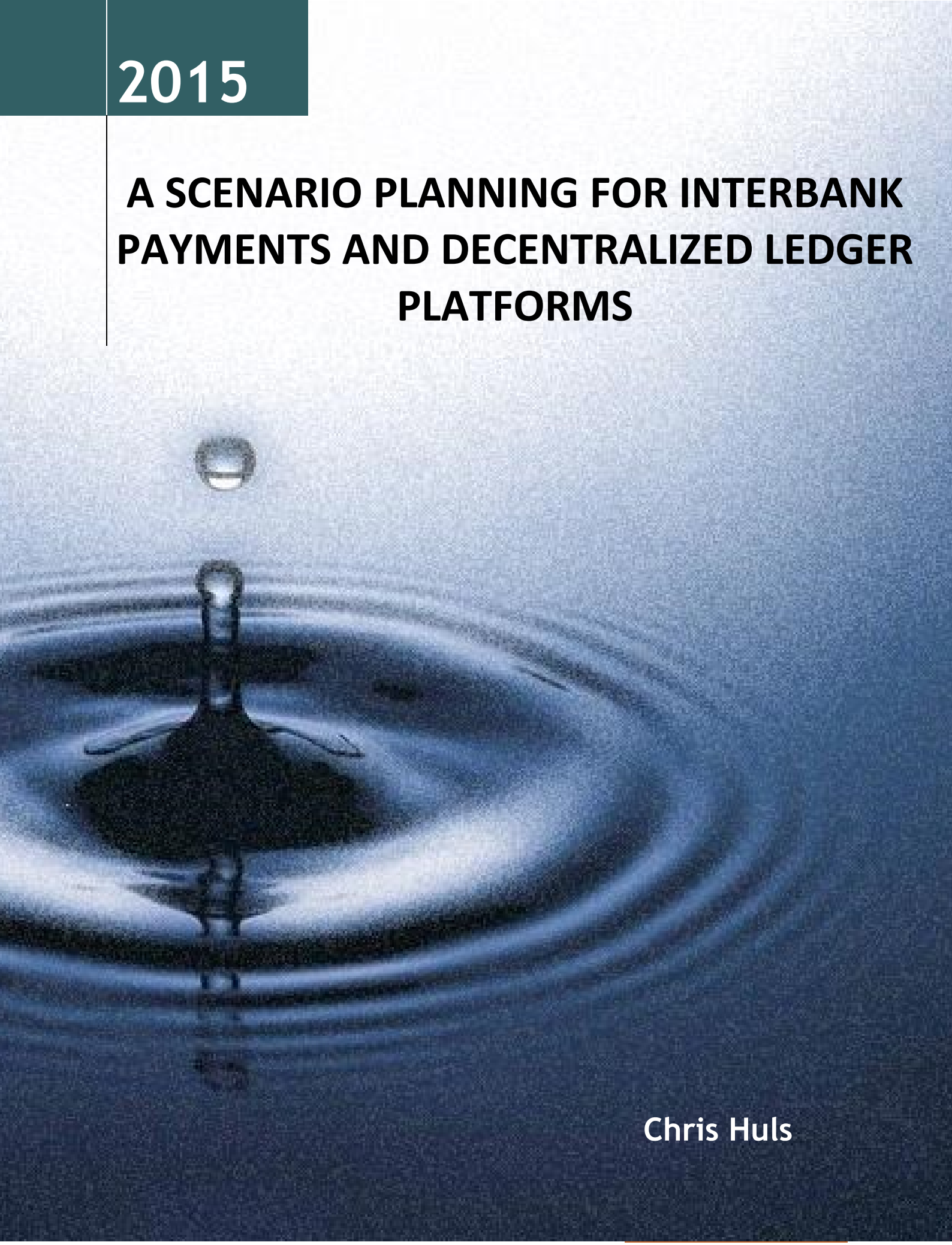
2015

A SCENARIO PLANNING FOR INTERBANK PAYMENTS AND DECENTRALIZED LEDGER PLATFORMS



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Master's thesis Business & Information Technology

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A scenario planning for interbank payments and decentralized ledger platforms

Utrecht, April 2015

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Publicity
This version concerns the public paper, which does not include recommendations for Rabobank Netherlands.

Autore Deo, favente Regina, Luctor et Emergo

Management Summary

The current international payments infrastructure dates from 1974 and is regarded as slow, outdated and expensive. Cross-border payments nowadays take place through correspondent banking, which may use multiple banks in different countries, resulting in high costs and slow payments. As the majority of global financial institutions are not likely to mutually adopt, and therefore depend on a single and centralized payment architecture, Decentralized Ledger Platforms (DLPs) might bring change by offering a payments backbone which requires no central trusted party. Examples of such DLPs are Ripple, Stellar, Hyperledger and Open Transactions, which are all follow-ups of the disruptive Bitcoin protocol created in 2008 by Satoshi Nakamoto. The crypto currency Bitcoin itself is volatile, too anonymous and has several potential security risks. These may be reasons for financial institutions not to adopt the Bitcoin, but the technology behind the Bitcoin itself, the blockchain, is promising and of future value.

Although many DLP enthusiasts exhibit great knowledge and future perspectives about the use of a DLP, many uncertainties arise by outlining how exactly these DLPs might change the financial industry of the future. Therefore, this research tries to understand what DLP-facilitated future interbank payments look like and gains this understanding by means of scenario planning. This leads to the following research question:

> *What are future scenarios for the implementation of decentralized ledger platforms facilitating interbank payments?*

Although DLPs can facilitate numerous use cases, the use case chosen in this research is interbank payments, focusing on international cross-border payments. The scenario planning is fed by an elaborate research of literature about organizational adoption of radical innovations, the current way of carrying out interbank payments, crypto currencies and DLPs. The scenario planning itself consists of trends, uncertainties and dynamics – actions of stakeholders –, which are thought of and verified by a multitude of stakeholders and experts from different backgrounds and industries.

A scenario planning is carried out by analyzing trends, uncertainties and dynamics. In collaboration with the interviewees, the following global trends are found: developments in digital (biometric) identity, privacy awareness, change of a bank's business model, stricter regulation but also regulators pushing for faster and cheaper payments, new small and big entrants in the payments industry and open banking initiatives. Some of the found DLP specific trends are: the rise of blockchain applications and crypto currencies, the first initiatives to regulate crypto currencies companies, various DLP use cases for retail payments and the impressive hacks of crypto currency exchanges. Next to these trends, important uncertainties are identified which might shape the future financial industry, based on a set of assumptions which generally indicate that some sort of a well-functioning DLP is adopted by banks to facilitate interbank payments. Four most striking uncertainties are:

- The degree of adoption among banks.
- Whether one DLP standard becomes universal or multiple standards co-exist;
- Which actor implements the technology and thereby takes responsibility and risks for a compliant and secure payment solutions;
- Which actor offers use of DLP technology to its customers. These actors can be incumbents as central banks or PSPs, but can also be regular banks, big tech companies or even supermarkets.

The actor identified most nearby to the individual is the front-end provider, who provides the user interfaces for payment options. Currently, the front-end provider role is fulfilled by banks (the Dutch Internetbankieren) or a joint venture of banks (Currence, iDeal). This front-end provider should in a few years be able to connect to the back-ends of financial institutions, in which a DLP can be used to provide a full payment solution to its member base. This front-end provider will need to have proper (biometrical) identification methods, which may be enabled by mobile applications as this is currently the most carried on piece of technology.

Financial institutions should take care of the various dynamics identified, which are: acquire knowledge about DLPs, experiment with DLPs, collaborate with other banks, startups, regulators and standardizing institutions as W3C, work towards a profitable business case. Also, financial institutions should empower an internal and external attitude change towards the blockchain, devoting resources to the compatibility, relative advantage and complexity of DLPs.

Acknowledgements

This thesis is the final work for my study Business & Information Technology. Throughout the years, when explaining the contents of my study, I often indicated that my field was bridging the studies Information Technology and Industrial Engineering and Management. My research is in an equal way a bridge between two different fields, but now to International Payments and Blockchain solutions. In both cases, the contrasting fields lack a shared understanding whereby this type of bridging research should improve the mutual understanding of both ends of the spectrum and thereby connecting both worlds together.

In contrast with the average graduation project, this research investigates a future situation and is therefore by definition more unstable. My research into Ripple and other DLPs concludes that the financial industry awaits the entrance of a disruptive technology which might irrevocable shake up the current infrastructure. Trying to write down unspoken trends and uncertainties with unforeseeable consequences is a very enthusing activity which requires some creativity and out-of-the-box-thinking. Together with employees from the Rabobank and external interviewees, we tried to sketch these consequences, which was very interesting to do.

After attending an Inhouseday of the Rabobank, I ended up at the Rabobank to investigate the Ripple protocol by means of my thesis. I am very thankful to my Rabobank supervisor Roel Steenbergen, who came up with the subject and supported me in multiple ways to gradually develop my research and write it towards a comprehensive whole. As the graduation process was external, I was located in the Rabobank Headquarters in the center of Utrecht, with a great view on the Dom, the great teapot and the UFO; elements which decorate the top-down view of the center of Utrecht. I recall great meetings with colleges and other interns, which complemented the whole.

I would like to thank all interviewees who agreed to meet with me (online) although some of them had very busy schedules. It was very interesting to hear views from completely different backgrounds and trying together to fit one's view into the whole. Thank you: Jochem Baars, Kanika Dua, Roy Duffels, Daniel Feichtinger, Evert Fekkes, Rob Guikers, Melanie Hekwolter of Hekhuis, Daniel Hes, Paul Ostendorf, Dan O'Prey, Mirjam Plooij, Sander Reerink, Welly Sculley, Robert Jan Vrolijk, Eric van Vuuren, Edan Yago.

This thesis rings the bell for the end of my student life, which I enjoyed and appreciated it its whole. I would like to thank friends, family, housemates and members of my student association for enriching this time and I hope that the ones left behind further enjoy their student life and get the best out of it.

I hope you enjoy reading this thesis as much as I enjoyed writing it,

Chris Huls

April 2015

Table of Contents

Glossary

Blockchain
The technology behind crypto currencies and DLPs, consisting of a 'chain of blocks' in which each new block of transactions confirms the previous blocks and gives the most current state of a shared ledger.

Crypto currency
A digital asset which is secured and recognizable by mathematical properties. Crypto currencies can be exchanged in a DLP by applying a cryptographic signature transferring ownership. Crypto currencies can also be defined as "digital assets". Crypto currencies have a global acceptance, and are therefore greater in reach than virtual currencies.

Decentralized Ledger Platform (DLP)
A DLP is a decentralized shared ledger on which each user can issue or hold one or more assets or liabilities, for example crypto currencies, stores of values, or (shared) virtual currencies, which can be used to carry out near real-time cross-currency payments.

Fiat currency
Currencies which are issued and regulated by a central authority (e.g. Euros from the European Central Bank).

Fintech
Abbreviation for Financial Technology. Industry which offer new financial products and services based on new technologies, such as a DLP.

Front-end provider
An actor who delivers the user interface in which the end-user can manage his payments. This front-end provider can host the back-end technology itself, or it can only specifically function as a portal which provides proxy access to other payment channels.

Issuance – I Owe You
A service provided by a gateway whereby assets are collected on deposit, and the balance can be represented on the DLP ledger for transacting with other network participants. Otherwise known as I Owe You (IOU).

Payment channel
A payment channel is a way for the end-user to carry out payments, including the accompanying systems. Examples of current payment channels are the Dutch Internetbankieren (by bank account), by PIN and debit card (by iDEAL and bank account in the back-end) or by crypto currencies (by wallet).

Store of value
An asset such as gold, oil, or loyalty points which can be issued and traded in a DLP.

Wallet
A cryptographically derived private/public key pair. The public key is the address of the wallet and is exposed to the entire network to be able to receive funds. The private key is used to sign transactions and transfer ownership of balances held in a DLP wallet.

Virtual currency
Intangible currencies like virtual Euros, which represent fiat money held by a gateway. Wallet owners transfer their fiat currencies to gateways, in order to receive virtual currencies which can be used in the DLP. Virtual currencies can only be exchanged for fiat currencies at the issuing gateway(s) which means that these virtual balances are backed with deposits at its gateway, which can likely be a bank. Virtual currencies can also be defined as "digital liabilities".

List of Figures and Tables

List of Figures

List of Tables

Reading Guide and Disclaimer

Reading guide

In my honest expectation, partly based on my experience in the financial sector, I do not assume that interested readers will have time available and unlimited motivation to wrestle him- or herself through this thesis. It's a long, long read. Therefore, at minimum one can read the management summary and conclusions. Note that these sections absolutely do not cover this research, but rather provide an abstract introduction. For obtaining the most relevant findings, I strongly advice to read or browse through chapter 8, which contains the most important analysis of this research. If you have more time, you can - based on your experience read the building blocks – chapter 4 and 5 – and the informative case study of the Ripple protocol. If your level of enthusiasm is still high, you can take a look at the literature section in chapter 3. For the readers that want to verify my research, I present you chapter 1, 3 and 7 which describe global and specific methodology used to perform my research.

Disclaimer

All findings presented in this research are solely the findings and opinions of the author. This paper does not represent the public opinion of Rabobank Netherlands, Ripple Labs, or any of the other involved companies. All interviewees disclosed information from a personal viewpoint, which is not related to a company's involvement or viewpoint towards DLPs or crypto currencies.

The author takes no responsibility for information provided in this research regarding concepts, technologies or companies. The subjects discussed can get very complex and mistakes are easily made. I hope I interpreted all findings and information in a clear and truthful way, but I am not able to guarantee this.

1. Project description

1.1 Introduction

The current international payments infrastructure dates from 1974 and is regarded as slow, outdated and expensive (Ripple Labs, 2014b). Since the development of the Bitcoin by Satoshi Nakamoto in 2008, a valid alternative was offered to change the way (international) payments is executed nowadays (Wiatr, 2014). The crypto currency Bitcoin relies on a decentralized network which uses cryptography to ensure security and proper authorization to enhance consensus, also called the blockchain. In such a blockchain crypto currencies can be held, although this is not mandated to use its functionality. At the moment of writing, almost 500 alternative crypto currency coins (altcoins) have been issued (Coinmarketcap, 2015). The Ripple protocol, with its native coin XRP, contains the second-greatest altcoin and offers near-instant and cheap payment services to banks and financial institutions (Ripple Labs, 2014b). Whereas Bitcoin and most other altcoins have as main feature that they make banks obsolete, Ripple and other so-called Decentralized Ledger Platforms (DLPs) aim to improve the current payment infrastructure by collaborating with incumbent financial institutions. This research tries to understand the current way of interbank payments and what DLPs can offer to improve this industry. This understanding is visualized in a scenario planning which gives a perspective of alternative future situations for interbank payments.

Interbank payments

Current interbank payments can take place through a multitude of systems. European payments flow through systems as EURO1, STEP1 and STEP2, in which the latter facilitates the more recent SEPA payments. International payments flow through a series of correspondent banks which add time and cost inefficiencies to cross-currency payments. Interbank payments is a heavily regulated area, which is necessary to facilitate trust among banks, which is in turn required to move money around the globe. Most important regulatory and compliance issues to take into account are Know Your Customer (KYC), Anti-Money Laundering (AML), and the new Payment Service Directive (PSD II) which increasingly enables new entrants to fulfill a role in the payments industry.

Decentralized Ledger Platforms and crypto currencies

A crypto currency is a type of unregulated, digital money, which is issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community. It is a math-based digital asset which is secured and recognizable by mathematical properties. (ECB, 2012b; Ahamad, Nair, & Varghese, 2013; Wiatr, 2014). The best known example is the Bitcoin, which uses the technology named the blockchain. Crypto currencies are placed in a decentralized shared ledger and characterized by a public and private key. Crypto currencies can be used as money, but due to high volatility and the possibilities of hackers to steal all crypto currencies once a secret key is discovered, financial institutions and regulators are not inclined to use or regulate crypto currencies (ECB, 2015). A DLP is built on the blockchain technology which offers one or multiple assets or liabilities, for example crypto currencies or stores of values (e.g. gold, loyalty points), to be stored on a single shared ledger, to be tradable among all kind of users. Each willing user (can be a bank) can create an account to hold assets or do payments and will only have to pay marginalized fees. Examples of these platforms are Ripple, Stellar, Hyperledger and Open Transactions. DLPs have an open architecture, are mostly open source and can be used as a backbone layer in new payment initiatives. The terms blockchain and DLP are alternately used, whereby a DLP is a specific type of blockchain. All DLPs are thus implementations of the blockchain technology, but not all blockchain solutions are DLPs.

An important distinction used in this research is between the crypto currency and virtual currency. Many sources (ECB, 2012b; IFF, 2014) use the term virtual currency to describe a crypto currency as defined above. This research uses the term ‘ virtual currency’ to describe a virtualized fiat currency, which is issued by only one or a few financial institutions and thus only redeemable by these institutions. In contrast, crypto currencies have a global reach and acceptance and are at every entry point redeemable for fiat money. Virtual currencies have thus a reach specifically chosen by its issuers which enables better oversight and security.

Another design choice is to use the term ‘decentralized’ instead of ‘distributed’ ledgers. Technically, DLPs are distributed; each individual can create wallets and run validating nodes, just as with Bitcoin. The difference

with DLPs is, is that with the addition of entrance points, the gateways, the market orientation of a DLP works towards a decentralized setup, in which each node enables its members to use the network. Without these nodes, their members have restricted use of their payment options. In this research both decentralized and distributed technologies are discussed, with as main difference that the first knows some sort of centralized actors.

1.2 Problem statement

Problem statement

Research into the benefits from decentralized ledger platforms is currently very divergent and numerous possibilities of DLP types and uses cases arise. Also, including (third) parties and implementation manners are exploratory discussed (Scott, 2015; Coindesk, 2015). Through all these possibilities, confusion arises and it is complex to point out in what direction development and collaborations point. For the business side of a financial institution, it is necessary to know what to expect in order to be able to anticipate wisely on current and future developments. The problem formulated is the proliferation of DLPs and resulting myriad of new entrants and new use cases, which leads to a troubled view on the future.

Goal

To address the above mentioned problem statement, the goal of this thesis is to shine light on the current and future developments and create scenarios which take these developments into account. The goal of this research is to acquire knowledge about alternative future situation of DLP-facilitated interbank payments, and this goal is fulfilled by means of a scenario planning. This thesis improves understanding of the most promising decentralized ledger platforms and comes up with a few sets of scenarios which should address future situations, accompanied with some necessary assumptions. Business managers should be able to understand these scenarios and be able to identify in the future which scenarios to drop and which scenarios become prominent. These scenario descriptions include some dynamics and recommendations, which can be used to act instantly on future events.

Research questions

In order to achieve the goal of this thesis, the author set out to answer the following main research question:

> *What are future scenarios for the implementation of Decentralized Ledger Platforms facilitating interbank payments?*

This research question is divided into six sub questions:

1. *What are the factors influencing the successful adoption of a radical IT innovation?*

Decentralized ledger platforms, can be described as a radical IT innovation. This question is answered by a literature study which needs to extract enabling and disabling factors for organizationally adopting a radical IT innovation.

2. *How do interbank payments take place nowadays?*
3. *What are Decentralized Ledger Platforms?*
4. *How does the Ripple protocol work?*

These three questions are answered by background research. These questions need to deliver understanding about the current way of interbank payments and the working of decentralized ledger platforms. As currently the most promising DLP concerns Ripple, the fourth questions takes Ripple as a case study and explores this protocol thoroughly.

5. *What are the alternative scenarios for Decentralized Ledger platforms implemented for interbank payments?*

This questions leads directly to the main research question and delivers different sets of scenarios. These scenarios are first created after answering the previous sub questions, and are validated by stakeholders and experts.

6. *How should Rabobank Netherlands address these potential scenarios?*

The validated scenarios are combined with the literature findings in order to give recommendations to Rabobank Netherlands regarding how to use these scenarios and underlying findings to anticipate on current and future developments and work on a strategy towards the incorporation of a DLP.

1.3 Scope & Methodology

Scope

The scope of this research is interbank payments and decentralized ledger platforms. Interbank payment compromises all sorts of payments in which at least two different banks are involved. Decentralized ledger platforms represents all kinds of blockchain solutions which aim to improve the current way of payments. Geographically the scope is both national and international. As decentralized ledger platforms deliver most benefits in international payments, the main focus is about international payments. The case study of Ripple is carried out from a national (Dutch) perspective.

The scope does not focus on customer payments, although consequences for the customers on both banking and retail perspectives are shortly discussed. The scope does not include financial product innovation, as the financial products stay merely the same: just the channel and infrastructure might change.

Methodology

In Sandberg & Alvesson's (2011) systemic review of constructing research questions, several gap-spotting or problematization tactics are discussed which identify the types of research questions needed. This study combines the interbank payments industry with the DLP industry, in which the first has matured, the latter is nascent and the combination of both has not been researched yet. Therefore, the gap-spotting type is neglect spotting, further specified in 'overlooked area'. Edmondson & McManus (2007) couple the state of prior research to the methodological fit, and state that research question should be an open-ended inquiry, data collected should be qualitative and constructs should be typically new, with few formal measurements. Furthermore, they state that the theoretical contribution should be suggestive and give an invitation for further work on the issue or sets of issues opened up by the study.

The type of research performed is known as grounded theory, an inductive technique of interpreting recorded data about a social phenomenon in order to build theories about it (Bhattacherjee, 2012). Strauss & Corbin (1990) have refined specific coding techniques, from which the type 'open coding' is used. The open coding technique is used to identify concepts and key ideas, hidden within textual data which are potentially related to the phenomenon of interest. This open coding technique is used in most parts of this research, as it enables to exploratory build a model from the ground to gain understanding of the phenomenon of interest, which is the DLP-facilitated interbank payment. This open coding technique is used in combination with a thematic analysis (Guest et al., 2011), which enables to perform a structured qualitative research.

The different steps in this research and the dependencies between research activities are visualized in Figure 1.1 below. In the figure is indicated which activity (block) or which group of activities (swimlane) contribute to which sub question. Each step of the research introduces its own specific methodology. Chapter 2 and 7 contain the methodology for respectively the literature search and review (chapter 3), and the scenario planning (chapter 8). Next to this, the background research chapters 4, 5 and 6 each start with a small methodology how data was collected and processed.

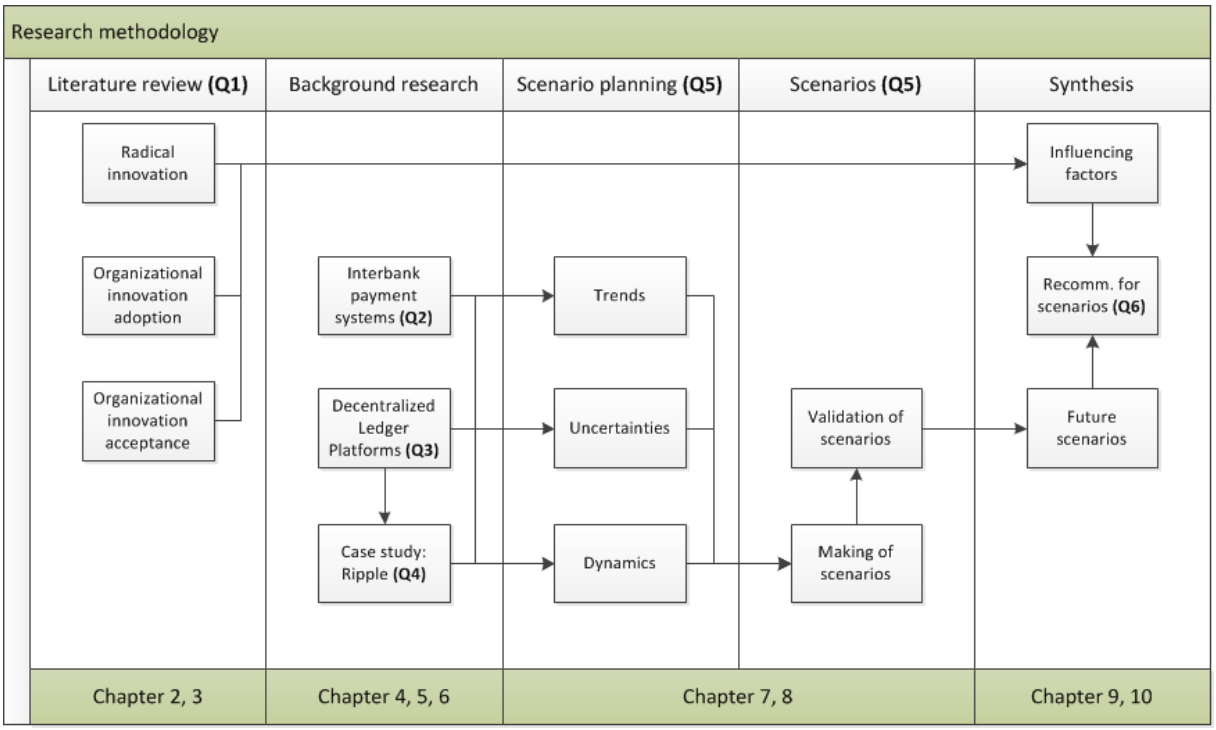


Figure 1.1 Research methodology

1.4 Research relevance

The introduction of the Bitcoin in 2008 was a call for disruption in the financial world. Due to compliancy issues, hacks and its complexity it did not yet fit to change the financial infrastructure. Ripple, among others, present improved blockchain applications which take into account the current infrastructure of the financial world, which gives banks their chance to stay involved and show globally interest. Despite this interest, it is completely unclear what forms a potential mass-collaboration between decentralized ledger platforms and financial institutions can take. The author has found no existing research about this, except for the general statements that banks will keep involved. During the case study, it became clear that no one has yet a clear understanding of the possible future directions DLPs might take us. To address this knowledge gap, this scenario planning is performed.

