mind. Especially during the last test, tool 3.0, multiple times participants said "*I hadn't thought of it that way*". During the discussion a lot of barriers were found, but it also showed participants they were sharing these problems and could perhaps, help each other solve it. In the end, the design creates a starting point for a new mindset. It offers guidance in exploring new insights and perspectives, and the group dynamic causes participants to see other views and to incorporate new and challenging ideas.

4. Professional and collaborative environment

In regard to its use in a professional and collaborative environment, this has not been adequately tested. What can be said however, is that multiple times throughout in talks with professionals, some have spoken out against the use of tools such as designedly canvasses or Lego serious play, as they do not see the value in setting of playful nature. The spoken to companies seem to find games childish and unnecessary, they do not know, understand or believe in the concept of latent knowledge, which will be reflected upon further in this chapter, and if they do, they rather hire others to do it for them and have it processed into workable strategy, rather than to immerse themselves in it.

Final remarks

Overall, the final design and the process of getting there were rocky and knew a lot of struggle. Failure however is part of following the lean methodology. In that sense, the final canvas, tool 3.0, is also not final. It has not yet been tested in a corporate setting and it still houses a number of unsolved issues. In the end, it is mainly created to facilitate a discussion and to create guidance in trying to find what is important to the group. In that sense it might not seem revolutionary or disruptive, but its contribution to a productive discussion is a well needed and welcomed addition. When talking to a manager at Achmea in one of the confirmative conversations, they established great interest in discovering barriers together with new partners. Furthermore, during the tests, participants showed pleasure in gaining new insights from each other and through discussion. Setting up an environment that allows a group to grow in this way, the researcher feels, is a great first step in the development of something so complex as the field of DLT-innovation.

5.4.3 Reflection on the design and DLT

When looking at the at the contribution of the design tools to DLT-development in this thesis, two things immediately come to mind. First is the aspect of design thinking. In this approach of design thinking, five steps are mentioned:

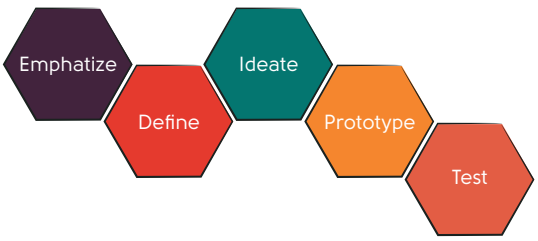


Figure 82: The five stages of design thinking

In the workshop, the first stages of the design thinking approach are addressed, albeit not exactly in the right order. In the workshop, first the context is defined, after which several stages of empathizing are performed. By doing so, just like a designer, the participants get a better understanding of why the ecosystem or network they are in behaves the way it behaves. Sometimes the motivations of those around you in the network, are not entirely what you think them to be. And this is exactly where the second design approach comes in.

According to Sanders & Stappers (2012), there are different ways of applying design with different results (figure 83). None are better than the other, it simply all depends on what one wants to achieve. In case of this research, the approach of the theoretical framework and the canvasses, all aim to achieve a level of knowledge that is referred to as latent. It is knowledge that we possess and that shapes who we are, yet that we are not aware of. To tap into this deep layer of knowledge, a special type of methodology is needed, that of performing a generative session together with those involved. Now when looking into the question of how this knowledge can be used to aid the development of DLT, the canvasses come in. Most people on this earth do not reflect upon why they know, feel, act and dream the way they do. Thus, this part of knowledge that defines us deeply, is mostly hidden. For people to change their

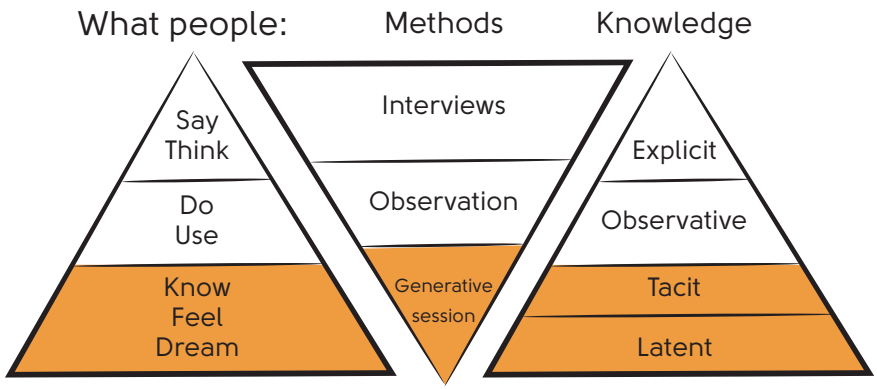


Figure 83: Types of methods and knowledge (Sanders & Stappers, 2012)

mindset, one needs to tap into these beliefs. One way to do so, is by creating sessions and workshops such as proposed in this thesis. The application of design in order to translate theoretical methodology into steps that people understand and like to perform, helps in creating an environment that can ultimately benefit DLT-development greatly. As currently, the deep need for DLT is unknown, session and workshops such as proposed in this thesis are needed to help people understand where the value of DLT lies, but also, why they might be scared of the changes it brings. By applying design tools, a wide range of people can be helped to discover their aversion towards change, which, once accepted, can be bridged and bended into a positive thought. This way most socioeconomic barriers can be broken down.

5.4.4 Recommendations

As mentioned, the design is not final. There is still a list of shortcomings and aspects that have not yet been explored. For this, the following list of recommendations was made:

- There are still a lot of people struggling with the understanding of DLT/ blockchain. It is advised for professionals to come up with a universal and simple description, perhaps assisted by a clear example.
- Testing needs to be done in a professional and collaborative setting.
- The tools need fine-tuning in creating alignment amongst participants.
- Further testing should reveal if and how the design can be made autonomous.
- Research should be done in showing if and how a mindset regarding DLT can be influenced through the use of design.
- The relationship between vision making and DLT-development should be elaborated upon.
- Test how serious tools can be designed in such a way that they are not perceived as silly or childish games, but do allow playful experiences.