1.5 Thesis structure

This thesis consists of three main parts. The first part is the literature study, the second part is the background research and the third part is the scenario planning.

- In the first part, Chapter 2 discusses the methodology used for the literature search. Chapter 3 summarizes the literature.
- In the second part about the background research, Chapter 4 investigates interbank payments, Chapter 5 investigates decentralized ledger platforms and crypto currencies and Chapter 6 is the case study of the Ripple protocol.

In the third part, Chapter 7 includes the methodology and design choices for the scenario planning. Chapter 8 contains all steps of the scenario planning, including the validation of stakeholders. Chapter 9 then combines the validated scenarios and underlying findings with the literature, in order to give some answer the sub and main research question and draw a conclusion. Chapter 10 contains a recommendation for financial institutions, in particular Rabobank Netherlands, which is not included in the public version of this research.

Part I

Literature review

2. Literature methodology

This chapter presents the methodology used to find a solid literature base and process this literature. The scope, search terms and excluding criteria are discussed. The type of literature study is a systematic review, where guidelines and practices are implemented from Kitchenham (2004).

Scope

This literature study is not about the generation of innovations itself. The product, a channel for interbank payments, already exists. This study is about the almost definite innovation which may be adopted in the current financial infrastructure but which also might change the current infrastructure. Therefore, the main focus is on adoption of innovation instead of innovations itself.

The context of this literature study is the possible adoption of a radical innovation in a big corporate firm, for example a bank. Therefore, this background is taken into account which deliberately excludes studies solely focused on small entrepreneurial companies (e.g. startups). The scope does explicitly not contain 'being innovative' (the generation of innovations as explained above) and governmental or organizational innovation policies, as they would lead to the generation of innovations. Also out of scope, is the role of individual employee or customer who may or may not adopt the innovation. As this research mainly focusses on the organizational adoption of an innovation, it consequently excludes innovation theories about persuading employees to use new facilitating technologies (i.e. ERP systems) or about attracting customers to newly developed or adopted technologies.

Search terms and query

In order to perform a complete, consistent and broad literature review according principles of systematic review (Kitchenham, 2004), first a broad set of papers regarding (financial) (radical) innovation is explored to define the search terms and scope. The first hindrance was the confusion between radical innovation, disruptive innovation and discontinuous innovation. Although multiple scholars (Garcia & Calantone, 2002; Crossan & Apaydin, 2010; Pérez-Luno et al., 2014) try to give overall definitions, agreements on overarching definitions are not reached. Despite all excellent journal papers, the clearest explanation was found in a blog from Krishnan (2012), also indicated by Christensen (1997). In this blog, Krishnan describes the difference between the two most used terms: 'radical innovation' and 'disruptive innovation'. As the author explains, disruptive innovation is about the creation of a new market, while radical innovation is about a huge efficiency or performance boost for existing markets. This boost is due to new technologies, but the outcome will be already known by the customer and knowingly desired. Although, these same customers are still resistant in adopting these innovations as they are new and the benefits still need to be proven. For disruptive technologies, the market does not exist yet and customer attraction is uncertain, let alone customer adoption. The first search term is thus 'radical innovation'.

As innovation needs to be approached from an organizational perspective, and not from an individual perspective, the search term 'organization*' is added. The asterix indicates that any amount of characters (including nothing) can be added after 'organization', which allow also terms as 'organizational'. The third search term is about the adoption or acceptance of these innovations. The resulting query is presented below.

(TITLE-ABS-KEY (radical innovation organization acceptance) OR TITLE-ABS-KEY (radical innovation organization* adoption)) AND (EXCLUDE (SUBJAREA , "MEDI"))*

Databases

The literature databases Scopus and Web of Science were used to find relevant literature. The search script below was entered in both searching engines. Scopus resulted 76 papers, Web of Science 68, which leads to a total of 144 papers.

Excluding papers

After duplicates were removed, 111 papers were left. Each abstract was carefully considered and only when there was no doubt that the paper was not useful, it was removed from the list. After removing papers based on abstract, 62 papers were left. From these 62 papers, only 51 were downloadable and readable. These papers were qualitatively reviewed, and 43 papers were kept which are all more or less included in this research. Figure 2.1 below visualizes the literature search.

Next to these papers, literature is included which the author has discovered and used during prior research or which came up during exploratory literature searches. Some more papers are downloaded based on information and citation in the list of 43 papers, which are also added to the list. In total 19 additional papers are used.

The innovation terminology used might be confusing. As explained above, this research focusses on radical innovations instead of disruptive or discontinuous (or all other forms of) innovation. As became clear in the papers which define innovation types, scholars use different terms for the same concept and are thus heavily in disagreement. Therefore, innovation research discussing disruptive or discontinuous innovation is also included, as it is unknown what exact definition each scholar uses. In the same manner, the exact definition used to describe a DLP innovation can both fall under disruptive or radical innovations. If only the back-end payment structure innovates heavily, the innovation might be perceived as radical. If also new payment methods and perspectives evolve due to DLPs, the innovation is perceived as disruptive as it creates new market, which further complications our confusion.

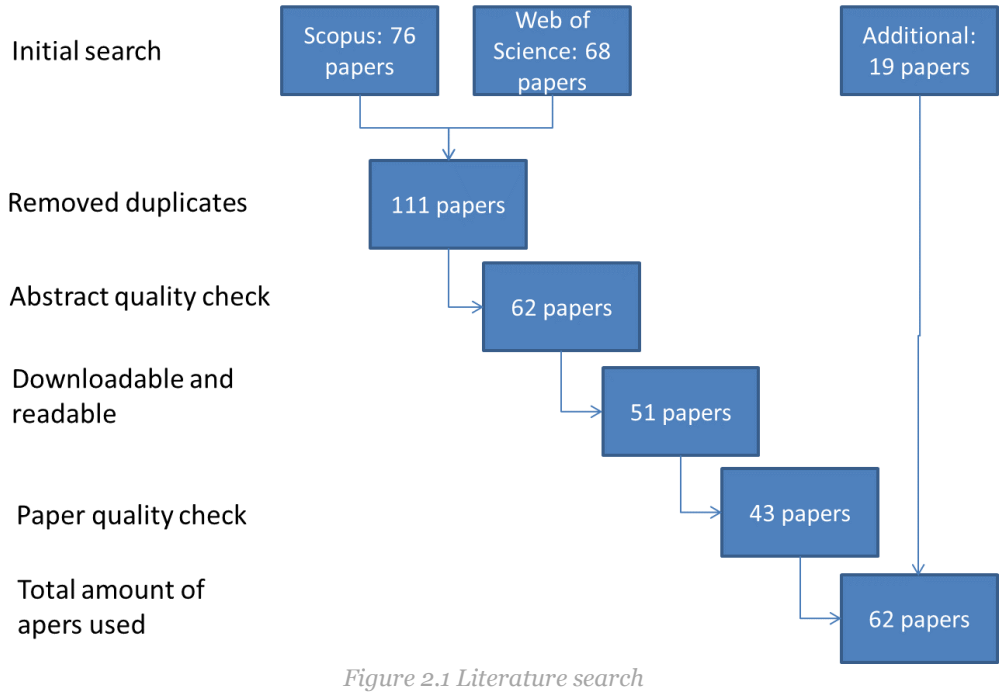


Figure 2.1 Literature search

3. Literature review

3.1 Definition of innovation

In order to review information about disruptive innovation and adoption of innovations, it is necessary to recall the basics of innovation theory. A good start for this is the systematic review from Crossan & Apaydin (2010). The authors synthesized various research perspectives regarding the innovation field, based on a set of 524 qualitative papers which are written in the period of 1983-2010. The authors defined innovation as "a production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems. It is both a process and an outcome". This is a shortened version of the current and up-to-date understanding of the concept of innovation, first made public in the European Commission's Green Paper of Innovation (European Commission, 1995). According Crossan & Apaydin, innovation is widely regarded as a critical source of competitive advantage in changing environments. Organizations that generate or implement innovation, will be more sustainable than organizations that are more reluctant towards innovation. This view is globally shared by important scholars in the innovation field (Hamel, 2000; Christensen, 1997).

3.2 Basics of radical innovation

Most scholars in the innovation field distinguish two main types of innovations. Radical versus incremental innovation. Or, disruptive versus sustaining innovation. Or, continuous versus discontinuous organization. The first is about an innovation which brings something completely new, the latter is about improving an existing product or process. In their paper about technical innovation typologies, Garcia & Calantone (2002) examined the different definitions of innovation. After a broad comparison of multiple innovation typology methods, they defined a radical innovation as a "new technology that result in a new market infrastructure". And, radical innovation introductions result in discontinuities in both macro and micro level. An important aspect is that radical innovations do not address recognized demands, but instead they create a demand previously unrecognized by the consumer. An example named by the authors is that in 1970 most households could not imagine a reason why they would need a home computer. Today, a multibillion dollar market target these exact households. In this manner, radical new technologies act as catalysts for the emergence of new markets. Radical innovations can thus be characterized by technological uncertainty, as the technology is not broadly explored yet, and market uncertainty, as there are not yet customer demands. This give radical innovations a hard time to break through. Note that the definition and characteristics given by Garcia & Calantone leans more to disruptive innovation, as defined in chapter 2, but still sufficiently describes for both slightly different innovation types.

Garcia & Calantone link to a tool to identify radical innovations, introduced by Foster (1986). Foster created an S-curve which describes the origin and evolution of technological discontinuities/radical innovations. This S-curve is presented in Figure 3.1. The theory predicts that radical innovations begin with a many research, time, marketing and resource inefficiencies. This is because knowledge bases have to be created and the innovation needs to be evaluated from different perspectives. Once knowledge is generated and proves the presumed advantages of the product, technological performance will rise until its limit. The innovation will be adopted by several instances, and at the same time this limit will be reached due to unforeseen restricting characteristics (Foster, 1968). A current day example of this is the Bitcoin, which has a current market capitalization of 3 billion dollars (Coinmarketcap, 2015). The Bitcoin and consequently the Blockchain technology are radical innovations in the financial world. Although, more and more publications show that Bitcoin is less trustworthy due to hours of validation time and the so-called 51 % attack (Ametrano, 2014), and not controllable for regulations (Innopay, 2014) and thus might ultimately disappear and be taken over by a radical-incremental innovation which improves these shortcomings of the Bitcoin. The first producers or developers of radical innovations suffer from teething problems and unforeseen consequences. As such an innovation gets increased attention and becomes partly adopted, detrimental consequences such as scalability issues might present themselves which might then limit the success of the innovation.

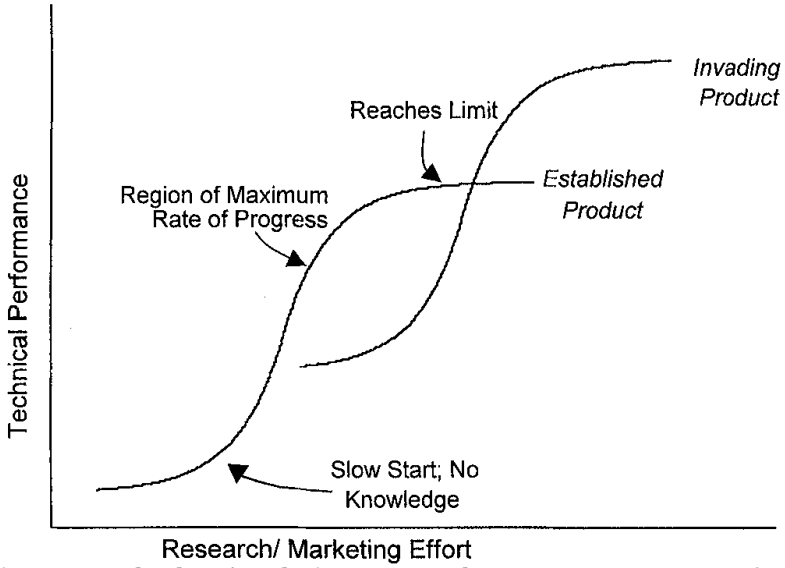


Figure 3.1 Technology/Marketing S-Curve Phenomena. Source: Foster (1986)

In a paper from Veryzer (1998) about the product development process of discontinuous innovations, eight steps are identified based on existing projects which should be sufficiently addressed in order for a firm to support discontinuous innovation. In the second step, whereby highly discontinuous ideas are converged, there are two driving forces: a product champion and a critical mass of contextual factors. The product champion is the visionary who sees all pieces of the puzzle fitting together and sees the strategic importance of the new product. Contextual factors are for example company turbulence, resource availability, alliances and technology interactions. Surprisingly, just in the 6th of the 8 steps the customer comes into the picture. Veryzer, and many other scholars with him, strongly argue that customers should not be part of radical innovation developments, as the new product or process is not fully specified and the demand still needs to be created. Customers just do not understand the development yet.

Regimes

An important and highly cited paper about innovation is from Nelson and Winter (1977). Their innovation theory states that every change is an innovation and involves considerable uncertainty. Organizations should incorporate the stochastic evolutionary nature of innovation and leave room for organizational complexity and diversity. Innovation occurs within technological regimes, which guides the search and innovation activities of engineers. A (technological) regime is a group of products or services which contains the ecosystem of currently used mechanisms. An example of a regime described by Geels (2002) is the sailboat regime, which was gradually surpassed by the steamship regime. Regimes and their developments are also the main subjects of the paper of Van den Ende & Kemp (1999). They state that new regimes originally develop in old ones, and are geared out by problems or emerging inefficiencies of the old regime. Eventually, when a new regime gets massively accepted, it grows out of the existing regime and forms its own regime. Such a regime shifts has some implications. Novel technologies are produced on the basis of knowledge available in the existing regimes, what can be a disadvantage for new first movers, as they cannot yet anticipate on the potential structure of a new regime which might arise during a technological revolution, which was also a conclusion from the S-curve of Foster.

Geels (2002) conceptualize his findings by a socio-technological landscape. This landscape is visualized in Figure 3.2.

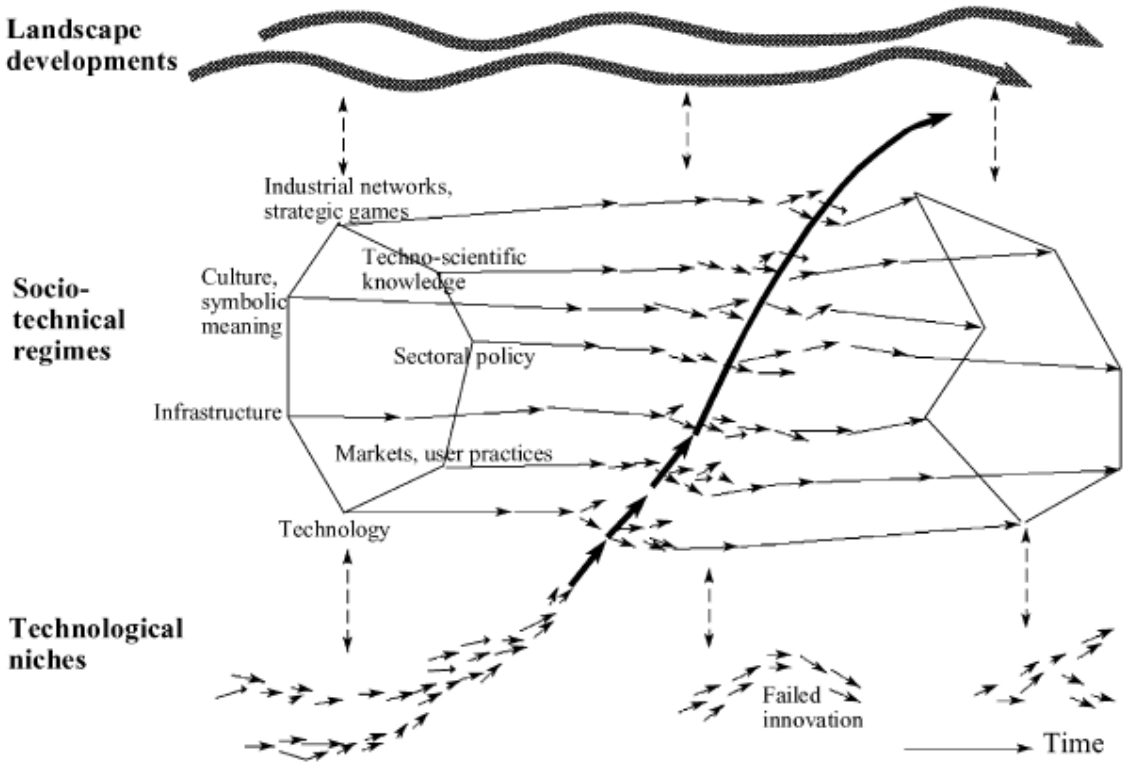


Figure 3.2 Landscape of Technological Transitions. Source: Geels (2002)

In Figure 3.2, the bottom of the landscape contains technological niches, the place where radical innovation emerge. These niches provide some protection to these innovations, the so-called incubation rooms. Potential radical innovations are thoroughly tested and improved, before exposing it to the socio-technical regimes. The middle layer, the socio-technical regime, incorporates all products, services, infrastructure, industrial networks, markets and user practices needed to support a technical regime. For example, the computer-regime would not exist if there was no software, computer lessons, programming languages, additional markets, computer experts and governmental policies. All these products, services and practices need to be incorporated around the revolutionary technology in order to get gradually accepted by the mass market. This gradual shift from a technological niche to a socio-technical regime creates tensions in the existing regimes. This existing regime might be altered or even displaced by a new regime which forms itself around the new technology. Regime shifts are accompanied by social processes that both facilitate and constrain the transition process.

Such regime reconfigurations do not occur easily, because elements in a sociotechnical configuration are linked and aligned to each other. Regulations, infrastructure, user practices and more elements are all tightly connected in the existing regime which give radically new technologies a hard time to break through. If a regime is confronted with problems and tensions, the linkages in this regime get looser and the chances of breakthrough increase. At this point, the upper layer introduces itself: the landscape developments. These developments are macro developments which influences the existing regimes. An recent example of this is the outbreak of the Ebola virus in West-Africa. Hospitals in all countries need to prepare rooms in their hospitals to be able to safely take care of Ebola patients. Extra requirements will be asked for some of these rooms, which can lead to a breakthrough of new hospital technology. In the case study of Geels (2002), steamships were able to breakthrough by a change in the physical landscape, the Suez Canal. As sailing ships were hardly able to maneuver through this canal, steamships could transport faster and cheaper, which eventually caused the breaking through of the steamship as a transport vehicle.

3.3 Characteristics of radical innovation

Product innovativeness

Danneels & Kleinschmidt (2001) researched dimensions of product innovativeness and their relation with the go/no-go decision regarding radical innovations. They found five dimensions of product innovativeness, which

have distinct relations with this decision and product performance: market familiarity, technological familiarity, marketing fit, technological fit, and new marketing activities. The fit of a project in a firm refers to how well the internally available resources fit the requirements for the new product project; the extent to which the new product fits within the firm's resources and capabilities. New products may enlarge the domain of the organization, and to the extent that they do so they make the organization face an unfamiliar domain.

Market visioning/product champion

In their paper about market visioning, O'Conner & Veryzer (2001) discuss the importance of linking market opportunities to radical innovations. By examining eleven radical innovation projects, they found qualitatively four themes which emerge by radical innovations. These four themes are presented in Table 3.1 below.

Theme	Description of theme
1. Drivers of vision	Occurrences or contexts that motivate individuals or groups within the organization to engage in thinking about how advance technologies might link to market opportunities
2. Multiple roles in visioning	The extent of influence that an individual has on a radical innovation's success through articulating and selling the vision; the number and types of people that play key parts in the process.
3. Tools and methods for foresight development	The mechanism by which a vision is formulated and sustained. Processes that help teams/firms vision. The effectiveness of processes relative to reliance on a visionary individual
4. Idea acceptance	The ways that a vision is reinforced within the firm. The actions that are taken to convince the team/firm that it is correct.

Table 3.1 Market Visioning. Source: O'Conner & Veryzer (2001)

As presented in this table, first vision is build and sustained. In this, a first drives is senior management who setting the innovation context, which is also mentioned by Lawrence et al. (2011). Senior managers should energize innovation activities and articulate innovation goals. Another driver is the opportunity recognizer, the role of scientific discovery and degree of formality/informality of innovation processes. From a process perspective, early prototyping helps to commercialize technologies, as the often-spoken benefits suddenly become tangible. Examples of external drivers are regulators, whose change in regulations can stimulate innovation.

Second, there are a number of roles that individuals play in creating and evangelizing a vision through an organization. There are five roles:

- Senior management as a stimulator of the activity.
- The opportunity recognizer's role in connecting a technical idea with a commercial possibility.
- Ruminators as contemplative people, with wide experience base who spend time thinking about the future, and are able to connect disparate pieces of information.
- Product champions are the evangelizers who lead the charge, are entrepreneurial in accessing resources to accomplish a mission, and are action-oriented and focused. Sometimes, the champion gets locked in their own vision.
- Implementers, often volunteers. Those that enjoy it to think of the possibilities of having an impact by working on a project that will "change the world". People who are willing to risk.

Research has illustrated the importance of these product champions, for example senior engineers and middle managers, who act as boundary actors in redefining linkages across domains within firms and between firms and their environment to introduce radical innovations (Brusoni & Sgalari, 2007). These focal individuals play an integrating role and act as the channel of transmission of innovation across domains and the development of new bodies of knowledge and expertise.

Third, there are a few tools and methods for aiding the development of long-term visions. Read a lot, visit useful universities and conferences, develop a relevant web of relationships. This includes also meetings with internal R&D teams and other firms. Other methods are scenario planning, core driver mapping, and science and technology mapping. All these tools help to anticipate on the future, and reduce in that way uncertainty.

Fourth, visions undergo a process of validation and internal acceptance that may depend heavily on reaching out beyond the familiar customer/market set of the firm. It is important to validate the technology itself internally as a firm, instead of the externally by the market, as the latter is still highly uncertain. Validation should mainly take place by approval of top management for long term promises and resources available. Validation should not occur by quantitative measures as discounted cash flow, rate or return, as these are too shortsighted for radical innovation measurements. Building support for the project, according the authors, relies on demonstrating technical feasibility to gain attention to the scientific novelty, building a prototype to 'prove' the benefits of the concept in usable form, and selling the business concept including all costs, benefits, risks, initial application areas and strategic implications addressed which concludes in a go or a no-go decision (O'Conner & Veryzer, 2001).

Innovation timing

The disruptive IT innovation model allows managers to better ascertain when it is good to be among those who lead, and when, in contrast, it is good to be among those who follow, learning from the accumulated experience of their predecessors (Swanson 1994, p. 1089). In another study, Carlo et al. (2014) investigated the timing of radical information technology innovations. They differentiate between two types of organizations: first-movers, which are the first the explore radical technologies, and late adopters, which only follow after success of first-movers. They concluded that firms can benefit from apparent second mover advantages if they want to innovate disruptively and quickly. It is possible to catch up more easily than assumed in past times, because the rate of adopting base technologies increases with time. They found that for late adopters, the amount of innovation in the base has a stronger impact on the amount of related process innovations (innovations in-between base innovations and customer oriented service innovations) adopted, relatively to early adopters. A reason for this is that late adopters are in general more resistant to change; they will thus focus more on exploitation of the adopted innovation (Carlo et al., 2014). Organizations which are second-movers have the ability to avoid teething problems and might directly adopt improved innovations. This may save resources.

In contrast, first-mover advantages were observed in the amount of service innovations created based on the relative number of base innovations adopted. Early adopters of base innovations should be able to generate a more diverse portfolio of services to market and may in some situations benefit from such explorations (Carlo et al., 2014). An explanation for this finding is that first-adopters create a greater knowledge base about the adopted innovation and might learn of different use cases by addressing teething problems. This knowledge enables them to generate a more diverse portfolio of service innovations, which are on average more used by customers. Giachetti et al. (2010) add to this that a firm's strategy can be to differentiate, or to imitate. Strategy research demonstrates a persistent tension between the need for a firm to be different and the need for a firm to be the same. Firms can choose reference targets, derived from the collective behavior of the industry rivals, or firms can track the market leader's behavior. This follow-the-leader behavior minimizes risks for firms, as there is already proof of success. The downside is that firms do not have a first mover advantage and cannot earn the first profits and respect of being a successful innovator.

3.4 Structure and strategy

Scholars have written much about the strategy and organizational structure to support the generation or adoption of radical innovations. A dated but important paper of this is from Ettlie et al. (1984), concerning organization strategy and structural differences for radical versus incremental innovation. They found out, that radical innovations adoption is significantly promoted by an aggressive technology policy and the concentration of technical specialist. They stimulate to make a centralized, but informal structure. Although most papers reviewed confirmed this and gave a great role to formalization, centralization and the product champion, Hameed et al. (2012) found that these factors were insignificants. These disagreements may point to the fact that all studies address different innovations, different industries and different stakeholders, which creates great difficulties to come up with a generalizable view.

Centralization

Centralization of decision appeared to be necessary for radical process adoption. An explanation for this might be that firms are often internally in conflict whether or not to pursue radical technologies. A centralized decision by a board might give outcome. Also, they suggest moving away from complexity issues towards a

more organizational generalists view. This means that greater support of top managers in the innovation process is necessary to initiate and sustain radical ideas (Ettlie et al, 1984).

Informality

Informality is required for enable sufficient and frequent communications with regards to the development or adoption of radical technologies (Ettlie et al.). This is confirmed by Veryzer (1998) and Garcia & Calantone (2002). In this regard, Salomo et al. (2007) researched corporate radical innovation systems and concluded that "radical innovation is clearly a knowledge intensive activity". Although Nahm et al. (2003) confirm that informality is needed to ensure frequent information flows, they vote for a nature of formalization which implies an internal environment with procedures and rules that encourage employees to be creative and autonomous in work and learning. It is not about an environment full of written policies and procedures, but with simple policies and procedures that enable employees to capture, organize and share knowledge.

Regarding the formality of innovation activities, Griffin et al. (2014) call for patience and some freedom for serial innovators; innovators who innovate on multiple projects. Taken into consideration the time innovators spent in in the first cycle of an innovation development to find and then understand interesting problems, it can look like they are highly unproductive, as very little visible output may be generated. The authors use the term "fuzzy front end" to describe the chaotic, messy up-front part of radical product development before there is a solid concept. Using formal product development processes may actually hinder these innovations.

Knowledge management

Salomo et al. (2007) give an introduction to seven papers about corporate radical innovation systems. The authors couple the dynamic capabilities model to the corporate radical innovation system, in order to explain how a corporate organization should behave in order to facilitate radical innovation. They define this as the "firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997). Their model has been applied in a variety of settings; including effectiveness in managing alliances, effectiveness of acquisitions, knowledge creation, transfer and product and process development. The most important learning, as above already shortly hinted at, is knowledge management. Next to this, there should be a corporate mind-set which approves the identification and exploration of radical technologies and top management need to have oversight of current radical innovation explorations, which is also hinted at above by centralization. Both corporate mind-set and knowledge management touch the subject of firm learning, which flavors an orientation characterized by directed learning, continuous refinement of processes and routines as means of achieving competitive advantage. Some researchers assert a firm's ability to learn, and the style in which it learns as the true catalyst for resource reconfiguration strategy and ultimately dynamic capabilities (Eisenhardt & Martin, 2000; Zollo & Winter, 2002). Nahm et al. (2003) add that organizations should have a high level of horizontal integration and only a few hierarchy layers, to stimulate fluent horizontal and vertical communication in the companies where employees are enabled to have a broad understanding of problems and issues. Employees should be cross-trained in multiple disciplines, what encourages more collaboration and a broadly shared knowledge base.

Governance

Robeson & O'Conner (2007) investigated the governance and decision making aspects of radical innovation management systems. By means of a literature study and an empirical study, they made a conceptual model which is represented in Figure 3.3. They describe the Radical Innovation governance board, which is responsible for particular innovation projects. This is thus not the board of the firm itself, although a representative of the innovation board may also take place in the main board of the firm.

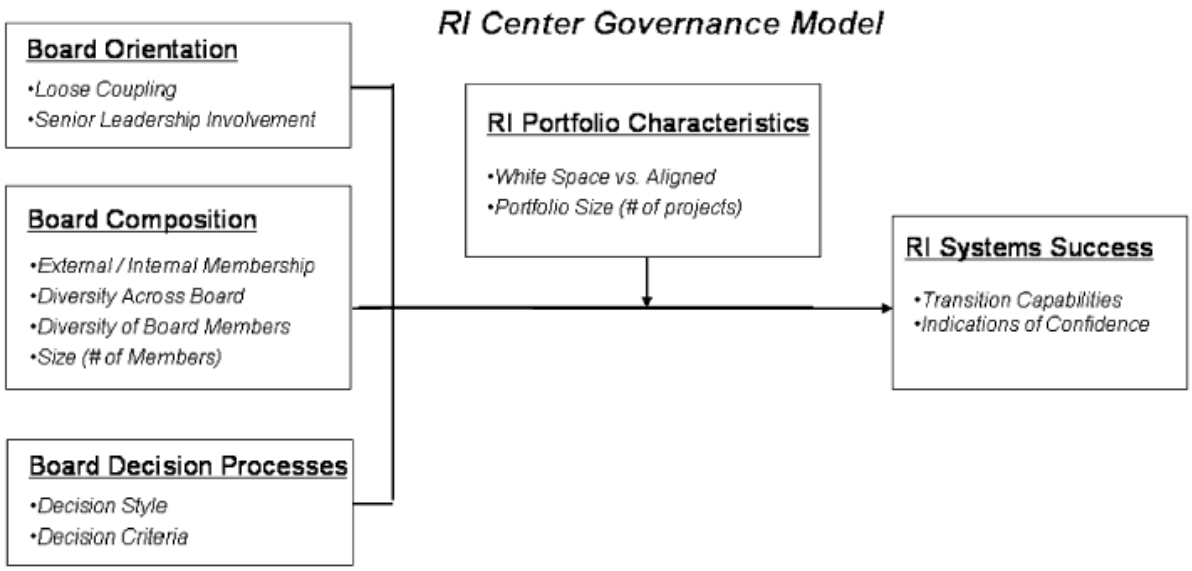


Figure 3.3 RI center governance model. Source: Robeson & O'Conner (2007)

Board orientation defines the coupling with the mainstream organization. If it is tightly coupled, this indicates that the innovation goals should fit tight with the organization's goals. Due to the high uncertainty in radical innovation projects, most organizations choose for loose coupling to get enough space and freedom to develop. Also, senior leadership is important, but this is moderated by portfolio characteristics. The less alignment with other projects, the more senior management attention is required. Board composition is about the diversity of the board members, and its size. The authors cite different studies that indicate a moderate degree of heterogeneity in the top management team is beneficial, and groups of five or six team members were found to be most appropriate for efficient performance. More group members reduces consensus, which in turn reduces decision quality. Robeson & O'Conner state that successful firms assure diversity, which can lead to extremely high decision quality, not by a mix of people from different functions, but rather by including personnel on the board who have been exposed to different functions throughout their career. Concluding, not only the mix of the team needs to be heterogeneous, but the team members themselves also. The board decision processes are about decision style: being transparent and straightforward, or keep all in the dark. An important mechanism found is the use of a 'bench mentality', which gives innovation workers a 'bench' of different innovation cycles to work in, which reduces concerns for job loss resulting from board decisions.

Organizational culture

An organizational culture is closely related to strategy and structure, and may result from some explicit strategy choices. Büschens et al. (2013) studied organization culture within a firm in relation to innovation adoption, and created a quadrant based on the tradeoffs Internal – External and Flexible – Control. Their method was a meta-analysis, which comprises 43 studies with a combined sample size of 6341 organizations. The four resulting culture types are Hierarchical, Rational, Group and Developmental, in which the first two are control-based and the last two are flexible-based. Each type of organizational culture is suited for the adoption of innovation, but with regards to the type of innovation to be adopted management can try to shift the organizational culture to the type desired. For example, open innovation needs an external view, while controlled innovation needs proper planning and stability, which is mostly founded in more incremental innovation.

3.5 External

Customers

According Christensen & Bower (1996), an important aspect in a firms' innovation policy is the voice of the customer. If customers do not desire a certain type of innovation, the firm might be unable to commercialize and would thus not benefit from the innovative product or process. The authors advice firms contrastingly to not listen too carefully to their customers, as customers might not think forward and will have less understanding of the market opportunities. According Christensen (1997), the very decision-making and resource-allocation processes that were key to success for established companies are the same processes that

lead these firms to reject new disruptive technologies. A well-known example is that if the first automobile developer, Henry Ford, would ask people what they should want, they would prefer a faster horse instead of the unknown technology of an automobile. Ahuja & Lampert (2001) describe this conflict as the capability – rigidity paradox. Existing capabilities provide the basis for a firm's current competitive position, but without renewal these same capabilities might become rigidities regarding the firm's future ability to compete.

In contrast, Heiskanen et al. (2007) investigated user involvement in radical innovation and encourage to look broader than Christensen and Bower's view to ignore customers. Their findings represent that often customer do understand the new technology fairly well. Their lack of enthusiasm stems from other reasons, including the innovation's instrumentalism, its impact on consumers' autonomy and organizational complexity. Customers are not willing to loose fun, pride or personal fulfilment, or may fear for different social interactions when agreeing with radically new products. Therefore, market investigators should take care of reasons customers can have to be not interested in radical technologies, which may be based on simple personal preferences. These investigators could use a concept testing method, which should not be used as a pass/fail screen for new innovations, but as an opportunity to learn more about potential impacts of the innovation on everyday life and society.

Open innovation

Innovation in a company can be open, or closed. Open innovation indicates that some innovation activities for a particular project are shared with other organizations also interested in that innovation. The advantage of open innovation is that knowledge can be more easily gathered, risks can be shared and organizations can make use of their complementary assets to improve the innovation process. Closed innovation means that all innovating activities take place behind closed doors. Benefits of closed innovations are reduced costs and complexity of collaboration and there is no risk of cheating or opportunism from collaborating ventures. Also rewards do not have to be shared, and there is no dependence on others.

Regarding the transparency in innovation models, Von Hippel and Von Krogh (2003) reviewed two dominant models, and invented a third one. The first is the private investment model: innovations are supported by private investments, patents are used to keep the innovation closed, and there is a perceived loss to society as no one beside the company itself is able to further develop the techniques/knowledge. The second model is the collective action model. Freshly created knowledge is made public, which creates huge opportunities of collective development activities, but reduces direct chances to make great money. Because of this, it is more difficult to motivate potential contributors and investors. The authors propose a third intermediary model: the private collective model. This model is in middle of the other two, as innovation knowledge is still publically available and collective action is possible, but manufacturers behind the project can profit from indirect activities (for example consulting) related to the project, and earn profit, respect and reputation. An example of this is the open source industry, were everything is free and accessible, but plenty possibilities exist to earn money or profit in an indirect way.

Dodourova & Bevis (2014) explored the concept op Open Innovation (OI) in the European car industry. They use the definition of Chesbrough (2006), who defines OI as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation". Although scholars much earlier came up with theories about OI, Chesbrough's work provides an overarching concept encompassing various research streams. In contrast to the traditional model, where innovation is internally generated and marketed, the OI model thus recommends utilization of both internal and external sources of ideas. The overarching theme is the leveraging and utilization of knowledge, in order to be more capable of exploiting innovations. This can be done by engaging in inter organizational networks. These networks consist of SMEs, large incumbent, knowledge institutions as universities, research centers, and governmental institutions as municipalities and regional institutions. Eventually, these networks can help Small Medium Enterprises (SMEs) to deliver innovative ideas and technologies, which large enterprises integrate in their product architecture in exchange for complementary assets (Dodourova & Bevis). The exploration efforts are for account of the SMEs and entrepreneurs, but the final stage of exploitation and commercialization is done by large incumbent, which has already organizational structures, networks and resources available. The authors conclude that intellectual property rights are of critical importance and they highlight the important role intermediary institutions play in facilitating inter organizational exchanges, creating accommodating environment, facilitating joint problem-solving between the various stakeholders, nurturing trust and credibility, and supporting and motivating innovation efforts.

A solution for these problems might be to use the idea of OI as a bifocal strategy (Di Minin, 2010). In the beginning of a radical technology life cycle, an incumbent may adopt the OI strategy in order to deal with the radicalness and technology and market uncertainty. Once in collaboration radical technologies mature, different actors can internalize consecutive innovations and commercialize these. After this, re-externalization is possible by outsourcing the development or production of components, as interfaces become standardized.

Alliances

Alvarez and Barney (2001) investigated alliances between large companies and entrepreneurial firms. Most benefits count for the large companies, as they are able to gain access to new technologies, talent and innovative capabilities. Advantages for entrepreneurial companies to set up an alliance with incumbent firms are gaining social legitimacy, access to financial resources and organizational resources as implicit knowledge, distribution, marketing, etc. The authors described the weak position of these entrepreneurial firms; history presents that once a real innovation gets successful by means of this type of alliance, the incumbent firm can easily drop the entrepreneurial firm which has not the resources to fight the 'big giant'. Such an alliance can be formalized by contracts, but often are necessary resources and ultimate benefits too unclear to specify these aspects detailed in a contract.

Commercialization

Elaborating on the network aspect for the generation or adoption of innovations, networks can also be used to commercialize innovations. Aarrika-Stenroos et al. (2014) investigated how divergent network actors help in commercializing and diffusing innovation. According the authors, a single company is rarely capable of generating successful diffusion during the commercialization of an innovation. Success requires cooperation from individual actors, organizations and stakeholders, which makes the network aspect of commercialization of crucial importance. By means of a synthesized literature research, they came to the following model of actors which contribute to the commercialization of an innovation, presented in Figure 3.4.

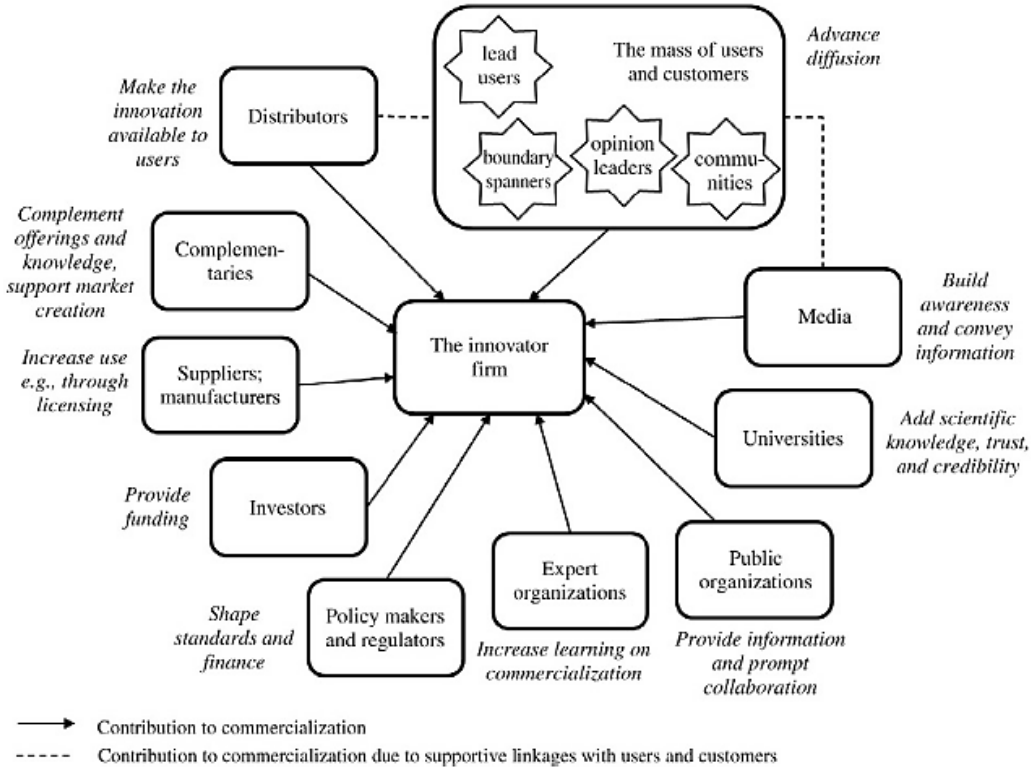


Figure 3.4 Ecosystem of Innovation Commercialization. Source: Aarrika-Stenroos et al. (2014)

The authors also came up with a pilot in the form of a pre-commercial project. In such a project, one of the parties of the above figure must be capable of commercializing the technology while the other parties typically play the roles of technology users (test the technology; be the first customer), scientific partners and technology developers. This pre-commercial project enables to pool expertise, share risks and costs, accelerate

development and bridge the research-industry gap. An interesting example of this is the agreement of Coolblue (a major IT webshop in the Netherlands) and PostNL (a major post order company in the Netherlands) to test sending orders on Sundays. Although technology is not that testable, it gives great insights for two leading parties in the buy-from-distance field in the opportunity to deliver orders at Sundays (PostNL, 2014).

Environment

Mintzberg (1979) created four dimensions to assess the environment: dynamism, complexity, diversity, and hostility. Dynamism is created by the stage of the life cycle of the industry and the pace of change of technologies that dominates the industry. Complexity arises through interconnectedness among constituents in the environment, which is above also shortly introduced under 'Alliances'. Diversity is related to the number of stakeholders, and hostility is related to the nature of competition in an industry and the extent of resources available to the firm. Pérez-Luno et al. (2014) conclude that of these four dimensions, dynamism has been shown to have a more significant impact on innovation; rapid change and uncertainties require quick organizational response and adaption by innovation. In dynamic environments, the more radical and internally generated the innovations, the higher the company's perceived and objective performance. On the contrary, in stable environments, the less radical and more internally generated the innovations, the higher the company's objective performance. Another interesting aspect influencing the environment is regulation. According McArthur & Nystrom (1991), in regulated industries incumbents tend to be passive and slower to change because they rely on regulatory barriers to slow new entrants into the market. Such constraints make the environment more stable, but incumbents should be aware of potential changes in regulators opinions.

3.6 Adoption of innovations

Adoption versus generation

Pérez-Luno et al. (2014) analyzed 381 Spanish firms in their strategies regarding innovation generation versus innovation adoption, combined with the extent of radicalness. They found that in dynamic environments, the more radical and internally generated innovations, the higher the company's perceived and objective performance. On the other hand, in stable environments, the less radical and more internally generated the innovations, the higher the company's objective performance. According the authors and other scholars, companies can thus better generate innovations than adopt innovations generated by others, because then they still have a first mover advantage. If a firm adopts innovation, it assimilates knowledge and technologies that have been developed elsewhere, and the innovation is only new to the organization. If an innovation is generated, the innovation is new to the whole environment, and there is thus a first-mover advantage.

Radical or incremental

McDade et al. (2002) investigated the organizational adoption of high-technology products "for use". For use means that these products are related to the making of the product or offering of the service, but are not directly tied to it, like "for manufacture" machinery. They used panel data of 400 firms in 14 different industries, and found out that firm size is important, but far less important than organizational preferences regarding adoption innovation. Another interesting finding is that a large portion of the market adopted new high-technology products of incremental impact, even though radical or semi-radical products were more preferred. A possible reason for this is a technological "lock-in". Most firms are practically forced to adopt an incremental product, given their previous investments in the technology integration or the supplier. Regarding decision makers, they found out that most decision makers are less willing to adopt radical technologies "for use", even though these radical products are mostly preferred. Managers must reduce the financial and technological risks, to compromise this perceived risk of adopting radical innovations. To reduce technological risks, an organization can create a prototype to use which enables the innovation to be tested and, if successful, creates a group of advocates for the new product within the firm. This in turn influences organizational preferences, which is an important element according their study for organizational adoption of radical high-technology products.

Influencing adoption

According Rogers (1995), size, organizational knowledge, formalization, centralization and interconnectedness are considered as determinants that influences the adoption of a radical innovation. In addition, Ziggers (2005) found that adoption of innovation is determined rather by organizational characteristics than by external factors such as external networks or competitive pressure. These organizational characteristics are critical, as they should address corresponding organizational barriers. Adoption new innovations results in high switching

costs, prior investments get obsolete and existing products, markets and organizational relationships might be cannibalized (Candy & Tellis, 1998). These barriers will always exist for radical innovations, in which the organization prior was active in particular market, thus resulting in leaving old technologies and procedures, which can be costly. These costs are a great argument for resistant managers, if the success of such an innovation is still uncertain.

Srinivasan et al. (2002) came up with a new construct which further explain the adoption of innovations: technological opportunism. The authors define this term as "an organization's ability to acquire knowledge about and understand new technology developments, which may be developed either internally or externally". This concept consists of two elements. The first is technology-response capability, an organization's willingness and ability to respond to the new technologies it senses in its environment that may affect the organization. As theoretical foundation they found that institutional pressure, complementary assets and perceived usefulness influence technological opportunism. As empirical foundation, they interviewed senior managers from over 200 firms. The results made clear that firms can become more technologically opportunistic by three different means. Firstly, focus on the future. Review current technology options and actively monitor new technologies. Be willing to cannibalize existing investments, if necessary. The second element is, let top management advocate the use, development or adoption of new technologies. This critical role of top management in championing the development of firm-lever capabilities is well-known in the literature, as described in chapter 3.2.1. Third, create of a more adhocracy culture. Such a culture values flexibility, entrepreneurship, creativity and adaptability, and is positive for technological opportunism. Key aspect in this is information acquisition.

The Deloitte and CIO Magazine Technology Trends survey of 2012 investigated innovation and technology trends by spreading a survey to 210 Dutch CIO's and Innovation managers. Interesting are the answers to the question regarding the biggest technology challenges/dilemmas, which are represented in Figure 3.5 below. The figure presents that the most difficulties arise when dealing with security and compliance when innovating with new technologies. Therefore, it is necessary to allocate resources to the security and compliance process. Other barriers found are architecture, the cost/quality dilemma and business value model.