5.5 Conclusion deliver

In this final chapter of deliver, this thesis will look back at the gathered insights and the reflection upon the design. To do so, it starts with the research question that played a central role in this part of the thesis, SQ3C:

How can design tools be used to aid the adoption of DLT?

To answer this question, a hypothetical framework was created. This framework aimed to achieve a change of mindset that is needed to further the development of distributed ledger technology, as was found and proposed in the previous parts of this thesis. Through iterative testing, this framework was evaluated, which yielded eight factors that influence the perception, adoption and acceptation of design for DLT as seen in figure 84.

Through gathering and testing the insights of figure 84, an optimum per factor for this thesis was distilled. It was also during the testing process, that it was discover the theoretical hypothesis was too elaborate and complex to be worked into a proper design workshop. Therefore, a new hypothesis was proposed as shown in figure 85, which yielded better results.

For now, it was found that once participants were trying to understand the different aspects of DLT and the possible future solutions it could offer, the step of going back to a solid future vision was too complex and actually caused participants to go back to a closed mindset. Further testing needs to prove whether this model is actually suited for DLT-development and a change of mindset in a professional environment.

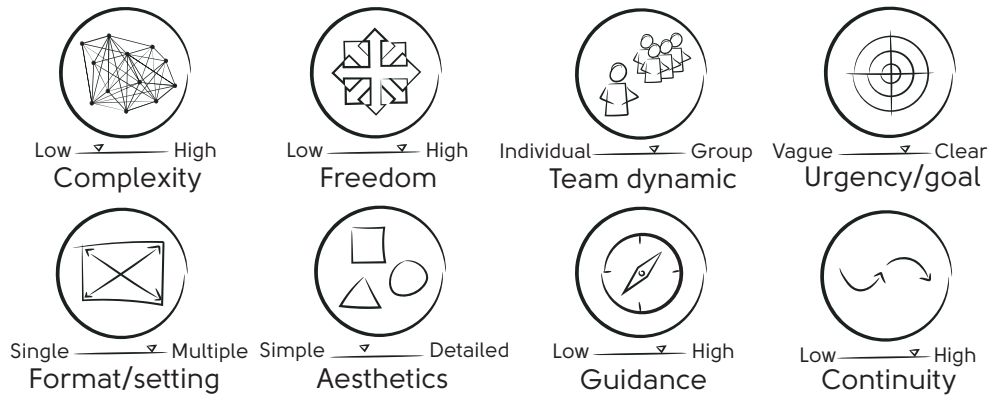


Figure 84: The optimal factor settings for designing canvasses for DLT

In the end, what is created in this chapter is a design tool that introduces participants to two important aspects crucial to the development of DLT. First, participants are asked to engage in network thinking, a process in which participants think not of themselves versus stakeholders, but of themselves in an ecosystem of peers. Next, the design encourages a discussion surrounding different critical points of their ecosystem, after which the participants are introduced to the basic aspects of DLT.

Going back to the research question (SQ3C), it can now be answered. Design tools can aide the adoption of DLT through creating discussion and introduction to new topics in a simple and engaging way. The power of design tools is best described in the following philosophical way:

The key to design tools is to let people experience complexity, but leave with a grasp of simplicity

What design does, is take complex theory and present it in a way that participants get a grasp of the possibilities, yet do not lose themselves in the complexity and walk away satisfied knowing it can be quite simple. This is specifically important to the development of DLT, as it is a technology that can potentially do a million things in the right collaborative setting, yet loses its value when people its is closed off by narrow-minded thinking and protective isolation. Design tackles these aspects by letting people experience the power of network thinking and by making the complex aspects of DLT into simple fuel for discussion. For this particular tool, design is not used to solve the issues at hand, but to find new insights and ultimately uncover common ground for collaboration.

In the end, the design created in this part of the thesis can be symbolized best as a journey towards the future. Like any popular sci-fi movie, such as Star Wars or Blade Runner, what is needed is a certain amount of reference. Something which is best explained by looking at figure 86. Most people tend to think of the future in line with their current life, perhaps a bit upgraded. However, looking back, history has never been a straight predictable line. What is needed for people to understand new context and meaning, is a journey that weaves together both current context through points of reference with new possibilities, ideas and concepts. Something which strategic and communication design combined are excellent at doing.

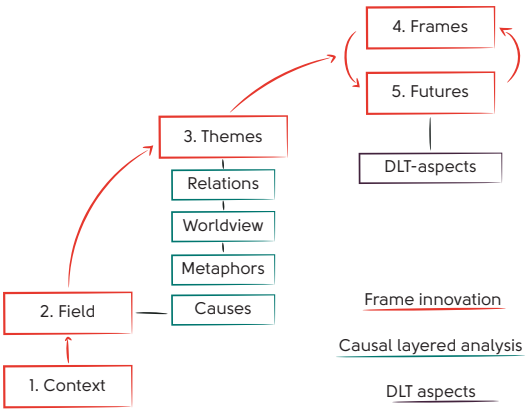


Figure 85: The new theoretical hypothesis framework

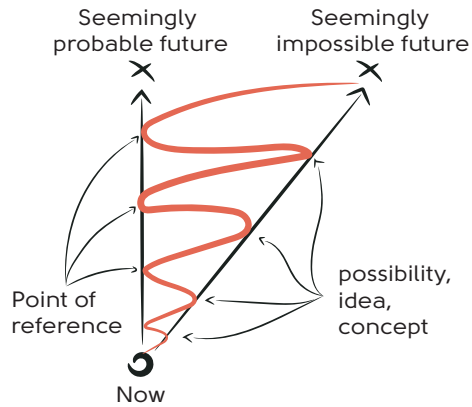
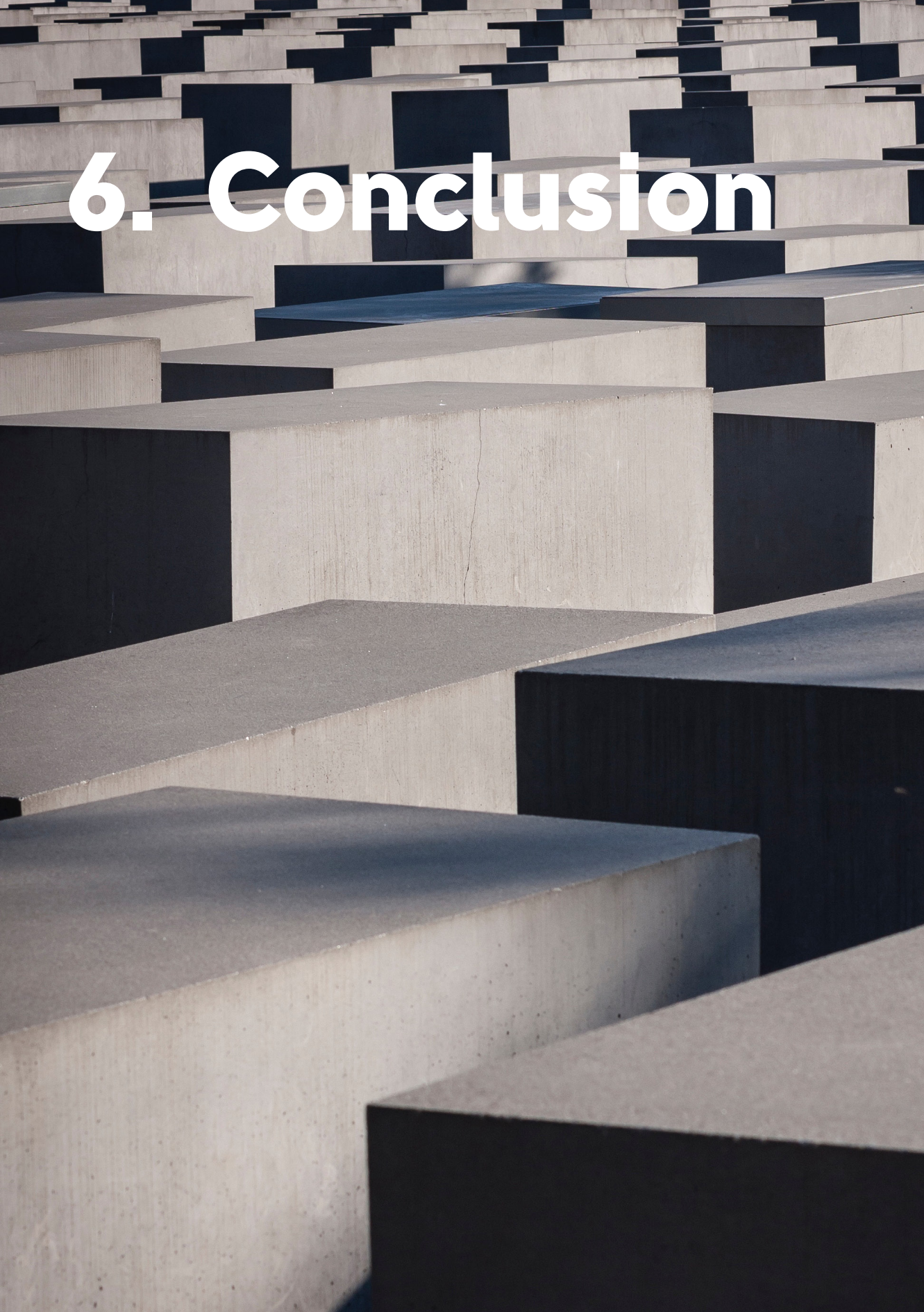


Figure 86: The future guidance through reference model



6. Conclusion

6.1 Introduction

All good things must come to an end, but fear not, for this is only the beginning. Distributed ledger technology is merely at the dawn of its existence and there is a lot to be anticipated.

This chapter looks back on the insights gathered in this thesis, which follow the familiar structure of the double diamond model. In chronological order, the journey through the model will answer the sub research question, after which an answer will be sought to the main research question. From there a final conclusion is given. This conclusion will focus not only on the final design and the reflection thereof, but also on DLT-development at large, for this thesis is only an exploratory research. It's ultimate aim, to discover the power of DLT-development in combination with the strengths of strategic and communication design.

6.1.1 Main insights and research questions

The concluding chapter of this thesis kicks off with what it all started with, the initial research question:

> *How can combined strategic and communication design be applied to aid the adoption of distributed ledger technology?*

In order to answer this research question a set of sub-questions was formulated. These questions and their answers will be discussed briefly per the structure of this report, which are the four chapter of the double diamond model.

Discover

In the discover phase, an answer was sought to the first three sub-research questions. To start, the first question was explored:

> ***SQ1:** What are the current needs in the adoption process of distributed ledger technology?*

After exploring the available literature and theory on the developmental process of DLT, a quick image could be shaped as to what the current status of DLT-adoption is and what its needs are. At the moment of writing, DLT-development is experiencing the effects of hype and its peak of inflated expectations. Enthusiasts have seen the light, but the majority of people, both in companies and in society, feel disillusioned. In the mass' eyes there have not been significant breaks and the technology itself is experiencing growth problems connected to its immaturity. The problem of adoption is mainly caused by the lack of focus on desirability and viability of the technology, as most companies have merely been exploring the technology from a technical stance. Thus, what can be concluded is that the current needs in adoption process are to gain traction and to show the sceptics and the mass they lead, what desirable impact DLT can truly have.

As distributed ledger technology is a networking technology, collaboration is of the essence in its development. In order to find out what its role is in the adoption of DLT, a second question was proposed and explored:

> ***SQ2:** What is the role of collaboration in the adoption of distributed ledger technology?*

A more in depth and additional search in literature regarding collaboration in DLT revealed that collaboration is of the essence in proper DLT development. However, as inter-organisational collaboration with peers is something which is new to most any organisation, those wanting to innovate find themselves stuck in endless discussions and deliberations in the formulation stage of collaboration. Here the right form of collaboration can help to create sustainable relationship that can tackle a technology as complex as DLT. For this organisational learning is proposed; a type of organisational management that stimulates the growth and sharing of knowledge and learning throughout all layers of a team or collaboration.