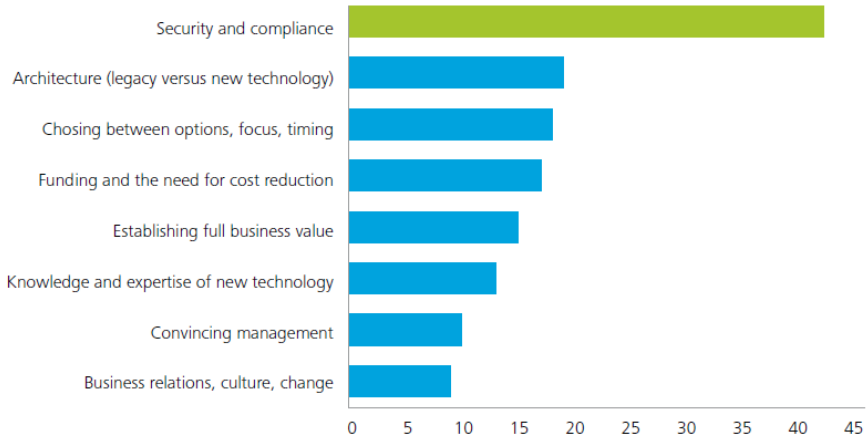


Figure 3.5 Business innovation barriers. Source: Deloitte (2002)

Perceived adoption factors

Many authors have written about (perceived) adoption factors which influence the organizational adoption of radical innovations. Studies of Tornatzky & Klein (1982), Rogers (1983), Teng et al. (2002), Moore & Benbasat (1991), Hameed et al. (2012), Sharma & Citurs (2005) are used to collect and summarize these factors. Some authors gave a single list, other authors divided factors in various categorizations. Moore & Benbasat noted the difference in adoption factors and perceived adoption factors, in which the spread of correct knowledge is a key determinant. Below a comprehensive list is given, sorted on amount of authors who mentioned it. The abbreviations used are respectively TK, R, T, MB, H, SC.

1) compatibility; T, R, TK, MB, H, SC
2) relative advantage; T, R, TK, H, SC
3) complexity; T, R, TK, H, SC
4) cost, profitability; T, TK, H, SC

5) communicability; T, R, TK
6) divisibility; T, TK
7) social approval, image; T, TK, MB
8) observability, visibility, triability; T, R, TK, MB

These factors basically define if the radical innovation is of such a type and function that organizations tend to adopt. These factors influence other, indirect stakeholder and environment factors, such as top management support, allocation of resources, IT expertise, competitive pressure, stakeholder demands, environment uncertainty, industry and regulatory pressure and standard stability (Hameed et al., 2012; Sharma & Citurs, 2005).

3.7 Summary of Literature

Many aspects defining radical innovations, its organizational adoption and relating factors have been discussed in the previous literature sections. Many forms of qualitative and quantitative research exists which investigate specific parts or the overarching view of the organizational adoption and acceptance of radical innovations. Starting with some definitions of radical innovation, this type of innovation is thoroughly described based on work of a high variety of authors. Characteristics of radical innovations are given, which have their influence in the structure and strategy paragraph. From an external perspective some literature is incorporated, after which the most important paragraph started: the adoption of radical innovations. This paragraph ends with an overview of adoption factors, which can be of great use for innovation managers to incorporate in their innovation policy. Further in-depth conclusions are not included in this paragraph, but will be drawn at the conclusion section.

As presented in Figure 1.1 of the research methodology, findings from the literature are directly used to enrich the scenarios and the recommendations to cope with the scenarios identified.

Part II

Background research

4. How do interbank payments take place?

4.1 Introduction and methodology

In order to understand what impact decentralized ledger platforms can have on interbank payments, it is necessary to know the basics of the current systems, architectures and practices which facilitate interbank payments. This chapter presents this information and describes mainly the current situation. In chapter 5, decentralized ledger platforms are presented and their potential future role in the interbank payment area is discussed. This chapter firstly introduces the payment infrastructure, after which the area in which DLPs can have greatest impact is discussed: correspondent banking. Furthermore, various payment channels are discussed and compliance regulations are presented.

Methodology

This chapter applies a thematic analysis (Guest et al., 2011) which is a commonly used way to collect and structure data for a qualitative research. In this case, it involves collecting and examining information that already exists and is easy to get, such as company records within the project organization at Rabobank, published government reports, contributions from experts from Rabobank and Dutch consulting company Ordina (in special payment consultant Daniel Hes), industry papers from international consulting and advisory companies, whitepapers from companies active in the industry and news bulletins on the Internet. Figure 4.1 presents the type of resources used and gives an indication from the subjectivity of the information.

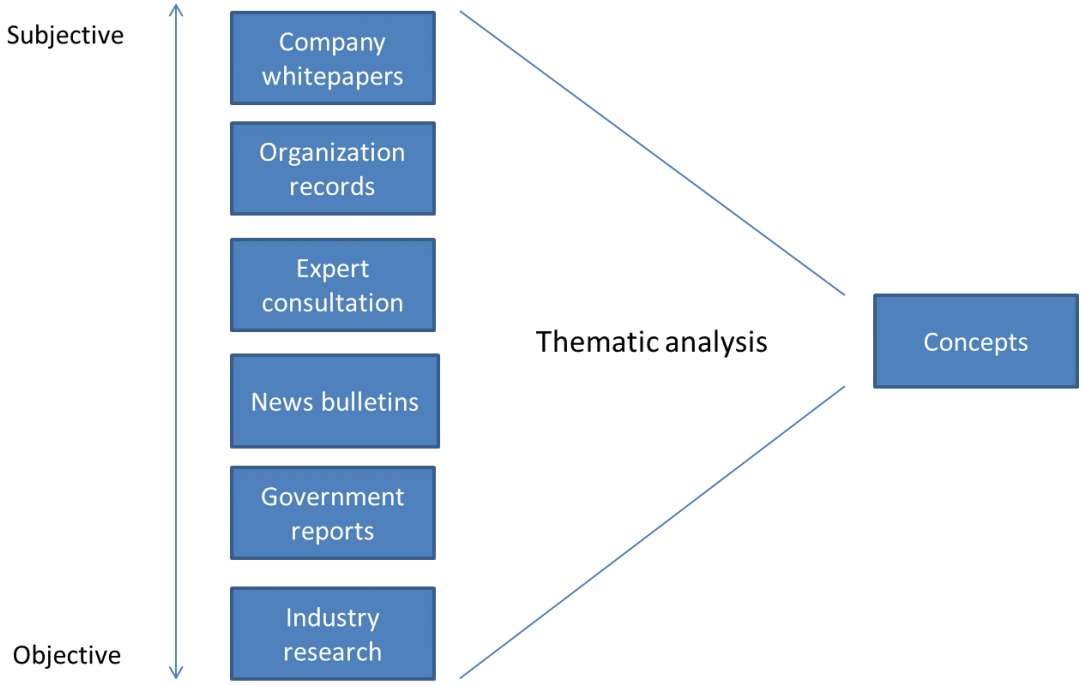


Figure 4.1 Background research methodology

The process used to collect and process the information to achieve a more complete characterization of the context is a thematic analysis (Guest et al., 2011), in which the so-called free-flowing text is analyzed by selective coding (Bhattacherjee, 2012). This selective coding involves identifying a central category or a core variable and systematically and logically relating this central category to other categories. The identified core concept is interbank payments, and all other variables, categories and relationships are systematically connected to this concept.

4.2 Payment Infrastructure

Although from an end-user perspective a payment simply flows from the sender account to the receiver account, the whole infrastructure of participating actors and services is more complex. Different financial services and systems target one or multiple financial layers, and it is necessary to have a basic understanding of this infrastructure to visualize to which areas a DLP might bring change. An opinion paper of the Euro Banking

Association (EBA) on the next generation of alternative retail payments includes an overview of the current setup, including a range of new financial services. This overview is visualized in Figure 4.2.

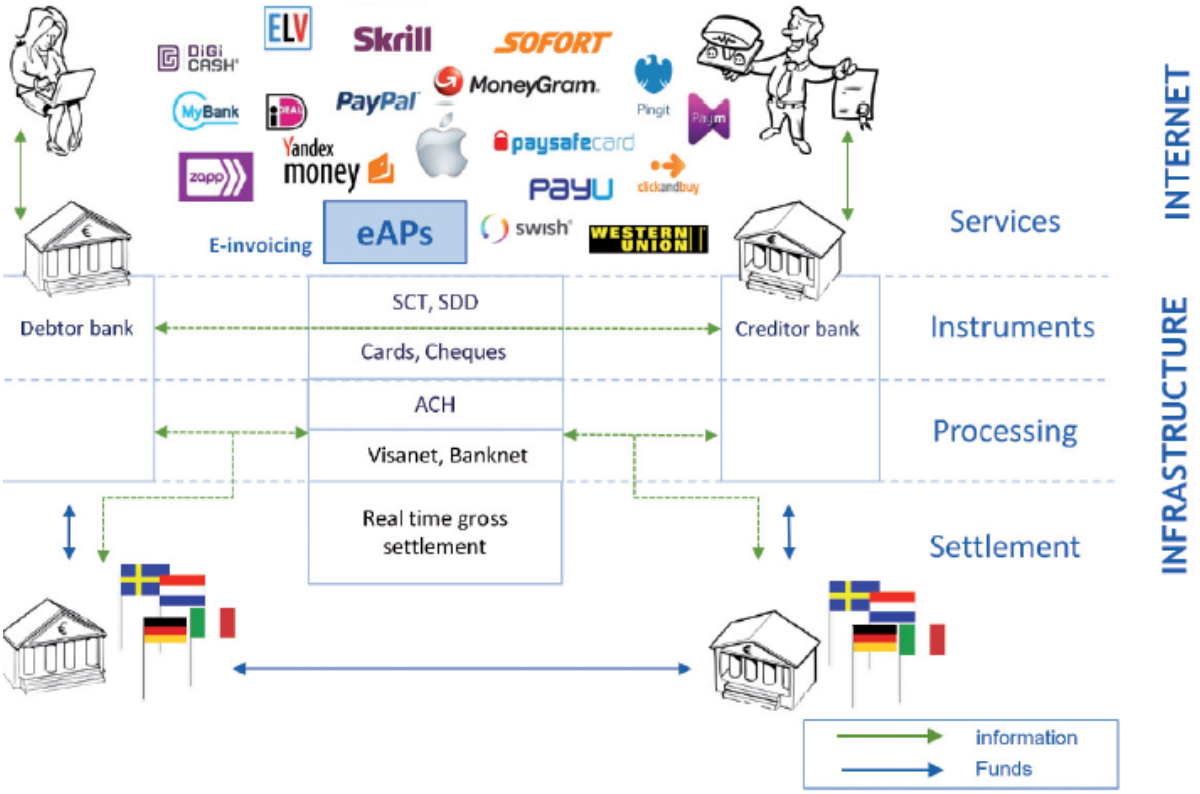


Figure 4.2 A stacked ecosystem evolved on top of the "traditional" infrastructure for SCT, SDD, cards and cheques. Source: EBA (2014)

In a cited report of the ECB (2010) about the payment system, these layers are described as following:

- The Instruments: A tool or set of procedures enabling the transfer of funds from a payer to a payee. The payer and payee can be one and the same person. There are cash and non-cash instruments. SCT, SDD concern SEPA payments, further explained in paragraph 4.3.
- Processing: The performance of all of the actions required in accordance with the rules of a system for the handling of a transfer order from the point of acceptance by the system to the point of discharge from the system. Processing may include clearing, sorting, netting, matching and/or settlement.
- Settlement: The completion of a transaction or of processing with the aim of discharging participants' obligations through the transfer of funds and/or securities. A settlement may be final or provisional.
- Services: This is a new layer, which contains services accessible for end-users. These services rely on the other three services.

Whereas most new fintech innovations try to nestle in the Services layer, DLPs as Ripple try to surpass the overall financial architecture and become an alternative for ACHs (Automated Clearing Houses) (EBA, 2014). As explained in the next paragraph, DLPs can improve the current practice of correspondent banking by enabling a whole new network of participants, instead of improving only a part of the chain.

4.3 Correspondent banking

International fund settlement is mostly done by a technique called correspondent banking. A correspondent bank can conduct fund transactions, accept deposits and exchange transactions-related documents on behalf of the other financial institutions. Correspondent banks are more likely to be used to enable transactions to foreign countries, and act as a domestic bank's agent abroad. This way a complex network manifests itself for which a lot of contracts, technical implementations and regulation are needed. Currently the correspondent banking is seen as reliable, but also as outdated, slow and very expensive. The infrastructure between banks have not yet fully benefitted from the technological breakthroughs of the last decades.

A correspondent is a bank that handles the local leg of a business transaction and the associated documents, as an agent of a bank in another city or country. The common practice in the setup of a correspondent banking relation between banks involves three major activities. First, set up a contract containing all conditions. This would include intraday funding, options for same day processes, lifting fees and the way of communicating (channel and keys). Second, opening nostro and vostro accounts. Third, implementing the communication keys and channel of choice. Cross-currency transactions facilitated by multiple correspondents involved in multiple continents might take 3-5 business days due to different settlement procedures and different opening hours. These correspondent bank payments cost about €10, although this differs for each transaction. Correspondent banks may also present the possibility of same day payments in the form of a credit payment, but this is significantly more expensive.

Nostro/Vostro

Nostro and vostro accounts are opened by the two banks setting up a correspondent banking relationship. These accounts are special accounts held by the bank to receive and process each other's funds. When a bank would open an account at any other bank this will be a nostro account. A nostro account is your account of your money, held by the other bank. Since most of these relationships are bilateral, vostro accounts are also opened within your bank. A vostro account is another bank's account holding their funds, in your system. Using vostro and nostro accounts, funds can be transferred from one bank to another simply by debiting the sender bank'. When the beneficiary bank receives the funds (on the nostro account of the sender bank), it will process an internal settlement towards the beneficiary client account.

Funding the nostro accounts is not related to a single transaction. Funding or nostro cash management is done end of day based on overall position of the bank at the nostro account across all business lines – short or long and the forecast of activity for the next day. Based on this information – if for example the GBP (British Pounds) position of a bank is short, the treasury department buys GBP in the wholesale FX market or sells excess GBP if the position is expected to be long.

Multiple banks in a payment

The world knows thousands of banks that hold even more branches. Therefore it is not manageable to set up correspondent banking contracts with all banks and all branches in the world. This would take too much time and costs too much to uphold. Common practice for a bank therefore is to have one, two or maybe three correspondent banks in a country. The selected correspondent bank then uses its local network to forward the payment. Next to the sender bank, no more than three different banks may process one and the same payment within the SWIFT network. The identities of the involved banks are not always known between the sender and beneficiary bank.

Fees

Besides fees owed to the clearing house, additional fees will probably have to be paid to the correspondent bank for each transaction. These fees are called lifting fees. Whether the bank, beneficiary or paying party will pay these fees is determined per client and transaction. These fees heavily depend on local legislation. For instance, in the US the first bank to receive funds intended for another bank holds the right to deduct handling fees from the received fund. Because of all these fees, the concept of gross and net payments arises. In other words, the amount you send might differ from what is received in a negative way.

Central banks and validating positions

A very prominent player in any monetary system is the central bank. In the European Union, the European Central Bank (ECB) is the entity which creates Euros, regulates national central banks and influences inflation. The ECB therefore is the holder of all Euros and it issues positions to local central banks. As such all banks holding Euros must report to the ECB their Euro position. This is also the case for other currencies. For instance, all Dollar positions are reported to the Federal Reserve and Pound Sterling positions to the Bank of England. In this regard, SWIFT, explained below, only supplies a secured way of communicating positions shifts in any currency so that at the end of each day the bank can report to the right authority.

4.4 Channels

Payment messaging - SWIFT

SWIFT stands for Society for Worldwide Interbank Financial Telecommunication and is a messaging standard and connectivity hub for facilitating cross-border payments worldwide. More than 8.000 financial institutions and over 200 countries are active in this network. The network is based on correspondent banking which means that a network of "trust" relationships have been set up between banks. These banks communicate with each other using a standard messaging system native to the SWIFT network. That way not all banks need to have agreements in place with all other banks around the world to communicate and send funds, but rather use the trust that has been set up with a mutually trusted bank. For instance, if banks "A" and "C" are not connected in the SWIFT network, payments can be routed through them by exchanging payment messages via mutually trusted bank "B", hence the term correspondent banking. Note that SWIFT does not actually settle these transactions; rather, SWIFT provides a messaging system for banks to communicate payment and settlement information. Instead, the correspondent banks themselves provide the funds and infrastructure necessary to settle transactions, as explained above.

This system was created in 1973 when the internet, of course, was not available for this type of communication. In the present day, executing transactions by means of the SWIFT network and correspondent banking is regarded as expensive, complicated and slow. Although the messaging part is real-time, the actual change of banking positions takes a few days. Below Figure 4.3 presents a diagram which shows how a SWIFT payment is initiated.

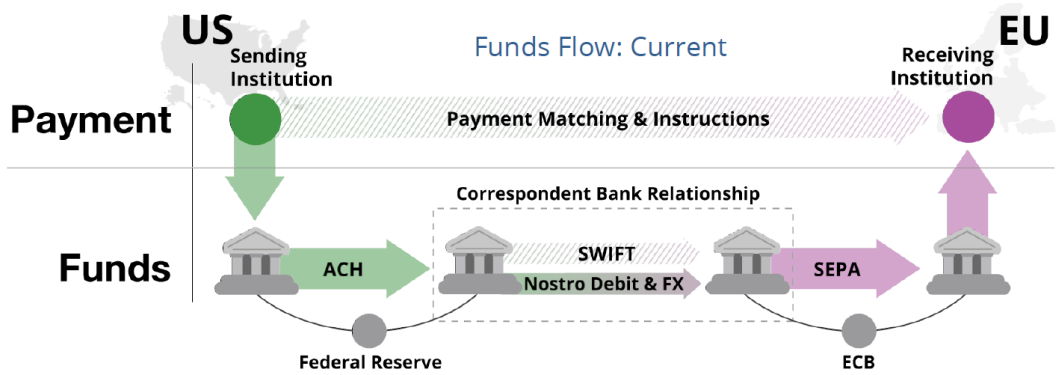


Figure 4.3 Current situation SWIFT payment. Source: Ripple Labs (2014b)

Keys

Relationship Management Application (RMA) is the norm for exchanging "keys" in the SWIFT network. All key management is based on the SWIFT PKI that was implemented in SWIFT phase 2. A Bilateral Key allows secure communication across the SWIFT Network. The text of a SWIFT Message Types (MT…) together with this authentication key is used to safely send information across the SWIFT network. These RMAs are setup between banks and managed by the International Markets department of a bank.

Clearing and Settlement

Financial transactions take place through clearing and settlement. Clearing is the whole process from the point in time a trade is initiated till the final settlement is made. Settlement is the last stage in the process where the involved clearing house will transfer the funds. DLPs such as are only a clearing mechanism, and if implemented will rely on the current settlement mechanisms. Settlement is executed by the TARGET2 system within the EURO-area, while clearing currently is performed by clearing houses which can be Equens, EBA Clearing, or also TARGET2.

Channels offered by the EBA Clearing (European Banking Association) are used for clearing funds directly between European banks. EBA Clearing offers three separate payment platforms called EURO1, STEP1 and STEP2 (or PE-ACH) to transfer funds.

- EURO1 focuses on Single, High Value and Urgent payments and is operated by SWIFT. Banks are processing payments through the SWIFT network. EURO1 is similar to STEP1.
- STEP1 focuses on Single, High Value and Urgent payments for small and medium sized banks and bank to bank transfers. All payments are being processed through the SWIFT network. The process of accepting payments is different due to the nature of the payment admitting party (e.g. Banks and

Retail). The main difference between EURO1 and STEP1 is that a STEP1-bank settles via a EURO1-bank. The admission criteria for a EURO1-bank are therefore more severe. For example a EURO1 bank needs to deposit collateral to EBA Clearing to gain access to the EURO1-platform. Also EURO1-banks grant limits to each other. These limits together form a minimum and maximum bandwidth in which the actual netted position can fluctuate. Very high value trades, performed by a bank's treasury desks, involves currency amounts as high as or higher than these minimum and maximum, therefore these trades are made by TARGET2.

- STEP2 focuses on bulk and non-urgent payments (bulk channels or direct link channels) and is run by SIA S.p.A. In this network all SEPA Credit Transfers (SCT), SEPA Direct Debit Core (SDD Core) and SEPA Direct Debit B2B (SDD B2B) are processed. With this channel no correspondent bank is needed.

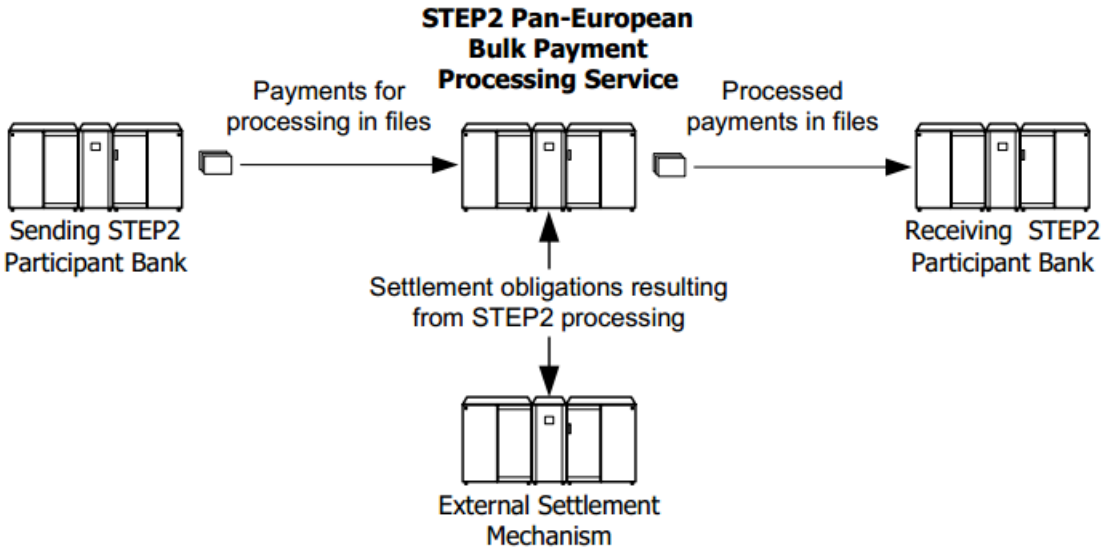


Figure 4.4 STEP2 payments. Source: EBA Clearing (2006)

Equens

Equens is a Dutch clearing house and also clears SEPA Credit Transfers (SCT), SEPA Direct Debit Core (SDD Core) and SEPA Direct Debit B2B (SDD B2B), therefore directly competing with EBA STEP2. At this point Equens is mainly used for national fund clearing, card clearing and iDeal transactions.

TARGET2

TARGET2 (Trans-European Automated Real-time Gross Settlement Express Transfer System) is an interbank payment system for the real-time processing of national and cross-border transfers throughout the European Union. TARGET was replaced by TARGET2 in November 2007. TARGET2 is the Real-Time Gross Settlement (RTGS) system made by Eurosystem. Payments made by TARGET are immediately settled on a continuous basis in central bank money with no pre-defined limit. TARGET2 settles inter- and intra-bank positions for market making and is mainly used for large volume EURO payments. TARGET2 is operated on a single technical platform. The business relationships are established between the TARGET2 users and their National Central Bank. Due to its design to process large volume payments this system is one of the largest processors in the world in respect to volume. The main objective of TARGET2 is making a more efficient cross-border payment market in the European payment area. Although TARGET2 is in itself real-time, it still depends on the back office systems of the sender and beneficiary bank. Most major banks have automated this process, but some small banks not yet and therefore the point to point payment is still not real-time.

4.5 Current standards

Standardization is of significant importance to connect different payment networks and mechanisms with each other. A formerly used standard in the financial sector was ISO 8583, which is currently being replaced with the extensible ISO 20022 standard, in which SWIFT has played a great role. The 20022 standard matured by using it for the SEPA credit transfer, and does currently address five different business domains in the financial industry: Payments, Securities, Trade Services, Cards, FX (ISO 20022, 2015).

Authority and organization of these standard committees are crucial for the adoption and continued development of a standard. The ISO (International Organization for Standardization) is an independent and non-governmental membership organization and the largest developer of voluntary international standards, active in many industries. Their authority and consequently the continuing developments depend on the committees active and the involvement of its members. Strong authority is beneficial for reducing a proliferation of standard extensions and needs to steer further development, while its power should be shared or divided among the most influential players in the specific industry, in order to reach momentum.