Lastly, the discover phase looked into the role design can play in the adoption of distributed ledger technology. As knowledge on this topic is rather scarce, the search broadened to software development in general, which created the following research question:

> ***SQ3:** In what way is design currently used to aid the adoption of software products and services?*

To answer this third question, both theory and practice were studied. Through this combination it was found that design in the development of software products and services plays a crucial role in user adoption, through the implementation of user centred methods. These methods allow the value, needs and emotions to be dug up and used in order to create products people love to use. However, it was also found that the type of development that DLT faces, is one that goes beyond the individual and can have impact on a societal scale. For this, the current design methods are not well equipped and a new, more network centred design methodology is needed.

Define

In the next stage of this thesis, the practical side of DLT-development was explored in order to understand what the current barriers and enablers in the process are. This was done through exploring two additional research question, the first being:

***SQ4a:** What are the current barriers and enablers of DLS development in practice?*

Through a set of eleven interviews, it was found that the factors influencing the development of DLT can be divided into three major domains: *IT*, *physical world connection* and *socioeconomic aspects*. It turns out mainly in the socioeconomic domain is cause for concern, as it is underdeveloped and raises a lot of discussion. This is in line with the found insights on the adoption of DLT, as the desirability and viability are largely neglected.

Next, the role of collaboration was also explored, this time through exploring the practical experience of those who operate in the field. For this the following research question was defined:

***SQ4b:** What is the role of collaboration in DLS development in practice?*

While researching the practical side of collaboration in DLS development, it was discovered that the professionals interviewed in general talked about four main areas: *the process itself*, *collaboration*, *the disruptive innovation process* and *the atmosphere or mindset needed to engage in this process*. When combining the earlier insights with these areas, the choice was made that the biggest impact in terms of adoption could be made in the mindset needed to engage. Meaning, the collaborative aspects that address an engaging atmosphere and allow people to feel engaged, might prove to be the most promising area for this thesis to explore.

With all the previous in mind, this part of the thesis ends with a design brief, in which the following design challenge is formulated:

Use frame innovation to create a design that uses the constructs of DLT to create a more open mindset, which enables companies to create disruptive yet desirable future visions that are both workable (IT) and communicable (internal/external)

What can be seen is that a specific methodology, namely frame innovation, was chosen in order to create a more solid foundation to design on.

Develop

In the third part of this thesis, an initial design was created. To do so, the design challenge was transformed into a theoretical hypothesis, which was presented in the form of a framework. This framework, which houses on a set of theories and methodologies that should engage participants in an active mindset focused on re-framing ideas and adjusting current views, was then used to create the first prototype: tool 1.0.

Deliver

In the last stage of this thesis, the final sub-research question was explored through a set of iterative tests:

> ***SQ4c:** How can design tools be used to aid the needs for the adoption of distributed ledger technology?*

Throughout the tests it was found that the proposed hypothesis was too elaborate and complex. This also led to the first sets of tools to be too complex, with too little urgency and continuity. Therefore, a change was made to make the model more simple and straight forward, starting from an exploratory point with a lot of freedom and slowly going towards a more guided process. All in all, it turned out eight interconnected factors could be found that make or break the design for DLT and that tweaking them to the right setting allows to be engaged in complex matter, in a relatively comfortable and guided way. This is also the answer to the final sub-research question. The power of design and design tools for distributed ledger technology lies in creating designs that can let participants people *discover complexity but leave with a grasp of simplicity*. It transforms the complex matter of DLT into bite-sized chunks and lets people engage in an experience of guided exploration, creating trust, anticipating future needs and allowing the appropriation of new knowledge.

Final conclusion

With this in mind, it is time to go back and answer the final research question:

> *How can combined strategic and communication design be applied to aid the adoption of distributed ledger technology?*

What distributed ledger technology needs, is a shift of focus towards desirability and viability, in order to further the adoption of this technology that promises wonderful solutions. But as found, the IT industry is not well equipped to address these issues. Expertise from other fields is needed, particularly of those who incorporate and guard desirability as a profession, such as designers. Design has the ability to take theory and research and transform it into something that is desirable and fits with the wants, needs and values of those people it addresses. But the field of design is broad, and not all design is suited for a technology such as DLT.

This thesis aims to understand the combined power of strategic and communication design. What was found is that both play an essential role in addressing the needs for the adoption of DLT. Strategic design is great for creating and guarding desirability, particularly on the level of user products and services. It however struggles to deal with more complex issues, such as inter-organisational collaboration or the interplay between society and the corporate world. These socioeconomic issues, which DLT struggles with most, can be dealt with through communication design. Together, both fields of design offer a strong base that can create and guard desirability on a level that incorporates the values and needs of all who are in the network, while also addressing the larger more abstract constructs that halt the adoption of distributed ledger technology.

In this thesis, the combination of both worlds is explored through the creation of tools that bring together those who understand DLT and those who are sceptic to its power. Through stimulating both parties to collaborate, explore new views and find common ground, a change of mindset that is productive for the adoption of DLT can be achieved. Here the

strength of the combination of strategic and communication design lies in its ability to address and communicate both individual as well as abstracts needs and values, in a way that is simple to experience, by addressing complex matter in a digestible and way.

6.1.2 DLT developmental outlook

What lasts in this conclusion is a developmental outlook as to where distributed ledger technology has come and what it needs to grow further. Distributed ledger technology is rapidly developing. So much so that is has become an innovation buzzword. Companies and enthusiasts jump at notion of implementing its technology, without even considering its basic nature. Other, the majority of people, shy away from it, as they simply don't understand its true nature and its accompanying impact.