4.6 Compliance

For intrabank payments, many compliance issues arise. These issues are mediated by several regulations, which are described below.

Know Your Customer (KYC)
Financial Institutions need to comply with the latest KYC legislation. KYC means that a bank knows its customer, which can be an individual, an intermediary, a business or an authority. KYC requirements generally address the customer's identity, affiliations, and transaction behavior. This means that a bank should know at each moment in time who its customers are and what transactions took place from or to specific customers.

Anti-Money Laundering (AML)
Regulatory banks need also to comply with AML regulations, in order to ensure that the payment network is not used for money laundering purposes. This monitoring is mostly done after payments have been processed by algorithms running on the bank's ledger, but some banks also check this upfront. Certain algorithms are used to distill abnormal behavior in order to determine the AML risks.

Financial Action Task Force (FATF)
The FATF recommendations are developed with the objective of preventing terrorists and other criminals from having unfettered access to wire transfers for moving their funds and for detecting such misuse when it occurs. Specifically, it aims to ensure that basic information on the originator and beneficiary of wire transfers is immediately available. In 2006 the European Union (EU) has translated and adopted Special Recommendation (SR) VII of FATF in the Regulation of the European Parliament (the EU Regulation 1781/2006), dated July 7th 2006 to a new version: the FATF 16. Besides the EU, most countries adopted and translated FATF SR-VII in a local regulation. These countries are currently working on local legislation to make sure they comply with the new FATF 16 requirements. The main FATF 16 revisions deal with full beneficiary information ("Qualifying cross-border Electronic Funds Transfer should be accompanied by full and accurate originator information and full beneficiary information") and with the role of an intermediary financial institution ("An intermediary FI should take reasonable measures to identify cross-border wire transfers which lack full originator information or full beneficiary information"). Although, at this moment only account number and beneficiary name are required for a money transfer.

Sanction lists
Sanction lists hold information on persons, countries of currencies for which a bank is not allowed to process payments for. A recent example of persons being added to these lists, originated from what happened in Ukraine this year and all consequences involved. An elaborate list of Russian and Ukrainian individuals has been published for which no transactions are allowed (Wikipedia, 2015).

An official list kept is the OFAC list (OFAC, 2015), powered by the US Government. There are also other US and EU lists which are very detailed and include companies, individuals, and even boats or airplanes. Each individual bank can add entries to these lists, and outgoing payments are screened against these lists before they are send. An example of an international restriction is that dollars are blocked from Cuba, and if a Dutch bank initiates a dollar payment to Cuba, the send funds will be blocked at one of the correspondent banks and it can take years before this money might be send back.

PSD
The ECB has issued some directives regarding payment legislation, intended for the entire SEPA area in 2009, namely the Payment Service Directive (PSD). This directive was adopted into local legislation and implemented

throughout 2013 and 2014. Among other rules, the legislation provides compliancy rules regarding the information stated for each payment for reconciliation. For instance, the way a transaction is shown on a bank statement is determined, as well as the information stated in the message. It is still unclear whether the provision on allowing third-party payment providers (TPPs) to directly access customer bank accounts will be included in the final proposal of the PSD2.

MOT

The MOT ("Melding Ongebruikelijke Transacties"; Reporting Unusual Transactions) describes whether or not a transaction is deemed unusual, which is determined by a list of indicators set by the ministry of Finance and Justice. Included in this list is:

- unusually high cash withdrawals and payments in cash;
- higher than normal Forex transactions;
- transactions that surpass a usual limit, that cannot be explained by the normal conduct of the business.

The reported case must contain the following data, if possible:

- the identity of the client;
- the reason, timestamp and place of the transaction;
- the amount;
- origin of the money;
- why the payment is unusual.

Summary of compliance

It is clear that many different compliance regulations are involved in payments. Banks are obligated to regulatory instances to comply to this regulation, in order to keep their banking license. Multiple different systems are nowadays in place which automatically scan incoming and outgoing transactions on the completeness and correctness of available payment information. If the corresponding payment information is incorrect or incomplete, a transaction can be put in a queue to be manually verified, or it can be cancelled.

Regarding this chapter, most important is that currently all necessary compliance systems and regulatory frameworks are already in place. With the potential adoption of a decentralized ledger platform, only the channel through which a payment flows will change. As sending information or receiving information through a channel as SWIFT or TARGET2 is just one step in the process, the assumed change to current compliance procedures is regarded to be manageable. Besides, due to the open source nature of these DLPs the threshold is significantly lowered to develop (collaboratively) compliance applications which can be built on top of the DLP infrastructure.

5. Decentralized ledger platforms

5.1 Introduction and methodology

Decentralized ledger platforms and crypto currencies are closely related, but are also independent from each other. Decentralized ledger platforms can exist without a crypto currency, for example Open Transactions (Cryptocoinsnews, 2014). Ripple for example uses only its native crypto currency, XRP, and enables to issue Bitcoins and other altcoins on the ledger in the same way as fiat money: as liabilities. This chapter will explore the concepts of crypto currencies and decentralized ledger platforms, in this order. As most DLPs are built on a sort of a crypto currency, first crypto currencies are analyzed followed by an analysis of DLPs, provided with some examples. Chapter 6 contains an elaborate case study of the DLP Ripple. Many technical terms and precise definitions are used in this chapter, so it might be beneficial to keep an eye on the Glossary while processing this chapter.

Methodology

By means of a thematic analysis (Guest et al., 2011) and the selective coding technology (Bhattacherjee, 2012), the main concepts and ideas are analyzed. The same type of resources is used as presented in Figure 4.1. The difference with the methodology from the previous chapter is that the main concepts researched are crypto currencies, and decentralized ledger platforms. Relevant and related concepts found are presented in this chapter. Regarding the resources, an academic paper about Bitcoin adoption factors is used (Spenkelink, 2014), combined with papers from a list of academic research made by Brett Scott (2015), containing more than 300 papers about Bitcoin and other crypto currencies.

5.2 Crypto currencies

Main concept of crypto currencies

A cryptocurrency is a currency which each individual may accept to hold and pay with, if the beneficiary also accepts this as currency. The main use case of cryptocurrencies is to provide a fast way to transfer funds globally, with minimal transaction costs, while being independent from a third party to handle the transactions. Bitcoin transactions are irreversible, this way the recipient of the funds is sure that he owns the funds for good and therefore less trust is needed to make sure the other party is reliable.

Crypto currencies are administered in a so-called “blockchain”, which is a chain of blocks with each new block containing the most recently validated transactions. Each block is verified, and after verification by reaching consensus among all nodes, the ownership balances are updated. Bitcoin uses miners, which are users that enable their computing powers to verify all transactions in the blockchain and broadcast this across the Bitcoin network (Babaioff, Dobzinski, Oren, & Zohar, 2012). This activity is paired by solving computationally hard problems, in order to ask a tremendous amount of processing power to verify Bitcoin transactions. Solving these problems proofs that they processed the transaction and that it is legitimate. This concept of “proof of work” is essential to cryptocurrencies because it guarantees the integrity of the blockchain.

Definition of crypto currency

Trying to define crypto currencies is a complex task. As the concept of crypto currencies is only yet 5 years old, numerous terms have risen which describe the same, or something completely different. Current popular terms for crypto currencies are: crypto currency, digital currency, electronic currency, virtual currency, Bitcoins, altcoins. Researchers give different definitions for these terms, and even worse, give the same definitions to different terms. In this research the term “Crypto currency” is used, as it is the most suitable term to describe the concept according the author.

A Bitcoin is a crypto currency, but not all crypto currencies are Bitcoins. Altcoins (abbreviation for alternative coins) are crypto currencies, excluding Bitcoins. Electronic currency and digital currency is too confusing with electronically presented fiat money, and virtual currency misses the concept of cryptography. The term “Virtual currency” is used in this research, but only addresses assets which are issued by one party on the ledger as a liability. This party owns and controls the distribution of this asset. A few definitions found in the literature are:

"Crypto Currencies is a type of digital currency which relies on cryptography, usually alongside a proof of-work scheme, in order to create and manage the currency. A decentralized network of peer-to-peer computer nodes working in sync creates and verifies transactions of transfer of said currency within the network"

Ahamad et al., 2013

"… a virtual currency is a type of unregulated, digital money, which is issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community."

ECB, 2012

"A Cryptocurrency is a modern digital medium of exchange. It is a new decentralized, limited and peer–to–peer payment system. Most cryptocurrencies are created to introduce new units of currency, whose total amount is limited. All cryptocurrencies use cryptography to control the creation and transfer of money."

Wiatr, 2014

Most papers about crypto currencies and/or the Bitcoin do not give definitions, but rather name the unique characteristics what a crypto currency makes a crypto currency. These characteristics are summarized:

- decentralized, peer-to-peer;
- code similarity;
- unregulated, issued by its developers;
- uses cryptography for security and authenticity.

The best known crypto currency is the Bitcoin. The Bitcoin is in 2008 invented by Satoshi Nakamoto, which is an anonym for a person of a group of persons, and has currently a market capitalization of $ 3,185,644,272 (Coinmarketcap, 2015). Next to this, almost 500 altcoins are created which all have some or many similarities with the Bitcoin. The 5 most valued crypto currencies are at the moment of writing Bitcoin (BTC), Ripple (XRP), Litecoin (LTC), BitShares (BTS) and Paycoin (XPY) (Coinmarketcap, 2015). In Table 5.1 below the market capitalization and market share of these crypto currencies are shown:

Name	Currency	Market capitalization	Market share
Bitcoin	BTC	$ 3,185,644,272	83,5 %
Ripple	XRP	$ 520,090,905	13,6%
Litecoin	LTC	$ 50,858,619	1,3%
BitShares	BTS	$ 29,778,096	0,8%
Paycoin	XPY	$ 29,219,407	0,8%
Total (of 493 altcoins)		$ 3,972,653,653	100 %

Table 5.1 Market capitalization and share of top 5 crypto currencies. Source: Coinmarketcap (2015)

Hardwin Spenkelink, another graduate student from the University of Twente created this same table in May 2014 (Spenkelink, 2014). That time, the total market capitalization was more than 8 billion, Bitcoin had a market share of 93,5 % and Ripple a market share of 0,5 %. Conclusions can be drawn that faith has reduced in Bitcoin and crypto currencies in general, and that Ripple has gained most market share. Bitcoin is still by far the greatest.

A very important note to make is the difference between the term bitcoin and Bitcoin. As described by Ametrano (2014) and many others, the Bitcoin refers to the coin, abbreviated with BTC. This coin can be used as money. The bitcoin refers to the underlying architecture of the blockchain. The bitcoin network is revolutionary and all altcoins and crypto 2.0 solutions (non-financial blockchain solutions) build on this architecture. The coin Bitcoin itself is just a coin and may lose its right to exist on the long term, but bitcoin network (the blockchain) has great future possibilities and will alter the financial world, as also declared by the new Rabobank CEO Wiebe Draijer (RTL Nieuws, 2014). The discussion in the rest of this chapter is about crypto currencies in general, but as Bitcoin is by far the greatest and best-known example, it will often be taken as vantage point.

Characteristics of crypto currencies

Decentralized

A first characteristic is that crypto currencies are meant to be decentralized. This means that there is no central operator who provides the servers which run the blockchain, but that each willing individual or firm can run this blockchain. If a network is ran by different individuals and firms over the world, there is no single point of failure and the network will not likely fail due to the spread out backup. This enhances faith in the network, as one not has to trust one single huge provider, but one can trust a mass of small providers which are less likely to fail simultaneously. Due to the lack of adoption some crypto currencies are yet somehow centralized, but if successful the coin will be completely decentralized.

Code similarity
As the majority of crypto currencies is based on the code of Bitcoin or Litecoin, crypto currencies look a lot like each other (Fastcolabs, 2014). If someone wants to host another crypto currency, he needs to know a programming language like C++. The source code of Bitcoin can be downloaded, preferred changes can be implemented and you have another crypto currency. This is called a 'protocol fork'. Most crypto currencies are open source, which means that their code is freely available and can be verified by each willing individual.

Unregulated
Currently, crypto currencies are not regulated. Crypto currencies are issued by developers, not by governmental bodies, and therefore in principal unregulated. Regulators cannot influence the coin or its price, and cannot freeze accounts of certain people. This gives freedom to the users of crypto currencies, but reduces the instruments of a government to influence. In December 2014, regulators came with a first draft of a Bitcoin regulation named the BitLicense (Financial Times, 2014). If such a regulation becomes generally accepted by regulators, it will bind individuals and companies working with crypto currencies, but will still not govern the currency itself. As the developers are in control of the currency, they also determine how many coins exist. This differs per crypto currency. Bitcoins are still being mined (found), Ripples are created at a fixed amount at the start at the protocol, and Stellar creates each year 1 % extra Stellars in order to keep up with inflation.

Cryptography
Crypto currencies are cryptographically secured. Users hold public private key pairs, where the public keys function as account numbers for identification, and the private keys function as a password, enabling these users to spend money from their accounts (Verbücheln, 2015).

Use cases of crypto currencies
There are many use cases for crypto currencies, and even more for crypto 2.0 solutions. Examples of these uses cases are c2c, c2b, b2b and bank to bank (interbank) payments. Crypto currencies can make intermediary parties as Payment Service Providers and banks obsolete, but also one type of intermediary party collaborating with a crypto currency platform can make the other players obsolete.

5.3 Decentralized Ledger Platforms

This research investigates decentralized ledger platforms, which are strongly associated with crypto currencies. Examples of these platforms are Ripple, Stellar, Hyperledger and Open Transactions, which are further explained in paragraph 5.4.

Definition
Decentralized Ledger Platforms differ from crypto currencies in a way that the first often incorporates the latter. A DLP often use crypto currencies for the efficient and effective functioning of the protocol, and is thus more than only a crypto currency. Basically, a DLP is a ledger with issuances of different types of assets. These assets can be fiat currencies, crypto currencies, loyalty points, etc. Basically everything what has value and ownership can be appointed, can be issued on such a ledger, and users can buy or sell amounts of this value. As the definition of a decentralized ledger platform does not yet exist, it is hereby defined:

A DLP is a decentralized shared ledger on which each user can issue or hold one or more assets or liabilities, for example crypto currencies, stores of values, or virtualized fiat money, which can be used to carry out near real-time cross-currency payments.

Open architecture

Important to note is that these platforms are very fundamental and created to design an underlying architecture, according an interview of IFF Technology with Ripple Labs (2014). An easy metaphor is the protocol SMTP. SMTP is created in 1982 and defined rules for sending and receiving emails. Following these rules, independent and different email service providers (Yahoo, Hotmail, etc.) were able to let their users send mail to each other by collaboratively agreeing on this protocol. Decentralized ledger platforms also bring out such a protocol, and hope for adopters to use their protocol. As most of these platforms are open source, one can speak of an open architecture in which each interested party can build applications on top of it. This open architecture allows thus to be further developed in the future, according the wishes of the adopting party or its customers.

Mining versus Consensus

An important difference between most crypto currencies and decentralized ledger platforms is the verification process. Bitcoin-alike crypto currencies depend on miners, as explained above. Common critique on this mining activity is that it requires huge amounts of computation power, thus great amounts of energy, which is not sustainable. Miners need to be rewarded, which currently takes place by distributing new Bitcoins to these miners. But, once all Bitcoins are mined, miners need extra rewards for their energy put in the verification process and will start asking fees. This may make a Bitcoin transaction more expensive in the long term.

Most DLPs rely on a consensus mechanism, based on the Byzantine Generals Problem (Ripple Labs, 2014). This means that only minimum percentage of servers needs to verify a transaction, before it can be added to the ledger. It provides the same security and authenticity as the mining process, but requires significantly less energy and the whole consensus process can be finished in seconds. Also, it is not threatened by the 51 % attack which are feared by Bitcoin users, which means that once a single actor has 51 % of the processing power it can create invalid blocks and enabling to double spend Bitcoins (Ametrano, 2014).

Ledger fork with consensus

The greatest risk for a consensus protocol is to experience a ledger fork. In this case, two separate ledgers are in existence for one protocol due to a consensus problem. This forms a problem for any blockchain technology, as there are 'two version of the truth'. This happened recently with Stellar. 5 December 2014, news was broadcasted that the Stellar network was forked (a ledger fork) due to flaws in the consensus algorithm. These flaws caused that the network moved from a majority agreed fork, to a minority fork, which invalidated a number of transactions. This may have led to double-spends, which cannot be reconciled (Coindesk, 2014).

Other validation mechanisms have already been created, for example Proof of Stake (validating power is related to ownership of crypto coin) or Proof of Burn (burn crypto currencies to become a validator). The main thought behind such a validation mechanisms is that validators should pay something of value or do significant effort while validating, in order to keep a single actor from suddenly delivering all validating power while it is able to falsify the ledger. With 'payment' or effort requirements, no actor should be able to gather so many resources that it can get a majority vote.

Decentralized versus Distributed

For the design of this research, the difference between a centralized, decentralized or distributed network is of great importance. These network architectures are firstly described by Paul Barak (1964). In a central network there is one rule maker who connects all participants. This is clearly not the case with DLPs, as nodes can connect with each other without going to such a rule maker. In a decentralized network, there is a select group of entities that is able to get access to the network, which can provide proxy access to its members. Distributed networks are defined that access is available to anyone who connects to it and information flows through the shortest of cheapest path in the network without any regard to (semi) central nodes. An example of a distributed network is the Bitcoin blockchain where everyone can hold funds independently of central actors. These network architectures are visualized in Figure 5.1 below.

Regarding Ripple and some other DLPs, it is technically a distributed network in which each willing individual can run a validating node and create a wallet, just as with the Bitcoin. The difference is that Ripple's market orientation works towards a more decentralized setup. In this decentralized setup, the validating nodes choose themselves which other validating nodes (other central actors) it trusts to validate the transactions, and each node provides access to the ledger for its members, the wallet holders. In Ripple, a wallet holder cannot send

transactions to other wallets without going (automatically) through the gateways which provide the wallets, which makes the setup of the Ripple network decentralized in its nature.

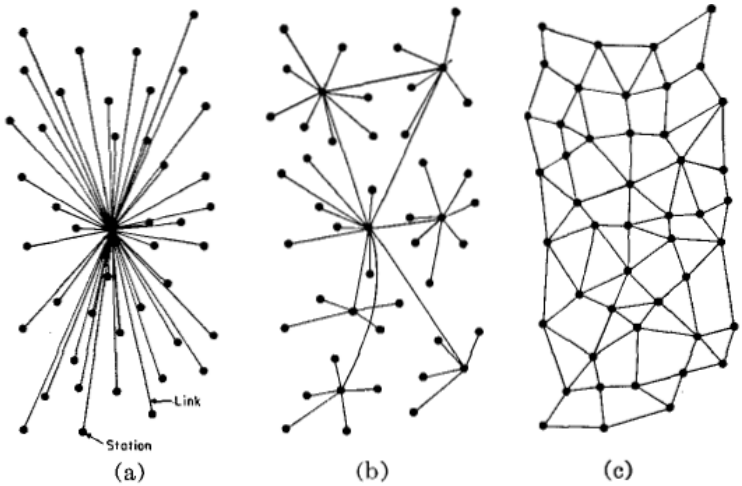


Figure 5.1 (a) Centralized. (b) Decentralized. (c) Distributed networks. Source: Baran (1964)

Crypto currencies versus Virtual currencies

An important distinction used in this research is between the crypto currency and virtual currency. This research uses the term ' virtual currency' to describe a virtualized fiat money, which is issued by only one or a few financial institutions and thus only redeemable by these institutions. In contrast, crypto currencies have a global reach and acceptance and are at every entry point redeemable for fiat money. Virtual currencies have thus a reach specifically chosen by its issuers which enables better oversight and security.

5.4 Examples of decentralized ledger platforms

In this paragraph the most interesting examples of decentralized ledger platforms are discussed. Decentralized ledger platforms are not defined by the technologies and network they use, but by the end product they deliver.

Ripple

Ripple is an innovative payment protocol and processing infrastructure, see Figure 4.2, that enables near real-time global payments at a lower cost than traditional means, which takes currently place by correspondent banking. As Ripple is, in eyes of the author, the most promising and best matured decentralized ledger platform, it is further described in a case study in chapter 6. Ripple Labs employs currently 94 people according their website (Ripple Labs, 2015).

Stellar

Stellar is a protocol fork of Ripple, created in early 2014. A fork is a copy of the source code, which is (slightly) changed. Stellar is started by former Ripple Labs employee Jed McCaleb and targets directly the end-user, while Ripple targets financial institutions. A main difference is that Stellar creates each year 1 % extra coins, in order to keep up with inflation. Stellar currently employs 18 people, and has another 10 advisors according their website (Stellar, 2015).

Hyperledger

Hyperledger is an open source decentralized network that allows customers or firms to issue their own cryptographic assets. These assets can represent fiat currencies, loyalty programs, commodity backed tokens, fractional ownership, anything of value can be recorded and ownership transferred. Hyperledger started in July 2014, and seems still in a startup phase. At first glance, it seems that Hyperledger is in functionality equal to a part of Ripple; digitizing assets. Hyperledger does also have a consensus mechanisms based on the Practical Byzantine Fault Tolerance algorithm, but does not have its own crypto currency. Hyperledger is designed to be run as multiple inter-operable consensus pools with different participants, with each pool processing multiple distinct ledgers. Each user can create its own ledger and manage its issuances (Hyperledger, 2015). Hyperledger

consists of 3 employees who are the founders, and 5 advisors. Hyperledger is open source and free to use, and Hyper, the commercial entity that created Hyperledger, plans to release higher level services, products, and support.

Open Transactions

Open Transactions is decentralized open source financial crypto library, which allows users to issue and manipulate digital assets. Open Transactions include a large variety of financial instruments, including smart contracts. As any user can create, sign and distribute new currency contracts, Open Transactions might destroy the altcoin market according Chris Odom, creator of Open Transactions (Cryptocoinsnews, 2014). Altcoins will not have to host their own network, but can use the features of their altcoins on the Open Transactions platform. Open Transactions works mainly with Bitcoins, and has voting pools to reach consensus. These voting pools should make it more difficult to hack into crypto currency wallets (OTblog, 2014).

Summary of DLPs

A great analysis of different consensus platforms is made by Richard Gendal Brown (Gendal.me, 2014). His findings are represented in Figure 5.2 below. These figures relates to Figure 5.1, as the first column represents centralized networks, the second and third represent decentralized networks while the fourth column is about distributed networks.

		Who do I trust to maintain a truthful record?			
		A central authority	**A group of known actors**	**A group of actors, some known**	**Nobody**
What is the universe of "things" I need people to agree on?	**Ownership of on-platform assets**	Central Bank, Commercial Bank		Ripple (XRP)	Bitcoin
	Ownership of off-platform assets	Custodian Bank	Hyperledger	Ripple (Gateways)	Colored Coins, Counterparty
	Obligations and rights arising from an agreement	Clearing House	Eris	Ripple (Codius)	Ethereum

Figure 5.2 Differences among consensus platforms. Source: Gendal.me (2015)

6. Case study: Ripple

6.1 Introduction and methodology

This chapter describes the functionality of Ripple, the current best matured decentralized ledger platform according the author, and gives an introduction to its developer: Ripple Labs. Ripple is an innovative payment protocol and settlement infrastructure that enables faster, more efficient global payments at a lower cost than traditional means. Ripple offers an alternative to global money center banks for correspondent banking, yet itself is not a payment system or clearinghouse. While central banks are typically the standard switch for domestic and same-currency transactions (see they TARGET2 system in chapter 4.4), there is no standard switch for cross-border transactions. Instead, this switch function is generally provided by international banks.

Ripple is faster and cheaper than today's payment options, while simultaneously reducing some payment risks. Users can send transactions internationally within six seconds, compared to 3-5 business days with existing systems. The transaction costs using Ripple are a fraction of traditional channels, making small value transaction feasible. As the Ripple system is decentralized, there is no central operator. This improves the transparency of the system, but reduces regulatory options as no one regulates Ripple Labs or participating parties yet. Central banks and other supervisory agencies can still set the rules and governance of behavior for banks using Ripple. The direct and atomic payment from sender to receiver eliminates the risk that the transaction may fail along the payment chain, and the ledger allows every transaction to be auditable.