DLT development and the understanding and accompanying image thereof is rather broad. For many, the technology stands for Bitcoin. An online currency that, due to its volatility, it used more for trading and stock brokering, than for payments. The wrong use of perhaps quite a revolutionary idea: a world without banks. On the other hand, blockchain is seen as a revolutionizer. A so-called universal solution to any type of (data) problem. A development which, in itself is not that bad. CEO's and board members alike don't like to talk about databases, but blockchain is sexy, thus popular talk. It has made database innovation hot. The upside: many are rethinking their data structure. The downside: DLT fits in about 10% of the cases, thus its costly development can be a burden and a risk.

As for those who know the technology, there is still a long way to go. Visionaries see endless possibilities; fully networked societies. Those who use more caution see the possibilities but also the large barriers ahead. The technology is immature, and its endless possibilities digitally, find themselves quite finite in the physical world. Think of identity and trust, major issues in collaboration and exchange. Digitally, we can create ownership, track goods and services, verify identities and create a system that lets us operate without the need for trust. But in the physical world, DLT is a background protocol that lacks any connection to physical objects and processes. Sensors are needed and third parties that monitor whether what is input online is true are of the essence. Exactly these barriers make collaboration hard. DLT might create online security without the need for trust, but companies and their employees live in the physical world. A world where customer loyalty and trust are amongst the top key performance indicators (KPI) and net promoter scores (NPS).

What distributed ledger technology needs is a way to allow the digital world to include the physical limitations we as people have. We need aspects such as trust, risk aversion, privacy, identity management, safety and security to be incorporated in its digital design. Designers can help to do so, by creating tools and methods to integrate the values we cherish as individuals but also as society. DLT development is still young, which offers us plenty of time to adept and adopt. If we want to create a solid foundation and avoid the moral and ethical pitfalls that the rapid development of the internet has allowed, we need to act now. Right in the early stages of development. Let collaboration thrive and let IT-professionals, designers and all others who are involved unite and create a better tomorrow through distributed ledger technology.

7. Discussion

7.1 Introduction

The last chapter in this thesis is that of reflection. Within this chapter the researcher and author will share his vision of what is learned throughout the process, what additional knowledge was gathered and might need more exploration and what the relevance can be for the fields of Science Communication and Strategic Product Design. After all this has been communicated, the chapter will end with a final note on the implications for the field of DLT, for designers and for researchers.

7.1.1 Reflection on the process

First, the general process of this thesis is reflected upon. The process followed in this thesis is a mixture of design-based research and practise-based research. It follows through a movement of comparing literature to the findings from practise, be it from interviews, DLT events, talks with expert or tool tests. This constant swing back and forth has allowed for continuous iteration, both in process as well as design.

The impact of using practise and design to influence the research process can most clearly be seen in iterations regarding the interview protocol. At first, the interviews were mainly focused on the software design process of distributed ledger development. However, from preliminary talks and explorative conversations with potential interviewee's, the understanding rose that DLT development is about much more than software. The roles that collaboration and network infrastructure plays were large enough to conclude they needed to be included in the research. This let do a revised protocol, that focused on three pillars: the project (software), the collaboration and the user-centredness. The latter looking at the user in the broadest perspective, from end-user to those who monitor and use data in their daily work.

This process of going back and forth was implemented all throughout the thesis. Experience was gathered through observations at meetings from Dutchchain, a Lego workshop, a network event etc. This helped in creating a broad understanding of what attitudes were present and more importantly, what triggers they were sensitive to.

Overall, this practise-based research through design method helped in gaining enough understanding to tackle something as large as DLT. In some ways this thesis is still too broad, but it aims at looking for a sensible context that can be built on. What can be learned from that is that critical reflection is needed more than was currently done. By going through design and practise, the researcher is forced to see new perspectives, which is good, but also counterproductive to the scoping within the process. Critical reflection and stricter decision making can help with this, in order to maintain and adjust the focus to a level that is comprehensible within the time-frame.

A workshop rather than a canvas

As Boer & During (2002) said: "innovation is an essentially human activity". This quote becomes incredibly relevant when reflecting on the chosen design format within this thesis. In one of the post-interview discussions with an interviewee, the business model canvas (Osterwalder et al., 2010) was mentioned. The interviewee felt such tools were a waste of precious time. He much more believed in fast iterations with customers. The process of constant validations, he felt, proves more than a filled in piece of paper. Overall, DLT innovation is something that comes from such a wide variety of stakeholders, that perhaps his argument was mainly, that fill-in-the-blanks canvases, directed at single user parties, are simply not suited for networked innovation. Based on that notion, the choice was made for a simple, time efficient workshop setting, rather than just a printable canvas. A workshop allows for the presence and guidance of designers and uses design thinking to its fullest, where just a canvas would be like performing a trick. It might help to some extent, but it can never achieve the needed broadness and depth.

7.1.2 The future development of DLT

Now that the process has been reflected upon, it is time to look and reflect upon the larger needs of distributed ledger technology. This thesis mainly focuses on the needs for adoption of DLT, but a lot more is needed after the initial stages are completed. The technology is still young, and as mentioned in the first chapters of this thesis, there are many steps to be taken in many direction. Connections need to be made, solutions need to be sought and inevitable changes sway the development from left to right.

To cope with this constant uncertainty, two theories were looked into for the further development of DLT: Strategic Niche Management and Organisational Learning. These theories have been the touched upon in some ways by the designed canvasses, but additional reflection is needed to make them successful. The relevant aspects of both are shown in figure 87 and will be explained in the next paragraphs.

Organisational learning

As described in the Discover phase, organisational learning is a way for companies to cope with wicked environments that continuously change, through constant gathering and sharing of knowledge, learning by doing and adaptation to new insights. As DLT-development is as volatile as the Bitcoin itself, a type of organisation that can deal with this is key in steering its development.

To create an environment of organisational learning, the designed canvasses have incorporated part of the aspects mentioned. In reflection, the design successfully made participants go into system thinking, where the analysed an entire ecosystem down to underlying exchanges and values. The latter, is directly related to understanding mental models, which are the deep-rooted values that makes us who we are. By understanding these, change can come from within the group, as they understand each other's motivations. This shared understanding is on its turn directly related to team learning. As the team moves past their initial prejudices and assumptions,

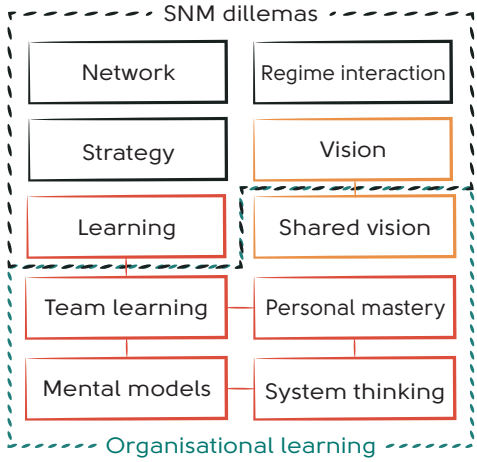


Figure 87: The combination of organisation learning and Strategic Niche Management needed in the development of DLT

a step forward is made. By going through the workshop together, a team starts to develop an environment in which learning as a group is stimulated. Now as far as personal mastery, this remains to be seen, as this is different for every individual. When it comes to a mindset, personal mastery can be seen as the openness to accept the flaws of others, the understand your own biases and to be able to temporary hold back on scepticism and allow oneself to imagine for a second.

As discussed, it remains difficult to reach a definite conclusion on the topic of (shared) vision creation. Within the current format, it might have been not realistic, either due to poor explanation, skill or time. However, there are plenty of examples where a diverse group of people have created a vision, thus leaving the researcher to conclude it is definitely possible.

In the end, the design presented in this thesis is just a way to ease into some of the aspects of organisational learning. It is advised for those who seek to work with DLT, to look deeper into what is needed to set a company or collaboration up for organisational learning. But from my experience into dealing with DLT and its development, it is certainly wise to pick an organisational form that can deal with something so complex and volatile.

Strategic niche management

Another important theory in the development of DLT is strategic niche management. This type of management is important to a technology like DLT because it is currently developed in a niche, which is defeating its own purpose. In the niche, the environment is save and protected but the origin of the blockchain was sought in free, uncontrolled networking with everyone and anyone. And, like those interviewed say: currently we don't need DLT, as in the niche there is nothing a regular database cannot do. In order to grow DLT and increase adoption, the dilemmas as shown in figure 87 need to be discussed and a solving strategy need to be made accordingly.

Upon examining the dilemmas of growth mentioned in strategic niche management, a few reflective comments can be made. In hindsight, the aspects of strategic niche management are, as the last word suggests, more suitable to be used in a position of management. Overall, I believe that ongoing discussion on the network, the strategy and the regime interaction are incredibly important in getting a technology such as DLT to move out of its current niche. Here it is incredibly important to also include the regime themselves, by for example performing workshops like suggested in this thesis. Furthermore, there is still incredible value in creating a shared vision with all relevant industry partners. Therefore, it is suggested for DLT-professionals to develop a strategy that includes all aspects of SNM.

Network centred design

Throughout this thesis and the research interviews, there has been a lot of talk mentioning ecosystems and networks. This paragraph will look into how design can be applied to incorporate this.

Inherent to its nature, distributed ledger technology is best suited for a network environment. A place where different peers or stakeholders partake into exchange through a distributed network. With this in mind, we have found that the methods of user centred design where too narrow minded. Which begs the question, how does one call design with not a single user, but the values of an entire network in

mind? Design that can focus on the individual, but also on the broadest, most abstract societal issues.

Research shows there is a field that has coined itself Systems Oriented Design (Sevaldson, 2013). This field of design focuses on "design for a complex world". Its main mission: "to build the designers own interpretation and implementation of systems thinking so that systems thinking can fully benefit from design thinking and practice and so that design thinking and practice can fully benefit from systems thinking". This field, which relies heavily on system thinking comes most close to what is needed for DLT development. It combines a variety of methods in such a way that allows the designer to create Gigamaps. Maps that show an entire system and incorporate methods such as the service blueprint, journey mapping, scenario thinking and causal loop modelling.

When looking for the right version of design that suits DLT, systems-oriented design comes a long way. However, it is mainly aimed at designers to help them solve complex problems. DLT development looks at end-users, but also at registers, maintainers, monitors and many other stakeholders that are (in)directly involved with the system. What is needed here, is the fit that user centred design offers for software development, combined with a network-oriented focus. In this thesis, I have proposed to call this network centred design. This type of design tries to incorporate the current user-centred design methods, in a broader, network inclusive context. It places the understanding of values central, by co-creating with a broad set of stakeholders to create empathy and understanding of all players relevant to the network. Its ultimate goal is a broader vision by the network, through the network, that is based on understanding rather than assumption.

The role of the designer

Now that a new type of design has been suggested, a last reflection is done on the role that a current designer can play in this. What became evident in this project, is that empathy and reframing can help individuals to get a better understanding of different perspectives. Current design can do this, but only so on the level of individuals and not on the scales of a network or entire ecosystem.

What is needed to tackle problems of a network magnitude, are people who can manage a broad set of perspectives and who are able to connect these perspectives and facilitate a dialogue between them. It is my opinion this task is best suited for a designer, perhaps best executed in the role of neutral design facilitator managing the process. With their T-shaped expertise, designer understand the core of design, but also possess the level of knowledge needed to understand the other stakeholders (Gemser et al., 2016).

Additionally, as Gemser et al. (2016) mention, design also plays a crucial role within the process of innovation itself. Where only having designers as facilitators, they can be seen as bias and trying to steer the process, something I have experienced myself. Having at least a second designer present as a member of the process, this designer can guard the desirability (the network-centredness) of the project, where the rest will most likely focus more on feasibility and viability. Additionally, a designer as a member can help in alignment with skills such as drawing or other forms of visualisation.

For this project, it turned out that the presence of a designer can help groups to achieve a broader vision. The imaginative ways of the designer expanded the conversation with provocative statements and more radical ideas.