Methodology

According Yin (2009), a case study method is the preferred research method when the main research are "how" or "why" questions, the researcher has little or no control over behavioral events, and the focus of the study is contemporary (as opposed to historical). Most of the research questions are directly or indirectly "how" questions; this thesis should deliver how the financial infrastructure can look like if decentralized ledger platforms play a role. The researcher has no control over behavioral events, and the focus is absolutely contemporary; each month new information gets publicized about developments in the ecosystem of crypto currencies and decentralized ledger platforms. Therefore, the method of a case study is chosen. This case study adds value in that it provides a rich case description which can serve generalization purposes if the project organization faces similar types of DLPs (Ghaisas et al., 2013).

The approach for the data collection is a documentary study, started with reports and whitepapers from Ripple Labs itself, explaining their protocol. The most important document is "The Ripple Protocol: A Deep Dive for Financial Professionals". Other used sources are the Ripple Wiki (Ripple Labs, 2015c) and the Ripple Knowledge Center (Ripple Labs, 2015b), explaining the low level and high level functioning of the Ripple network. Next to this, participants and experts on Ripple are consulted for their feedback on the Ripple protocol and its functioning. All data collected by means of the documentary study and the informal interviews are analyzed by means of a thematic analysis (Guest et al., 2011) and selective coding (Bhattacherjee, 2012) is used to structure the findings.

From the three types of quality research as explained by Bjattacherjee (exploratory, explanatory, and descriptive) this case study is descriptive in its nature and seeks to describe all concepts related the phenomenon in interest; Ripple. Therefore, the main focus of this case study is to gain in-depth understanding of a decentralized ledger platform. As it is a complex and confusing task to investigate and compare all decentralized ledger platforms in detail, there is chosen to only explore and describe the, according the knowledge of the author, best matured alternative: Ripple.

6.2 The Ripple Protocol

Ripple is a universal Internet protocol founded in 2012 which enables a low-cost and fast payment system for value transfer. Ripple's innovative technology enables users to exchange money (including fiat currencies, digital currencies, gold, securities, contracts and other items of value) within and across national boundaries. Ripple also holds its own currency, XRP, which is explained later on in this chapter.

At its core, Ripple is a physical network of computers running open-source software (on servers known as rippled servers) developed and maintained by Ripple Labs. Although today many rippled servers are managed

by Ripple Labs, anyone – including banks – can operate a rippled server, limiting dependency on Ripple Labs. This software runs the Ripple protocol, which is in simple terms a set of rules that define how rippled servers communicate with each other. These rules govern how two parties can transfer ownership of any currency, commodity, contracts or other items of value. Ripple's transaction protocol (dubbed RTXP) can be compared with SMTP, which is the protocol for email that enables different e-mail services (Hotmail, Yahoo, etc.) to communicate regardless of the e-mail service used by the sender and receiver. According to Ripple Labs, their protocol is not designed as a consumer payment service but as a means for banks, interbank payment processors and other financial services providers to facilitate faster and more efficient payments, ultimately improving customer experience and enabling the financial institution to implement innovative payment solutions more easily. Ripple presents itself thus not as a competitor to banks, but instead a technology banks can use.

Financial institutions serve as gateways providing access for funds to enter and exit the network. This means that customers of financial institutions do not have to know anything about Ripple or its protocol, as the facility is enabled by their own banks to send and receive money within seconds and against fees (that could be significantly lower than usual, but ultimately determined by the bank). The degree to which customers know that the Ripple network is used for their payments is up to the bank. This is similar to how end-users interact with settlement infrastructures today. For example, bank customers do not see "SWIFT + correspondent banks" but rather "international wire."

From an information perspective, Ripple is a ledger supported by a decentralized network of participants. If multiple financial institutions integrate Ripple, they can all use Ripple as a trusted intermediary ledger to clear, net, and settle transactions within seconds. Developers at these financial institutions can build innovative payment applications based on the Ripple protocol, which can be used internally, externally and in a selected group of institutions. Benefits of this decentralized setup are not having a central operator which sets up regulations, fees and restrictions for using the Ripple network, also avoiding the single point of failure risk. The parties using Ripple determine the rules and governance they wish to adhere to themselves. For instance, existing payment network rules (determined by existing organizations such as the International Payments Framework Association) can be adopted on top of the Ripple protocol to govern interbank payment activity. It also enables compliance and risk management to be set up through contractual agreement, which can be regulated by regulatory instances.

6.3 The roles of involved parties

The Ripple network consists of two important parties: Gateways and Market Makers. These parties are graphically presented in Figure 6.1 below, which represents a transaction in Ripple

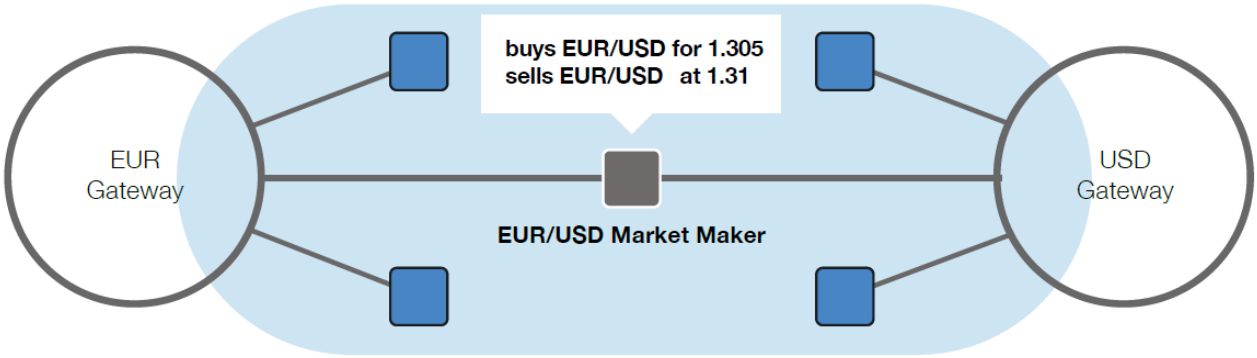


Figure 6.1 Wallets, Gateways and Market Makers in Ripple. Source: Ripple Labs (2014b)

The EUR gateway, USD gateway, and market maker are the only entities required to have a Ripple wallet. Users may be exposed to the Ripple Network through their financial institutions gateway wallet.

Currently, in two different manners wallets can be added to the Ripple network. The first is, when a private user wants to enter the Ripple network and registers himself by the website rippletrade.com. When registering, a private/public key pair is generated which represents a wallet. This set up is done within minutes. A wallet is represented by the blue boxes in Figure 3.1 above. This wallet keeps the digital money of the user, which can

be in all possible currencies. A wallet needs 20 XRP to be activated and once a wallet is activated it can never be deleted. This activation can take place by a gateway, for example SnapSwap Europe (www.snapswap.eu). This private user trusts this gateway for holding his fiat currency op deposit, while receiving virtual currency. A private user can manage his wallet by the Ripple Trade website. The second manner is, when a bank wants to enter the Ripple network. Banks can use the Ripple APIs to generate a wallet address. This address keeps the digital balances of the bank, which can be in any currency. Banks can develop applications to communicate with the Ripple servers to manage their wallets.

The Gateway

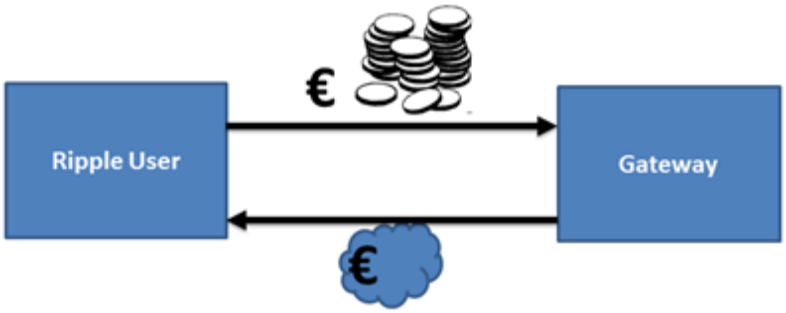


Figure 6.2 Setting a relationship between a Ripple user and a Gateway

A gateway exchanges fiat money for virtual money, by issuing the virtual money on the Ripple network and sending this to the user's wallet. Much like a bank, the gateway retains assets to finance its debt obligations issued on Ripple. A Gateway is a financial institution which exchanges fiat money, situated on a regular bank account for virtual money on the Ripple network, and vice versa, as shown in Figure 6.2, Ripple gateways allow individuals or companies to access the Ripple network. This gateway is represented by a circle in Figure 6.1 above. After a new Ripple user receives virtual money from the Gateway, he may trade it for any other virtual currencies issued by a trusted gateway or for the crypto currency XRP.

In order to hold virtual currencies issued on Ripple, a user must first establish a trust relationship (a "trust line") with the gateway that hold its funds on deposit. Establishing a trust relationship is represented as a transaction, which is publicly and permanently stored on the Ripple ledger. Setting a trust line is a process allowing users to control whom they trade with, what currencies they wish to hold, and how they wish their transactions to flow. This process will be further explained in paragraph 6.4.

When a Ripple user holds Euros in the form of virtual currency at a gateway, this is represented as EUR@GatewayA, indicating that GatewayA holds the fiat Euros from the Ripple user, and the Ripple user holds the virtual Euros issued by GatewayA. This implies that a user's virtual money can only be redeemed at the gateway it was issued from. That effectively stops the option of redeeming fiat currency at a gateway (or bank) with which the user does not hold any virtual money at all. In the future, gateways might be connected with other technologies such as email, PayPal accounts, Facebook account, phone number, etc.

The Market Maker

A Market Maker on Ripple posts offer to buy and sell virtual currencies issued by Ripple gateways. For example, a market maker may facilitate trade between EUR@GatewayA and USD@GatewayB by first opening accounts at GatewayA and GatewayB. Market makers are important sources of liquidity for cross-currency transaction within the network and primarily consist of bank trading desks, hedge funds and quantitative trading firms. The market maker is represented by the grey box in in center of Figure 6.1.

In the example figure, the market maker exchanges EUR@EURGateway at one financial institution for USD@USDGateway at another financial institution. If the sender of a payment wants to send funds from the US to the EU, he can leverage the prices that the market maker advertises. When a payment is sent, the market maker will buy USD@USDGateway from the sender, and simultaneously release EUR@EURGateway to the beneficiary. The market maker must "pre-fund" liquidity at both gateways (often via traditional rails like international wire) in order to have currency (i.e. inventory) to deliver against a payment on Ripple. Therefore, the market maker is the main source of liquidity on the Ripple network.

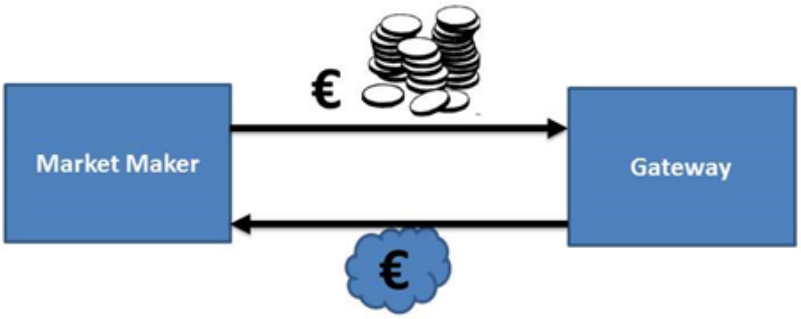


Figure 6.3 Setting a relationship between a Market Maker and a Gateway

If implemented in the production environment, a bank will become its own gateway and will have at least one Ripple wallet registered on the ledger. The bank itself or the bank's clients can make use of this wallet and thus benefit from the Ripple network. In all likelihood, participating banks will also become a market maker in its own network for transactions initiated by themselves or by partner banks. It is possible for transactions to be split among multiple authorized Marker Makers in case a single Market Maker does not hold enough liquidity to settle the complete transaction.

Same currency transactions
If the source and destination of a payment agree to have the same currency and issuer (for example, A sends B 10 EUR@BankA, when A has EUR@BankA and B desires EUR@BankA) then a same-currency transaction does not require a market maker. Note that USD@Citi is different than USD@Chase and therefore this would require a market maker.

Nowadays, same-currency interbank transactions (e.g. EUR@BankA to EUR@BankB) are virtually always settled via the central bank. Corporate banks hold settlement accounts pre-funded with central-bank money, and can exchange these funds via ACH or RTGS services authorized by the central bank. To maintain this oversight by the central bank for same-currency transactions, banks can use Ripple in two ways:

- Real-time clearing and netting: If the central bank is not integrated with Ripple, then corporate banks can use Ripple to continuously clear and net payments. Once the net positions reach a threshold determined by a common scheme, the banks can settle via the ACH or RTGS system, see paragraph 4.2.
- Real-time settlement: If the central bank is also integrated with Ripple, thereby enabling corporate banks to exchange central-bank money balances via Ripple, then corporate banks can use Ripple to continuously clear, net, and also settle payments.

6.4 Additional concepts

In this paragraph some additional concepts will be explained which are related to or incorporated in the Ripple protocol.

Cryptography
Ripple uses the same signature scheme as Bitcoin, 256-bit ECDSA keys and elliptic curve SECP256k1.

Trust lines
Ripple is currency agnostic and trades many different currencies and items of value. Yet, to govern this flexibility, users establish 'trust lines' between parties on the network to define the maximum amount of which currencies or value items they are willing to hold. A trust line in Ripple is an explicit and verifiable statement to hold debt obligations issued by a gateway. It must be set prior to receiving funds issued by a gateway. The maximum limit on a trust line may not be surpassed, as per the rules of the Ripple protocol. Summarized, trust lines are a mechanical way to broadcast that an account is willing to take the counterparty risk of another account. Trust lines indicate the direction of counterparty risk, therefore private or banking wallets needs\ to lay trust lines to their gateway, in order to trust them in keeping their deposited fiat money. Financial institutions may take advantage of this feature, but end-users are unlikely to.

Rippling

Rippling is a way for any user in the Ripple network to value a currency issued by two different gateways at a 1:1 ratio. In Ripple, the same currencies issued by different gateways are treated separately. For instance, Euros issued by Gateway A are treated as a different issuance from Euros issued by Gateway B. Rippling allows Euros issued by one gateway to be redeemed by another gateway that also issues Euros, which requires these gateways to trust each other fully. While this is an advanced feature and unlikely to be used by most financial institution on Ripple, it does provide flexibility in contractual agreements with domestic institutions on Ripple.

Ledger
From the start of the Ripple network, all validated transactions are stored in the distributed ledger. New transactions are signed by the payment source, broadcasted to the Ripple validation network, verified and likely added to the ledger, which is further explained in paragraph 6.5 below about consensus. The transaction metadata in the ledger stores information about each party involved in a transaction, such as the sender address, beneficiary address, gateway(s), market maker(s), amount of payment, and currencies involved. No privacy-sensitive customer information is included. Wallet addresses – or public keys – are randomly generated text strings, for example: rfYv1TXnwgDDK4WQNbFALykYuEBnrR4pDX

The ledger is constantly growing as newly validated blocks of transactions are constantly added. Validated ledgers are signed by a set of trusted validation rippled servers, and the ledger number is incremented. This process is repeated every three to six seconds with each iteration resulting in a 'Last Closed Ledger' (LCL). A LCL is a perfect representation of all funds, wallets, gateways, market makers, order books and trust lines on the network. Every rippled server gets a copy of the ledger, but it is not necessary to synchronize all historical ledgers upon joining the Ripple network. Downloading the complete historical ledger supplies complete information about the addresses and their balances right from ledger zero to the most recently validated ledger.

Orderbook
Al above explained, in order for cross currency payments to occur in the Ripple network, market makers are needed. These market makers post bids for buying and selling currencies, which are publicly stored in an orderbook. This orderbook hold all active bids from all market makers and is securely stated on the Ripple ledger. Only the relevant orders in the orderbook will be displayed in the payment path; a market maker needs to be in your network for the order to show.

6.5 Real-time processing by consensus

The Ripple network provides a publicly shared ledger, updating constantly and collectively by a network of decentralized servers. This ledger keeps track of the accounts, balances and orders of all Ripple users. Transactions, each cryptographically signed by a wallet holder, result in changes to the ledger state.

Users submit new transactions to a Ripple server, which broadcasts these to other Ripple servers, which are chosen as trusted nodes, to be verified. Through an iterative process of consensus, these servers propose sets of transactions to apply to the ledger. Consensus quickly results in a validation of this set of transactions, agreed upon by a supermajority (currently 80%) of Ripple servers. This percentage has been mathematically determined and verified in academic reports (Ripple Labs, 2014a), stating that all settled transactions are provable correct and in agreement with each other and the current balances. This solves the double spending problem, which refers to the challenge of ensuring that a shared digitally-represented asset has not been spend twice at two different validators.

If such a double-spend is initiated, the consensus algorithm will verify and accept the first transaction and reject the second. Consensus ensures the correctness of transactions in this regard. A subsequent process of validation ensures all nodes are in agreement with the precise set and order of transactions applied to the ledger. Producing a new ledger instance takes seconds. This in huge contrast with Bitcoin, whereby it takes at least 10 minutes before a transaction is validated.

Transactions are atomic, which means they either fail and no changes occur, or succeed completely and are permanently written into the public ledger. This feature eliminates Herstatt Risk; the risk that the transaction is not settled after being initiated. In particular, it eliminates cross-currency settlement risk that arises where the working hours of inter-bank fund transfer systems do not overlap due to time zone differences. In this

situation, failure by one counterparty to settle its side of the deal starts a chain reaction of cross-defaults. The Herstatt risk is named after a small German bank (Bankhaus Herstatt) which failed in June 1974 during the period it was supposed to settle a contract after having received the payment from the counterparty. That failure caused a string of cascading defaults in a rapid sequence, totaling a loss of $620 million to the international banking sector. This risk is magnified many times over in the current foreign exchange markets where some 1.500 billion dollar is traded every day compared to the daily volume of about 10 billion dollar when Bankhaus Herstatt failed (Ripple Labs, 2014b).

Each ledger instance includes not only updated wallet states, but also a hash to the previous LCL, which enables to verify the whole chain of ledgers and makes the Ripple ledger auditable.

6.6 Lowering FX costs through competition

Ripple's impact on the foreign exchange market seems to be one of its greatest advantages. Whilst banks and financial institutions nowadays pay high currency exchange fees, charged by profit-making correspondent banks, this will be minimized by market maker competition within the Ripple network. When a Ripple user wants to send Euros and deliver this value to the receiver in Dollars, the Ripple protocol will find the cheapest path to do this conversion. It compares algorithmically all authorized market makers, and returns the least cost path for the exchange. As these market makers compete with each other, conversion fees will drop to minimum prices. See as example Figure 6.4 below, which presents a route from EUR, to USD, to JPY, to KRW. The sender holds EUR, and the recipient wants to be paid in KRW. This complex transaction is an atomic transaction; it either completes or it is rolled back completely. By the rules of the Ripple protocol, payments cannot get stuck in-between Gateways or Market Makers.

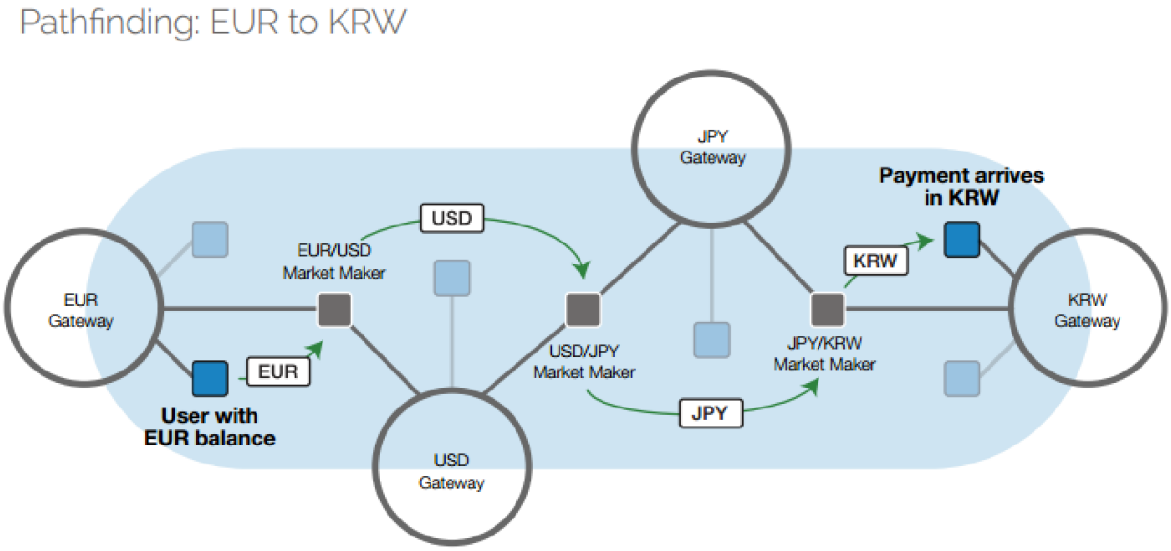


Figure 6.4 Pathfinding including multiple currencies. Source: Ripple Labs (2014b)

6.7 XRP

The Ripple protocol holds its own native currency: XRP, also called "ripples". This currency is similar to other crypto currencies, in that it is verifiable using mathematical methods validating its uniqueness and existence in the network. XRPs can only be traded within the Ripple network. From the start, Ripple Labs has created 100.000.000.000 XRP, and by definition no more will ever be created. The smallest identifiable part of an XRP is called a drop and is stated as 0,000001 XRP. Ripple's strength is their protocol, and the currency is mainly purposed to support this protocol.

XRP has two key functions: to prevent abuse of the system by serving the role of a transaction fee, and to act as a bridge currency, which helps market makers to exchange rarely used currencies and increase the total available liquidity network-wide. Users can choose to use XRP as their currency, or can use any other currency on the network and only hold a few XRP for transaction fees and account reserve.

Ripple, just as every other network service, could be a target for network attacks from hackers, for example distributed denial-of-service (DDOS) attacks. Malicious attackers could attempt to create numerous fake accounts or send huge numbers of meaningless transactions to overload the network. To prevent this from happening, Ripple requires a minimum per-transaction fee of about 0.00001 XRP and adjusts the fee dynamically in response to the transactional volume on the network. The goal of an increasing fee is to bankrupt a bad actor that is trying to overwhelm the network with spam transactions. This transaction fee is not collected by anyone, but is destroyed from the ledger after the transaction is completed. Initial reactions may be that in this case eventually all XRP will disappear, but according calculations this is not likely. If there is each day the same amount of Ripple transactions as SWIFT messages, after 50 years 98 % of the XRPs will still exist. As this fee has a value of $0.00017 at the moment of writing, it is negligible for typical Ripple users but it prevents potential attackers from sending large amounts of spam, in the form of thousands tiny transactions. Similar measures are taken for the creation of an account, placing an order in the orderbook and laying a trust line. Without these measures, malicious users can execute thousands of these actions and spam the Ripple network.

XRP can also serve as a bridge currency for illiquid currency pairs. Users of Ripple can theoretically exchange anything of value: fiat currencies, virtual currencies, commodities, securities, and even loyalty points. All these forms of value are kept on the ledger as liabilities to the issuing gateway, while the crypto currency XRP can be traded without having a counter value. If Ripple grows in the future and the number of included currencies increases, the number of currency exchange pairs can become unmanageable for the market maker and for the gateway. The pathfinding algorithm should search through all possible paths, which may take long. To solve this, each currency can be traded against XRP, which in turn can be traded against any other currency. This bridge function is presented in Figure 6.5 below. In the left is the situation without XRP, then the number of necessary currency exchange pairs grows exponentially. On the right is the situation with XRP, when the number of required currency exchange pairs grows linearly.