7.1.3 The combination of strategic and communication design

A lot has been said already about the combination and strengths of strategic design and communication design. Therefore, this final reflection will focus on my experience of applying both.

What is means to combine strategic and communication design, is basically to have a adjustable bifocal lens. There is no set configuration in which the two work; it is rather an intricate collection of choices in which sometimes you focus more on the one, sometimes more on the other, but always with a combination of both in mind. For example, when I was testing the canvasses, I not only noticed how the participants interacted with the design, observing their needs, but I also noticed and steered towards organisational learning. You constantly zoom in and out, looking at the individual and at the larger picture.

Throughout my thesis I have experienced the combination of both as described in figure 88. Basically you have two lenses and you play around with overlap contentiously. Much like the final configuration of the eight factors that determine the design of the canvasses, you adjust setting until it fits to the situation. You interplay between knowledge from both fields and the application through design, or the through the creation of new insights and theory.

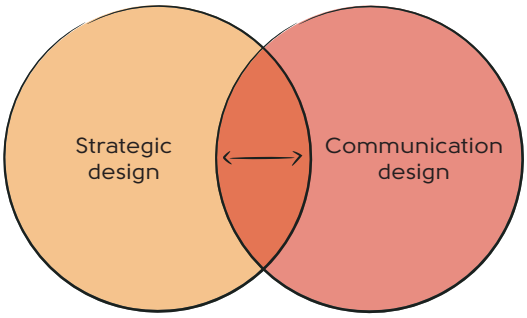


Figure 88: Switching between the two fields in a flexible manner

I found that the strategic designer in me looked for ways to improve the design, where the communication designer aimed to create a larger overview of the situation and reflected upon the bigger picture. This has for me been the essence between both. You play and tweak until its right and then you play some more, every-time finding new perspectives and new ways to approach the situation.

7.1.4 Implications for practitioners

Distributed ledger technology is roaring, but like the Lernaean Hydra, its development is a multiheaded beast. Tackling the many problems, avoiding the inevitable pitfalls and correctly foreseeing the impact of DLT-innovation, requires a broad range of disciplines, methods and tactics all working together in perfect harmony. In the following paragraphs, I will look at the implications this thesis has for DLT itself, for the field of design and for the development of research regarding such topics as DLT-innovation, adoption of networked technologies and the need for new types of designers with a range of tools equipped for the digital age.

Currently, there is a lack of proper tools and methods to deal with DLT- innovation. What is needed is a new generation of professionals to

stand up and develop the needed equipment for such a complex development. While this thesis has not definitively resulted in such tools, it touches upon a range of topics and insights that are valuable not only for DLT-development but also for the fields of strategic design and communication design.

DLT-development and innovation

For the developmental process of distributed ledger technology, this thesis provides several valuable insights. First, a broadening of focus is needed. Away from solely developing the technology, a movement is needed that looks at the broader impact of DLT and that focuses on creating truly desirable outcomes. One of such outcomes is the new and limitless collaboration. Even greater than the impact of the technology itself, is the promise behind it that brings people together. Or as one interviewee framed it:

> *"The true power of blockchain is that in particular organisations or partnerships or groups of people, realize they have a common interest"*

Knowing this, DLT-development should steer towards bringing a diverse group of people together, designing inclusively by involving everyone who might be impacted, from as early as the idea conception. Furthermore, DLT needs professionals from outside the domain of IT, that can guard the domain of inclusive design by critically monitoring viability and desirability. A sense of urgency needs to arise that developing a technology solely for the purpose of development, is not only a pitfall for innovation, but in the long run also harmful for the technology itself. Scepticism and aversion need to be addressed from the start.

When it comes organisations and collaborations wanting to dive into the use of distributed ledger technology, it is wise to create a strategy based on the lessons of the learning organisation and strategic niche management. Teams involved with DLT would do good to set up their environment to be flexible and open to quick learning. Failure should be approached following the lean methodology, where it can only be seen as progress and not setback. What helps in doing so, is creating and maintaining a shared vision, that is developed by and carried out throughout the team.

Furthermore, generative sessions such as created by the workshop in this thesis help immensely in group bonding and team learning, especially when they address a deeper layer of knowledge through mental models and system thinking.

Lastly, a shared understanding is needed of how to grow the technology. Applying the theory from strategic niche management in both the analysis of the current regime and in deciding how to enter this, can and will help the development of DLT in numerous ways.

In summary, the power of distributed ledger technology lies in its strength to connect people and have them find a common ground to build on. To guide this process, it is advised to bring outsides in who can establish an open environment based on the lessons of organisational learning. Within this environment tools such as the proposed canvasses need to be developed to allow continues reflection and learning, bringing DLT-innovation to a higher level.

Designers

The implications for designers, both in the fields of strategic design and communication design, are mainly found in dealing with an IT-development such as DLT. Addressing a technology as fundamental as a protocol, but not per se practically applicable requires a certain abstraction of perspective. Distributed ledger technology and its development are complex in multiple ways. First a designer should consider that DLT needs to be addressed and communicated in a way that looks at viability, desirability and feasibility all at the same time, while keeping in mind that this should be done not only with the (end) user in mind, but also society at large. The role of the designer in this is to facilitate an environment in which all these aspects are included, by finding and combining both theory and practise in such a way that tools can be created that stimulate the inclusive network centred approach.

Second, a designer should decide to which depth of DLT he or she wants to go. Trying to communicate all deeper principles of DLT has proven challenging and perhaps at times also unnecessary. Desirability and viability lie in the need for helpful features, not per se in understanding a fundamental protocol. People are addicted to the internet, without understanding what it is or how it works. However, this doesn't mean the designer should be oblivious to DLT's inner workings. Having an understanding of the world of IT, mainly agile development and user centred design, helps when creating the right tools for the right situation. Knowing how developers and system architects think and work, helps when developing new strategies and approaches. Currently, designers know too little about IT to address the issues correctly. Knowing what it means to Scrum, to work lean or agile, to go through sprints and to plan accordingly, is a skill that designers need to assimilate in this rapidly digitizing world.