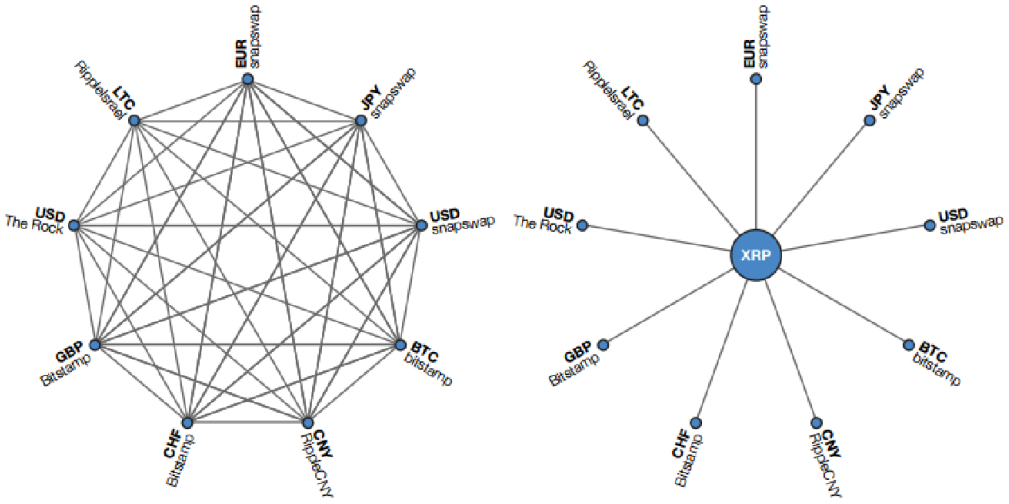


Figure 6.5 XRP as a bridge currency. Source: Ripple Labs (2014b)

XRP distribution

At the moment of writing, 67,964,048,601.50 XRP is still held by Ripple Labs, 32,035,239,593.50 XRP is distributed to Ripple users, while around 712.000 XRP is already destroyed. Ripple Labs believes that broad adoption of Ripple will result in organic demand for XRP over the long run and plans to distribute XRP to encourage activity in six categories. The categories are: Users (user giveaways to attract new users to Ripple), Developers (rewarding contributors who improve the ecosystem), Merchants (XRP rebates for retail transaction volume they bring on the network), Gateways (XRP rewards for gateway activities), Market Makers (XRP rewards for market making activities), and Ripple Labs (to fund operations).

Liability network

XRP is the only crypto currency native to the Ripple network; no other crypto currency can ever be added in the network. Bitcoins, Litecoins or any other crypto currency may flow through the network; however the currency itself can no longer be defined as such when entered in the Ripple network. In this case, these crypto

currencies are represented as IOUs (I Owe You) in the same manner as how fiat money as Euros and Dollars is represented. If wallets hold Bitcoins or altcoins, these issuances can only be withdrawn at the original gateway for real crypto currencies. All Bitcoins and altcoins in the Ripple network are thus referred to as virtual crypto currencies.

XRP is thus the only native digital asset to the Ripple network which does not have counterparty. All other assets are issued as a debt obligation containing an explicit counterparty. This implies that Ripple is merely a liability-based network as opposed to an asset-based network. This means most value (except for XRP) is held outside the Ripple wallets and is secured at the gateways on deposit, which is probably by means of bank accounts. This gives bank extra control in the settlement of fiat money as a result of Ripple transactions.

6.8 Technical concepts

This paragraph shortly describes the additional used protocols and the setup of the servers, API and clients.

Additional protocols

Ripple knows three protocols. The basic Ripple protocol RTXP, which runs the network and enables rippled servers to communicate with each other. The two other protocols are the federation protocol and the gateway services protocol, both explained below.

Federation protocol and destination tags

The destination tag is a text string linked to a transaction which maps the payment to the beneficiary end-user. Destination tags are used when transactions for multiple clients are send to only one wallet. The federation protocol is used to coordinate the use of destination tags in order to specify the ultimate beneficiary of a payment. As might be expected in the future, banks will have only a few wallets in the production environment. By use of a destination tag, beneficiary banks can register for which client the payment is intended, and can forward the payment to the bank account of this client. This federation protocol is presented in Figure 6.6 below.

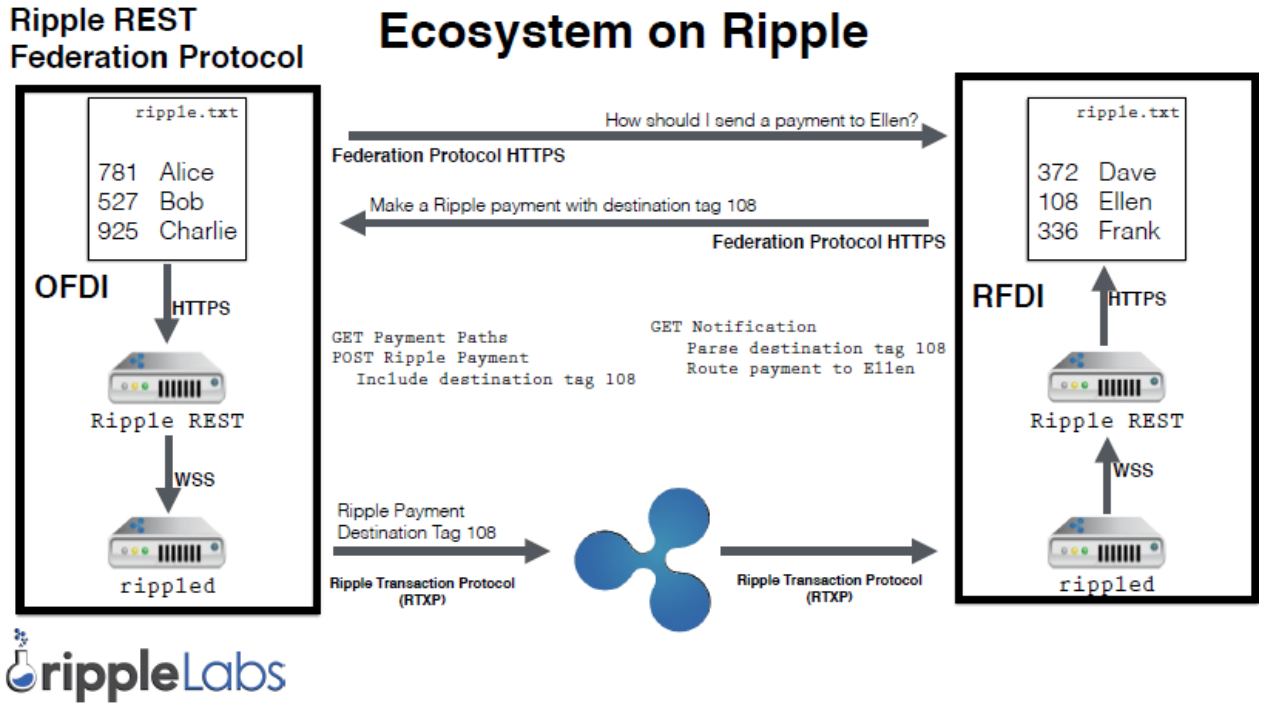


Figure 6.6 Federation protocol facilitating the use of destination tags. Source: Ripple Labs

Important to note is, that although the destination tag is publicly visible on the ledger, agreements made about what destination tag belongs to which clients are kept off-ledger. As presented in Figure 6.6, if Alice wants to send a payment to Ellen, the federation protocol sends a request by a secure HTTPS connection to the beneficiary bank's Ripple REST server. This server returns with a particular destination tag. Now the payment can be executed, including the destination tag, enabling the beneficiary bank to determine to which client this

payment needs to be forwarded. Destination tags needs to change frequently, as static destination tags (non-changing) will harm the privacy of users, as they are 'known' after one transaction.

Gateway services protocol

Another important protocol shaping the off-ledger information exchange between banks is the Gateway Services protocol. This protocol is currently under construction. The Gateway Services protocol can be executed by the gateways server, introduced below. The Gateway Services protocol enables gateways to ease their banking activities as a Ripple gateway, by adding a few features. As presented above, it facilitates communication with the beneficiary gateway about the payment conditions, the KYC information of the sender (if requested) and an invoice ID. This invoice ID is important as it can be used to reconcile transactions from a gateway database. Keep in mind that as the ledger is publicly accessible, particular payment information as the name of the beneficiary client needs to be kept off-ledger, but is still necessary to complete the payment. The current best solutions to have a compliant but private transaction, is to store transaction information from payments in an off-ledger, secured and encrypted database which can only be accessed by the sender and beneficiary bank. It is not sure if such databases are hosted by a central organization, a decentralized organization or if each bank uses its own database. The working of this protocol is visualized in Figure 6.7.

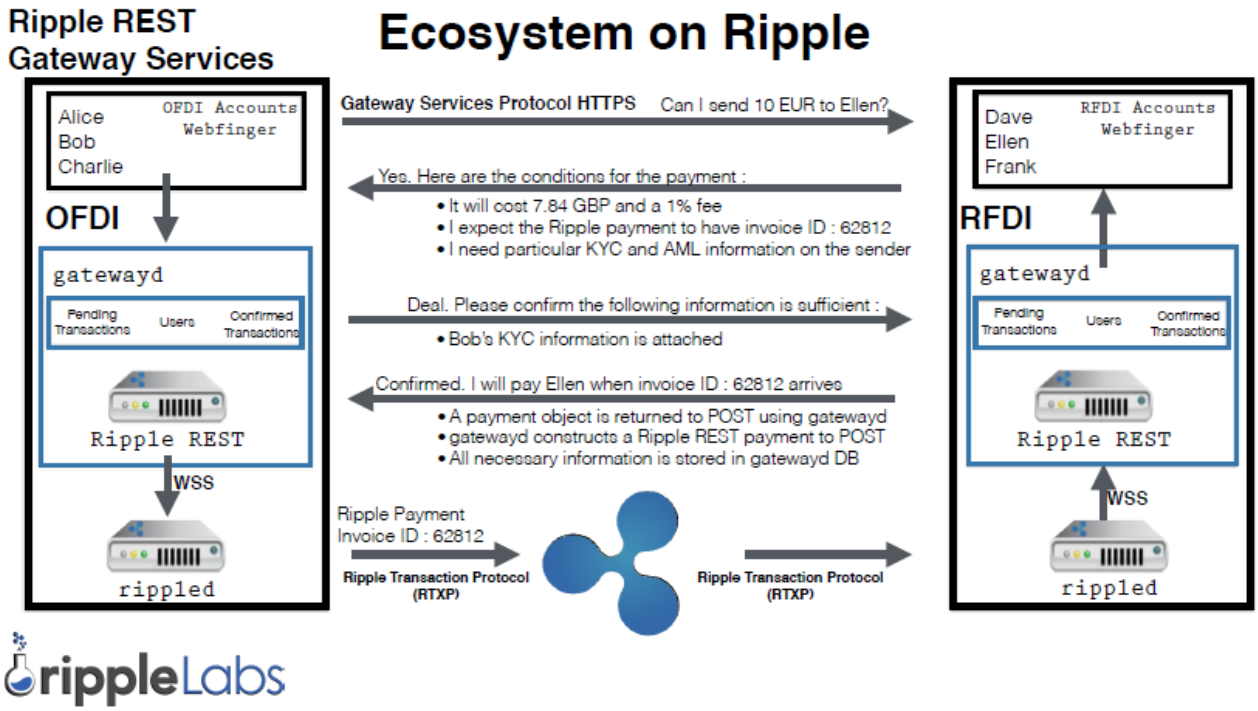


Figure 6.7 Gateway Services protocol. Source: Ripple Labs

Technical components

Figure 6.8 displays the technical Ripple components used for a Ripple implemented in a bank's systems, followed by a short description of each component. On the left of the picture are a bank's proprietary systems, summarized in the box 'Bank accounting system'. On the right of the picture the Ripple network is displayed, with various servers spread over the world for broadcasting, validating and updating the ledger. In the transparent box in the center of the figure, the supporting Ripple software is situated which enables a bank to connect to the Ripple system. Figure 6.8 does not include a representation of software needed by market makers to post bids and facilitate cross-currency transactions.

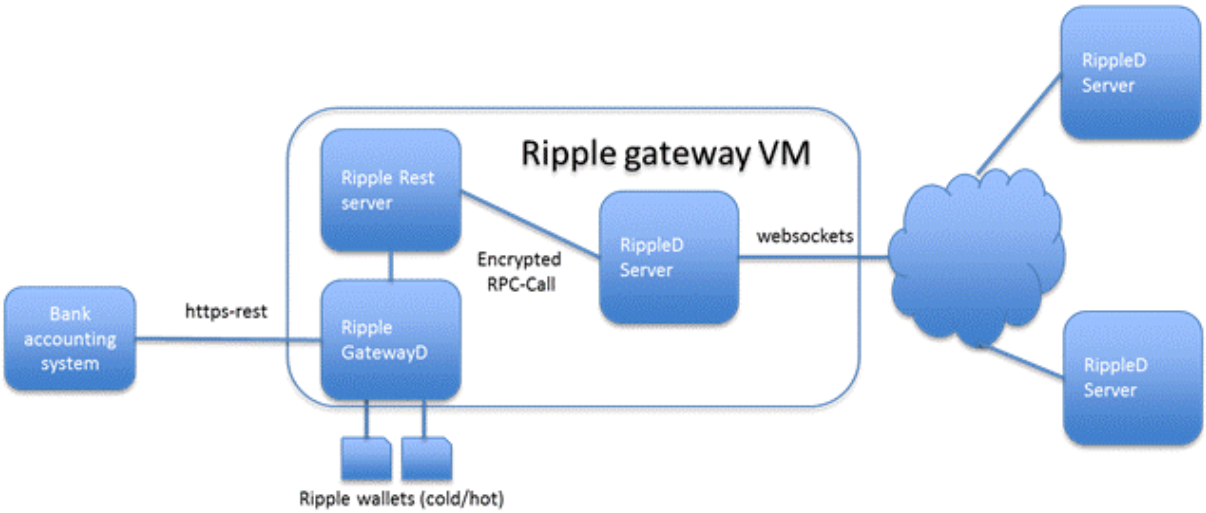


Figure 6.8 The Ripple technology linked to a banking system

Metaphor

To metaphorically explain the functioning of Servers, APIs and User Interface, one can think of a vending machine which sells cold beverages. In this, the Servers represent the tangible technology of identifying inserted coins, giving change, enabling one beverage to drop and cooling the machine. The API is the connection between the Server and the User Interface and permits the thirsty customer to receive a cooled beverage, to insert coins, etc. An API is the intangible software which translates user interface input to commands to the coin-counter, the change-giver, the beverage-dropper and the machine cooler. The API requests information from multiple Servers (is enough change still available, how cold are the beverages, is beverage X still available) and gives commands (enable cooling of the machine, drop a beverage, and give change). The User Interface is the button panel on the front of the machine in which a thirsty customer can choose his beverage. By pushing buttons and inserting coins, the customer gives commands to the API through this interface. The API then translates this in commands to the different servers.

Ripple Gateway VM

The Gateway Starter Kit (GSK) is an Ubuntu virtual machine (VM) image created by Ripple Labs. It may be installed into a bank's systems to create an instant development environment; it can thus be fully installed without any further modification. The GSK comes with a pre-compiled rippled server, a Ripple RESTful API server, and a gatewayd server. This gives the bank the full functionality it needs to operate as a trusted ripple server and a gateway for its clients.

rippled Server

Starting on the right side of the picture, the Ripple network is supported and maintained by a decentralized network of rippled (pronounce: Ripple D) servers. These servers may maintain historical ledgers, and broadcast new transactions throughout the network. Each server has a list of trusted validators (known as a 'Unique Node List,' or UNL), which it relies on to validate and update new ledgers. As the cloud in the figure represents the Ripple network, one can see that multiple rippled servers are connected to each other, by means of the Ripple Transaction Protocol (RTXP). It is the choice of the participating bank to host a proprietary rippled server, or to communicate with rippled servers from other participating institutions. The advantages are that implementation costs are less and less bandwidth is needed. The disadvantage is that you cannot trust your own server, as you are not in command and do not have control over its workload (what tasks it performs in what order). Therefore, the recommendation for each financial institution is to have their own rippled server, or share it with a few trusted others.

Rippled API

An API (Application Programming Interface) is a set of rules, protocols and tools for enabling communication among different software tools. An API keeps track of the input, operations and output of each software component, which enables other software components to communicate with that specific component. Direct communication with a rippled server may happen either through a WebSocket API or a JSON-RPC API. Both APIs use the same list of commands, with almost entirely the same parameters in each command. The

WebSocket API uses the WebSocket protocol, available in most browsers and JavaScript implementations, to achieve persistent two-way communication. There is not a 1:1 correlation between requests and responses. Some requests prompt the server to send multiple messages back asynchronously, other times, responses may arrive in a different order than the requests that prompted them. The rippled server can be configured to accept secured (wss:), unsecured (ws:) WebSocket connections, or both. Market makers will choose to use this API for its persistent connection to rippled servers.

The JSON-RPC API relies on simple request-response communication via HTTP or HTTPS (the rippled server can be configured to accept HTTP, HTTPS, or both). For commands that prompt multiple responses, you can provide a callback URL.

Ripple REST Server
The Ripple REST server provides communication to the rippled server through the rippled WebSocket API. It exposes a concise amount of information that typical institutions will require during integration.

Ripple Gatewayd
The Ripple Gatewayd (pronounced: Gateway D) Server provides extra functionalities to serve as a gateway. These functionalities enable a hot/cold wallet setup, registering users, keeping balances of users, etc. This gatewayd function as a top-layer on top of the existing communication to the rippled server. The gatewayd server exposes an API to conveniently make administrative changes to the gateway.

Ripple Gatewayd API
Just as with the Rippled server and the REST server, the gatewayd produces an API which enables communication with the gatewayd. This results in features like the addition of destination tags to transactions, transacting deposits from users, transacting withdrawals to users. The biggest difference with the REST API is that the REST API is not able to manage users, etc., while the gatewayd is better equipped to do this.

Ripple REST Client
The Ripple REST Client is the interface for making API calls to the REST server. Ripple Labs may offer participating banks this client, but this can also be created by the bank itself.

6.9 Ripple Labs

The basic concept of Ripple is established by Ryan Fugger in 2004. Mid 2011, computer programmer Jed McCaleb joined, and hired David Schwartz for developing the Ripple consensus algorithm in order to create a less computationally inefficient alternative to the Bitcoin “proof of work”-solution. In 2012, Chris Larsen joined who is currently CEO. July 2014, McCaleb disputed with the other co-founders over the company vision, and separated with the company to subsequently create Stellar, a direct protocol fork of Ripple. The company behind the Ripple protocol was first named OpenCoin, but changed its name in September 2013 to Ripple Labs, Inc. The source code was subsequently made open source. Ripple Labs states to be active in maintaining and improving the Ripple protocol, supervising creation of new tools for on top of the Ripple platform and pursuing commercial partnerships with financial institutions.

Ripple Labs has gotten much attention in the news. The Massachusetts Institute of Technology (MIT) recognized Ripple Labs as one of 2014’s 50 Smartest Companies, which places Ripple Labs among other big innovators such as Google, Uber, IBM and Snapchat. Ripple Labs has also raised capital from some of the leading venture capital and technology firms, including Google Ventures, Andreessen Horowitz, LightSpeed Venture Partners, IDG Capital Partners, and Founders Fund. Although Ripple Labs is growing (40 employees in September 2014, 94 employees April 2015), it is still a startup. This means that documentation is freshly written and important new functionalities are still under construction.

As of April 2015, three banks have publicized partnerships with Ripple Labs. Fidor Bank, an innovative German bank, is the only bank using Ripple in production. The often-named benefit of reduced fees becomes immediately visible, as they ask a fee of €0,50, instead of normally €5,00 for a cross-border money transfer (Fidor Bank, 2015). The other two banks are CBW Bank and Cross River Bank, both American banks. Ripple has

also partnered with Earthport, a provider of a global payment network, which might use Ripple to improve its global payment services.

Part III

Scenario planning

7. Scenario planning methodology

This chapter explains the concept of a scenario planning and presents the methodology used to come up with qualitative future scenarios about interbank payments and DLPs.

What is scenario planning?

Scenario planning is a disciplined method for imagining possible futures that companies apply to a great range of issues, according one of the best known authors in the field of scenario planning (Schoemaker, 1995). More detailed, Godet (2000) defines a scenario as "the set formed by the description of a future situation and the course of events that enables one to progress from the original situation to the future situation". Note that this second definition not only includes researching and describing future scenarios, but also investigates the path from the original situation to certain future situations.

Scenario planning goes further than stand-alone predictions, simulations, forecasts or contingency planning. Scenarios explore the joint impact of various uncertainties, which stand side by side as equals (Schoemaker, 1995). Using scenarios, one can scientifically think of future situations by connecting trends, uncertainties and stakeholders' motivations and roles. According O'Conner and Veryzer (2001), scenario planning helps management to stay aware of what else is happening outside the firm and the industry that may impact the firm's current competitive advantages. It allows anticipating on possible alternative futures, based on a set of trends, with a forecastable degree of confidence, as well as uncertainties with unknown outcomes. Scenario planning offers a framework for developing more resilient conservation policies when faced with uncontrollable, irreducible uncertainty (Peterson et al., 2003). Scenario planning consists of using a few contrasting or relatively similar scenarios to explore the most striking uncertainties, including the influence of future consequences of decisions. In this form, a scenario planning can also be used for decision making. According multiple actors (Peterson et al., 2003; Schoemaker, 1995), scenario planning should be constructed by a diverse group of people in a systemic, iterative process of collecting, discussing and analyzing scenarios.

7.1 Characteristics of scenario planning

Van Notten et al. (2003) investigated the evolvement of scenario planning over the past 50 years. They examined a large variety of about 70 different scenario studies of different industries, in order to determine what types of scenario planning exist. The authors came up with 14 different scenario characteristics, which are useful to determine beforehand what can be expected of a scenario planning. These 14 characteristics are categorized in three categories: project goal characteristics, project design characteristics and scenario content characteristics. First the characteristics of a category are described, after this these characteristics are adapted to the scenario planning of this thesis and design choices are made.

Project goal characteristics

Inclusion of norms?

There are normative and descriptive scenarios. According van Notten et al., descriptive scenarios explore possible futures while normative scenarios describe probable or preferable futures. The latter thus includes norms and values which can more quantitatively describe future scenarios (for example the amount of CO2 in 2020), while the first is more usable as an eye-opener to present the different possible futures.

Vantage point

The vantage point determines if a scenario planning takes the present as a starting point (forecasting) or a couple of future situations as starting point (back casting). Forecasting scenarios try to explore future situations based on the current situation, while back casting scenarios start from certain (desired) situations and try to determine normatively what direction to go to reach or avoid these future situations.

Subject of scenario study

The subject of a scenario study can be issue-based, area-based or institution-based. Issue-based take societal issues as the subject of their study (for example the future of television), area-based explore future scenarios for geographical area as cities, regions or countries and institution-based scenario planning address future scenarios of an organization, a group of organizations or a sector. Institution-based scenarios can in turn roughly be divided into two categories: contextual scenarios and transactional scenarios. The contextual scenarios describe the institution's macro-environment: the variables and dynamics that are not directly

influenced by the institution, while transactional scenarios describe the institution's meso-environment and include variables and dynamics influenced by the institution. Whether an issue addresses the contextual or transactional environment is determined by whether the institution can directly influence the issue under study.

Time scale
Time scale determines if the scenario planning addresses a long-term perspective, generally 25 years, or a short-term perspective, 3-10 years.

Spatial scales
Scenarios can be developed according to different spatial or geographical scales, ranging from the global international scale to national or regional areas and local areas. Spatial scales determine to what extent global developments are used for local scenarios, and vice versa.

Project goal characteristics for interbank scenario planning
For the scenario planning performed in the next chapter, norms are mostly ignored so descriptive scenarios are generated. Many uncertainties give a great opportunity of exploring alternative scenarios which result from these uncertainties, and it makes not much sense to set norms. Therefore, the vantage point is the present, although some recommendations are made how to cope with future scenarios. This will be fundamentally different than describing actions to undertake to reach a certain scenario, but it might be taken into account when making strategy decisions about what direction to go. The subject of the scenario study is institution based, with a main focus on the macro level. As the project organization (Rabobank Netherlands) is a major international bank, and thus able to influence the macro level by changing the meso level, this will also be taken into consideration. The time scale is short-term, about 3-5 years, as the current blockchain applications are rapidly evolving and within 5 years it should be possible to reach future scenarios in which DLPs are incorporated. Spatial scales are small, the focus is set on international and national level. Regional or local scenarios are not incorporated, as it is highly likely that they may follow the international scenarios, but will not influence these.