In summary, designers who want to design within the context of distributed ledger technology and its development, have a responsibility to guide and steer the process by including those aspects like desirability that come natural to a designer. Furthermore, they play an important role in judging the depth of understanding needed and communicating the principles of DLT to the outside world. Lastly, it is imperative that designer prepare themselves to be deployed in the IT-domain, as this is perhaps where their skills are needed most in the future.

Researchers

For researchers this thesis has dug into a new world of design that addresses an entire network or ecosystem, instead of an individual products or services for a specific user. This so called "network centred design" or "systems-oriented design" is a discipline that is starting to be up and coming in this world of infinite connectedness. When large Internet of Things networks start to pop up and a multitude of (eco)systems get linked and intertwined, a type of designer is needed that knows how to design for entire ecosystems, rather than individuals. Now the question is, how will he or she be different from a systems or process-engineer? The answer to this lies in design thinking and the power of design to dissect, address and include a level of emphatic understanding of values and needs, in such a way that most non-designer have difficulty achieving. Network centred design is focused on people's needs, aiming to include all people who might be influenced by the network and creating a system of inclusion rather than technical superiority.

As a final note to researchers, the role of the designer and design in general is a discussion worth entering. While now design offers solutions to problems, perhaps in the future of systems it will have a much more facilitating role. The question of whether or not the designer is a practitioner, a visionary, a facilitator, a manager, a devil's advocate, a coach or perhaps a combination of roles, is food for thought for a new generation of designers to come. And for those currently in the practise of design; they have to power to shape this field momentarily. As a concluding remark for researcher and design academics, I call for discussion. Discussion on the future of design, on (eco) systems and the networked society, and on how they influence each other.

In summary, for researchers it is important to reflect upon this thesis through the likes of network centred or systems-oriented design. This field, which is just starting to be developed, might prove an important addition to the worlds of communication and strategic design, especially in this day and age of ever-growing networked ecosystems. In this, it would be wise to reflect upon the role the designer of the future has, which perhaps will shift from practitioner to facilitator.

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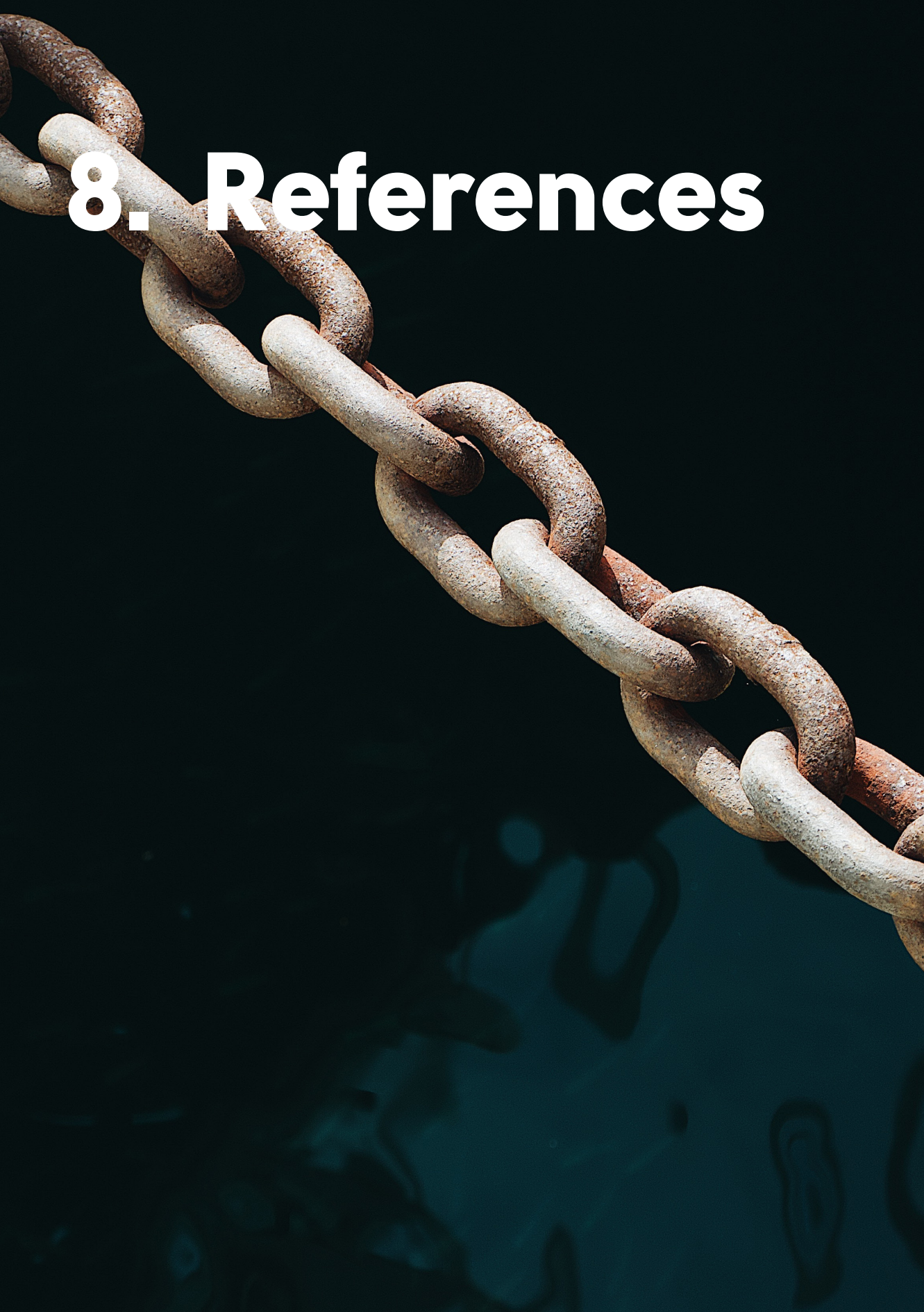

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