Project design characteristics
Nature of data
Scenarios can be qualitative or quantitative. Qualitative or narrative scenarios fit best in the analysis of complex situations with high levels of uncertainty and when relevant information cannot be entirely quantified. Quantitative scenarios, often simulated by computer models, are mostly used to develop energy, technology, macro-economic, and environmental forecasts. According multiple authors (van Notten et al., 2003), a combination of qualitative and quantitative elements can make scenarios more consistent and robust.

Method of data collection
Data for creating scenarios can be gathered in two ways: by a participatory approach or by a desk research. With a participatory approach, case data is collected by a participatory process among individuals. These individuals can be stakeholders (inhabitant of an area, employees of an institution, etc.) or experts. Participatory settings can be reached by workshops, focus groups or by interviews. The second way, a desk research is an individual approach in which scientific journals and computer simulations are used to generate scenarios. It is most likely that a more participatory approach is used by explanatory, descriptive, qualitative scenarios and a desk research is used if experts' opinions are not used, in case of more normative and quantitative scenarios.

Nature of resources
The nature of the resources describes a scenario analysis' financial and research resources, available manpower and theirs competences.

Nature of institutional conditions
The nature of the institutional conditions address the room for maneuver that a scenario project team is given. These conditions can be open or constrained. Examples of these conditions are political sensitivity to an analysis, freedom to come up with best scenarios (although perhaps not in interest of stakeholders), freedom to include important experts in the scenario brainstorming, etc.

Project design characteristics for interbank scenario planning

The nature of data is mainly qualitative. The levels of uncertainty are high, and possible scenarios will differ highly. The method of data collection is both participatory and by desk research. The desk research is partly covered in the previous chapters and explores the concepts and technology. Furthermore, desk research is carried out by including several news articles and blogs regarding the technology and the future of the technology, which findings are reported in the trend section. Next to this, a participatory approach is used in interviews stakeholders and experts. The nature of resources consists of a 6 months' job by one person with good understanding of the technology and moderate understanding of the financial architecture. This person, the author of this thesis, is a graduate student with good research competences due to prior research projects. The nature of institutional conditions is open, although precautions needed to be taken regarding presenting the background of this scenario planning. The subject of cryptocurrencies is highly sensitive product in the financial world, so information might be directly or indirectly withheld by interviewees.

Scenario content characteristics

Temporal nature

There are two types of scenarios regarding the temporal nature: chain scenarios and snapshot scenarios. Snapshot scenarios are like photos which only describe the end-state of a particular path. The process that results in this end-state is thus implicitly addressed. Chain scenarios are like films which describe the path of development to a particular end-state.

Nature of variables

The nature of the variables is about the type and nature of the variables used to differentiate in scenarios. There can be a homogenous set with variables from one particular field, or a heterogeneous set consisting of variables from different fields.

Nature of dynamics

The nature of the dynamics can be result in peripheral scenarios or trend scenarios. Trend scenarios extrapolate from existing trends, while peripheral scenarios include unlikely and extreme events. Trend scenarios are linear trajectories, and are also called 'surprise-free' scenarios. Peripheral scenarios describe a discontinuous path to the future and thus include 'surprises'.

Level of deviation

The level of deviation refers to the range of possible futures taken into account. There are two types of scenarios: alternative and conventional. Alternative scenarios describe futures that differ significantly from one another, with as goal to raise awareness and understanding about uncertain or new issues. Conventional scenarios adhere to the status quo or to present trends and their extrapolation into the future, in order to fine-tune the current strategy.

Level of integration

The level of integration refers to the degree of interaction between the variables and dynamics. High level of integration demonstrates a high degree of interaction, low level of integration has negligible interconnections between the different variables and dynamics.

Scenario content characteristics for interbank scenario planning

The temporal nature of the scenarios is a snap-shot scenario, which only focusses on possible end-states. Chain scenarios mainly address different forms of proof of concepts, pilots, and test, while the end-scenarios define the different possible end-states when combining DLPs with interbank payments. The nature of the variables is heterogeneous as they origin from different backgrounds and industries. The nature of the dynamics is mainly about trend scenarios, as there are too much possible 'surprises' and incorporating them in the uncertainties will raise confusion. If possible, risks which lead to unpleasant surprises are addressed. The level of deviation is alternative. At the potential start of a break-through disruptive technology one cannot yet determine how the technology exactly will be implemented. Therefore, the focus is set on alternative scenarios. The level of integration is high. Some variables have great interdependence, and dynamics can alter the outcomes of variables. All characteristics for the interbank scenario planning are summarized in Table 7.1.

Project goal characteristics	
Inclusion of norms?	Descriptive scenarios, mostly without norms
Vantage point	The present, with recommendations for actions to undertake
Subject of scenario study	Institution-based, focus on macro level
Time scale	Short term, 3-5 year
Spatial scales	Small, focus on national and international level
Project design characteristics	
Nature of data	Qualitative, due to high uncertainty
Method of data collection	Mainly participatory, but also desk research
Nature of resources	6 months work of an experienced individual, the author
Nature of institutional conditions	Open, with precautions regarding sensitivity of the subject
Scenario content characteristics	
Temporal nature	Snap-shot scenarios of possible end-states
Nature of variables	Heterogeneous
Nature of dynamics	Trend scenarios, ignore possible surprises
Level of deviation	Alternative, scenarios differ significantly
Level of integration	High

Table 7.1 Characteristics for interbank scenario planning

7.2 Types of scenario planning

The Global Business Network (GBN) matrix is the most default scenario technique according Bishop et al. (2007), in which two uncertainties are chosen and its two outcomes are mapped in a 2-by-2 matrix. This is a great starting point, but it is too abstract for a scenario planning in such a multidisciplinary field. Therefore, the variant Morphological Analysis (MA) is chosen which contain any number of uncertainties and any number of alternative states for each uncertainty. Strictly spoken the GBN is a subset of the MA. This unlimited amount of uncertainties and their outcomes enables to include all relevant factors, but complicates creating an overarching end product. In this, the design choice is made that the means (trends, uncertainties, dynamics) are of more importance than the end product (the final scenarios), and therefore the MA is used instead of the traditional GBN.

7.3 Training

Godet (2000), in a paper about tools and pitfalls for carrying out a scenario planning, calls for a 2-day seminar of training and practice to make the participants familiar with the main concepts and tools of a scenario planning process. Because the participants did not have the time available, this training is substituted by a documentary study in leading reports and researches on scenario planning by the author, which are in turned carefully explained to the participants during the interviews. Also, a session is held with a participant of a previous scenario planning at the project organization, which resulted in practical insights about performing a scenario planning.

Another aspect of training is introducing participants to the concept of the blockchain technology and to the basic functioning of the financial infrastructure. In order to give valuable input or feedback in the scenario planning process, it is crucial that participants have a moderate understanding of the technology and the possibilities regarding improving interbank payment. As most relevant stakeholders did not have sufficient knowledge about DLPs and crypto currencies, the author chose to not involve participants without at least moderate knowledge about the blockchain technology and the financial infrastructure. It would take too much time to train each individual in these fields, therefore such individuals are not interviewed. This reduces the potential amount of participants at the project organization.

7.4 Methodology

For the purpose of this research, a scenario planning methodology is used that is grounded on the work of Schoemaker (1995). His model is adapted based on more recent publications (Godet, 2000; Bishop et al., 2007; Peterson et al., 2003) and project-specific characteristics. Each deviation from the initial model is documented. There are ten steps, which are explained below.

1. Define scope
A scope is needed to determine what is researched and what not. Such a scope includes also some of the characteristics discussed above. Regarding the model of Schoemaker (1995), certain assumptions are added to the scope section in paragraph 8.1, in order to be able to academically discuss the future. In the end, everything planned or expected to happen in the future is uncertain, and therefore assumptions have to be made to only deliver a specific subset of all possible future scenarios.

2. Identify major stakeholders
Stakeholders need to be identified who have interest in blockchain technologies or financial structures or are affected by these subjects. For Rabobank Netherlands only, thousands of stakeholders can be identified who work in the international payments field. As explained above, most of these stakeholders have never heard of Ripple or other decentralized ledger systems and given the time it costs to educate someone DLPs and cryptocurrencies, it is not manageable to question them due to a lack of understanding. Therefore, only stakeholders are identified which work in these areas but do have an understanding of Ripple or other DLPs. Participants are invited for an interview based on their background, their expertise or their industry.

The goal of identifying stakeholders is not to directly question them for their needs, fears and expectations or to model them in a power-interest matrix. The goal is to get input and feedback from them on current DLPs and future scenarios for DLPs in the interbank payment field. In each interview, participants are asked for their vision on the basic trends, key uncertainties, dynamics and ultimately the scenarios. Their input is thus used for completing step 3-6, and 8.

3. Identify basic trends
This step analyzes what political, economic, societal, technological, legal, industry and DLP specific trends might affect the functioning or potential adoption of DLPs for interbank payments. Stakeholders will be questioned for these trends, but also the desk research approach will be used by analyzing papers from various fields about trends for the financial world. Knowing these trends helps to be better ensured of the likeliness of certain scenarios. If for example biometrical identification is a trend, this might be beneficial for scenarios in which identification in the DLP is of great importance. All participants should agree on these trends. If there are disagreements, the trend becomes an uncertainty and will be addressed in step 4.

4. Identify key uncertainties
Key uncertainties address the events or outcomes which are yet unknown, but will significantly affect future scenarios. Important uncertainties are addressed, and possible outcomes are determined. This enables to create different scenarios, based on these uncertainties. In this, the above discussed scope is of great importance. It can be regarded as an uncertainty if there comes a new crisis which affects current interbank payments, but this is not excluded from the scope. In this scope, some assumptions are presented which ignores this type of 'surprise' uncertainties. It is important to analyze the relationships between uncertainties and dynamics. Some combinations might not occur, and can therefore be excluded. The relations between trends, uncertainties and dynamics are visualized in a concept mapping in paragraph 8.6.

Uncertainties should not be under control of a certain actor. If an uncertainty can in any way be deliberately influenced by a stakeholder, this becomes a dynamic. These dynamics address future behaviors of actors within the system, or about unknown changes in system drivers (Peterson et al., 2003). To separate the controllable and uncontrollable uncertainties and events, a new step is added: identify dynamics.

5. Identify dynamics
Scenario dynamics are the events and processes that make up the story of a scenario (Peterson et al., 2003). These dynamics should be plausible in order that nature, networks or actors should not behave in implausible ways. In comparison to the key uncertainties, the dynamics are performed by (partly) influential actors and these dynamics form milestones of the path towards a possible end-state.

6. Construct initial scenario themes
As explained in paragraph 7.2, the technology chosen for scenario creation is Morphological Analysis. Most relevant uncertainties are chosen and they are mapped in one or more quadrants. Shifting away from the traditional method of constructing these scenarios, multiple sets of uncertainties are used to create multiple

sets of scenarios. These different sets of scenarios should be related, but may depend too much on each other. If one particular scenario of a first quadrant is reached, all scenarios of a second quadrant should still be available, although chances may change.

7. Check for consistency and plausibility
As the trends, uncertainties and dynamics are of qualitative nature, the check for consistency and plausibility is also qualitative. After sets of scenarios are made, particular scenarios are deleted or revised which are not plausible or in consistency with the environment. Scenarios might also get a little twist in order to make them more reliable. Some elements can be used to verify each scenario (Schoemaker, 1995). First, if the trends and uncertainties are compatible within the chosen time frame. Second, if there are any combinations of outcomes of uncertainties that can be regarded as impossible. Third, if there are potential stakeholder dynamics which may accelerate or delay some scenarios.

8. Validation by stakeholders and experts
There are two forms in which stakeholders and experts can validate the concept model of scenarios. The first form is the validation on the trends, uncertainties, dynamics and scenarios during the interview. After the stakeholder gives its own input, he validates the summarized input given previous by other stakeholders. Therefore, all mentioned trends, uncertainties, dynamics and scenarios already incorporate this form of validation from the stakeholders. The second form of validation takes place after all stakeholders are interviewed. A final model is created of all scenario planning elements and each stakeholder is personally invited to review this final model. This is a necessary step, as the first interviewed stakeholders did review less content than was ultimately delivered.

9. Develop learning scenarios and finalize scenarios
This step enables to finalize scenarios after receiving validation from stakeholders and subsequently converting these scenarios into learning scenarios including identifying factors. Scenarios are iteratively improved after validation by stakeholders, resulting in not explicitly mentioning this step during the scenario planning.

10. Future research and decision making
The last step in a scenario planning is finalizing scenarios and identifying directions for future research (Schoemaker, 1995). A scenario planning might also be used for decision making. Identifying factors and related consequences should be clearly stated to give management an opportunity to steer into a certain desirable future (Peterson et al., 2003). As a decision model is not in the scope of this research, this step is left out of the scenario planning, but is indirectly treated in the conclusion and recommendation of this thesis.

7.5 Threats to validity

Some threats can be identified which endanger the validity of the results of this scenario planning (Wieringa, 2015). For empirical research, four common measures are identified to determine the quality: construct validity, internal validity, external validity and reliability (Yin, 2013).

A first threat is the multidisciplinary background of this study. Several industries are brought together, under which: crypto currencies, open source software distribution, IT network architectures, the forex market, correspondent banking and international payments. The multiplicity and diversity of the researched construct – DLP-facilitated interbank payments – is a barrier for gaining in-depth knowledge of the subject, as this requires detailed studies of the various industries. The author of this research has studied these industries for 7 months and included stakeholders from all different industries, which partly mitigates this threat.

Construct validity examines how well a given measurement scale is measuring the theoretical construct that it is expected to measure (Bhattacherjee, 2012). Some tactics proposed by Yin (2013) are incorporated, such as the use of multiple sources of evidence, establish a chain of evidence and having key informants review the draft concept. Multiple sources of evidence can be found in academic literature, (in)formal news bulletins and reports, industry reports, company whitepapers and informal forum discussions, next to the interviews held with participants from different backgrounds. The chain of evidence is set up through the whole research to allow the reader to follow the derivation of any evidence from the initial research questions to the ultimate conclusion and vice versa, and is best visualized in the concept mapping of trends, uncertainties, dynamics and

scenarios in paragraph 8.6. Furthermore, audio files and interview transcripts are logically stored which enables to verify standpoints from the interviewees. Regarding the review, all stakeholders have been verified of the concept model and are asked for feedback. Although a scenario planning is different than a case study, the case-study tactic to review the final model by key participants is applicable in both cases. Important is that interviewees were asked firstly to come up with their own observations, before the interviewer shared the for that moment most up to date findings. This enabled participants to independently come up with their own vision and thoughts, which are directly verified by the most up to date findings.

Internal validity examines the degree to which the change in the dependent variable is caused by a change in the independent variables (Bhattacherjee, 2012). Since the dependent variable (the future outlet of DLP-facilitated interbank payments) is multidimensional and as it is purposed for future application, and causes and effects cannot be determined, only potential causes and effects can be taken into account. To analyze this, the scenario forming steps in paragraph 8.7 and the consistency check of paragraph 8.8 relate the different and heterogeneous uncertainties with each other, stabilizing internal validity.

External validity determines the generalizability of the study towards other people, organizations, contexts and time (Bhattacherjee, 2012). To ensure external validity, interviews are held with actors from different organizations in different international contexts. As the sole purpose of a DLP is to have a general payment backbone solution, functional generalizability seems sufficient. A threat to the external validity is that only employees from one bank, the Rabobank, are interviewed. As banks, at least Dutch banks, function mainly the same, the assumption is that the various views of the participants of the Rabobank are generalizable to the whole banking sector. The same assumption counts for the generalizability of opinions and backgrounds of DLP creators, payment service providers and the regulator. The mitigation factor in this is that most participants spoke from their own personal view, and did not represent an institution's view. Regarding the current low state of knowledge of DLPs and the various field related to it, most relevant companies will not have a strategy or common view how to address these new technologies, which reduces the impact of this validity threat. At last, the fintech industry contains a high variation of financial services providers, which all might have some unique characteristics. Due to limited time and resources, it is not possible to interview participants from all (types of) financial service providers. An interesting study incorporating most attitudes of financial institutions in the US is the feedback on the consultation paper from the Federal Reserve, which called the industry to respond on assumed gaps in the American payments industry.

Wieringa & Daneva (2014) state that case based generalization can occur by generalizing components and mechanisms found in the case, by similarity. This is generalization method is used in this research, whereby components and mechanisms are extracted from the case study of the Ripple protocol in chapter 6, which are in turn used to form trends and uncertainties ultimately forming the scenario planning. This type of generalization enables to look beyond the Ripple protocol and focus on the more general DLP technology, thereby enabling multiple DLPs to be taken into account. In order to generalize to the main concept of a DLP, the study about the Ripple protocol is treated as case study while the main concept is the more abstract, overarching DLP. An indirect threat to the external validity is the sensitivity of information. Most participants agreed that DLP technology might heavily disrupt the financial industry, which may result in the disappearance of some actors. Each actor should work on a strategy to steer into a scenario in which its company has a valid business case, and as this strategy is sensitive it may not be shared explicitly (the case of Ripple Labs) or implicitly. Interviewees might be biased to see only trends, uncertainties, dynamics or scenarios which enable their companies to keep a profitable business case.

Reliability estimates that if another researcher would follow the same research procedures as described, he would arrive at the same findings and conclusions (Yin, 2013). This is questionable, as this study investigates a future phenomenon. Characteristics of this phenomenon can change on a daily basis, which makes this research highly time dependent. Next to this, many design issues need to be made to arrive at a scenario planning including just four uncertainties and each researcher would choose its own design issues, as feedback from the interviewees did not indicate a single best possible scenario planning. If another researcher would follow the same procedures and make equal design choices, he presumable will arrive at a similar model, and more important, including the same basic information about trends, uncertainties and dynamics. To be able to verify this reliability, audio recordings, interview notes and the PowerPoint slides used to support and steer the interview are stored and accessible.

8. Scenario planning

This chapter describes the fulfillment of the various scenario planning steps introduced in the previous chapter and concludes with the iteratively derived scenario planning. Information presented in chapters 4, 5 and 6 regarding background information is used to give reasoned statements about crypto currencies, DLPs or interbank payments. Terms introduced in these chapters and in the introduction chapter of this research come back, therefore it might be useful to use the Glossary of this research when reading this chapter.

8.1 Scope

The scope of this scenario planning is decentralized ledger platforms for interbank payments. Current DLPs are often accompanied by native crypto currencies. All current and to-be-developed platforms are taken into consideration and are named in paragraph 5.3. Scenarios should describe alternative ways in which the decentralized ledger platform can be of use for interbank payments. Note that also customer to customer payments nowadays mostly flow through multiple banks, which are thus also interbank payments. Further scenario planning-specific scope choices are discussed in paragraph 7.1.

The goal of a scenario planning is to sketch alternative scenarios, from which one of them might happen in the future. This is impossible to indicate without assumptions. Therefore, used assumptions are:

1. Some type of a DLP is adopted to facilitate interbank payments. This assumption clearly states that the focus is on how the financial architecture might look like if such a platform is adopted, not what influencing trends and uncertainties are concerning whether such a platform gets adopted.
2. Regulators do not forbid the use of crypto currencies.
3. Decentralized ledger platforms will be further developed and banks will follow these developments.
4. No solution will be presented for an alternative international settlement system which also delivers low fees and instant settlement.
5. No detrimental hacks occur in which the technology itself can be blamed. Because, if this happens, regulators and major adopters might lose their interest in these technologies.
6. DLPs are scalable if taken into mass production by financial institutions. Currently consequences of scaling up transaction volume is yet unknown. Important is the distribution, use and properties of the crypto currencies, but also performance characteristics of a distributed network.

8.2 Stakeholders and experts

Stakeholders and experts are invited to participate based on their backgrounds, expertise or industry. Employees from incumbent financial institutions (Rabobank, Equens), from new entrants (Ripple Labs, Hyper, Epiphyte) and from regulators (DNB) are interviewed, including a futurologist. Interviews have taken place at Rabobank Utrecht for Rabobank employees, by Skype for cross-border interviews or on location by the stakeholder (DNB, Equens, and Neoversum). Each interview took between 1 hour and 2,5 hour. The interviews were semi-structured by means of a PowerPoint presentation which introduced the scenario planning concepts, enabled participants to come up unbiased with their thoughts on trends, uncertainties, dynamics and scenarios and helped to validate the current state of knowledge.

Each interview is textually summarized and iteratively analyzed by means of the open coding technique. The open coding technique is the best fit to identify concepts and key ideas, hidden within textual data which are potentially related to the phenomenon of interest (Bhattacherjee, 2012). This open coding technique is used in most parts of this research, as it enables to exploratory build a model from the ground to gain understanding of the phenomenon of interest, which is the DLP-facilitated interbank payment. Each interview is analyzed by mapping disclosed information to trends, uncertainties, dynamics or scenarios, after which these scenario planning blocks are iteratively updated. Once the basic set of concepts was identified, these concepts are used to code the remainder of the data, while simultaneously looking for new concepts and refining old concepts, as proposed by Bhattacherjee.

Internal stakeholders from Rabobank

Several departments in Rabobank will be influenced by an adoption of a DLP. Stakeholders are not selected based on their power or interest regarding such an adoption, but on their knowledge of DLPs and their different backgrounds.

Innovation department
The innovation department ran a project group to investigate the Ripple protocol. This project group has a great understanding of the Ripple protocol and other DLPs and its input is therefore very valuable. The following persons participated:

- Roel Steenbergen, supervisor of the project group and this research. As Roel had the responsibility on meta-level to supervise both projects, he is not interviewed. Roel participated in reviewing information and providing feedback
- Jochem Baars, initiator of this project
- Daniel Hes, business consultant of the project group
- Rob Guikers, IT consultant of the project group
- Roy Duffels, former project manager

Network management
Network management is responsible for correspondent banking relations and use of the various financial systems situated in the interbank payments ecosystem described in chapter 4.

- Kanika Dua, Global Network Director, affiliated with the Ripple project group

Compliance
Compliance is of great importance for financial institutions. All types of financial activities needs to be legislated and accepted by regulators. Therefore, a compliance officer can shine lights on barriers or possibilities regarding compliance aspects of scenario characteristics. The following person participated:

- Sander Reerink, Information Security & Risk Manager

Standardization
Without standardization multiple parties have difficulties in efficient collaboration. Standardization is necessary to achieve globally used business processes and protocols, facilitating mass adoption. The following person participated:

- Evert Fekkes, business information manager. Member of W3C Web Payments Interest Group

External stakeholders
Other Dutch banks
Alternative Dutch banks can be viewed as competitors, but also as potential collaboration partners. There are no interviews held with employees from other Dutch or foreign banks. On the one hand this is not detrimental as each bank should come to the same analysis and conclusions, on the other hand is it more difficult to validate one bank's findings and a threat to the generalizability of the results.

Payment Service Provider (PSP)
The European Parliament has distinguished six categories of payment service providers: credit institution, electronic money institution, post office giro institution, payment institution, ECB and national central banks and member states or local authorities. Equens is a Dutch clearing house and also settles SEPA Credit Transfers (SCT), SEPA Direct Debit Core (SDD Core) and SEPA Direct Debit B2B (SDD B2B), therefore directly competing with EBA. At this point Equens is mainly used for national fund settling and iDeal transactions. The function of Equens described here is that of a payment institution. A 'payment institution' is defined in the Payment Services Directive ('Directive') as a legal person (incorporated) that has been granted authorization to provide and execute payment services, such as placing and withdrawing cash on a payment account, throughout the European Community.

The following person participated:

- Eric van Vuuren, Business Developer Advisor at Corporate Strategy, Equens

Regulator
A crucial role in accepting DLPs is the regulator. The Dutch regulator is De Nederlandsche Bank (DNB). DNB can shine light on future regulation mechanisms and possibilities which can create or remove barriers for adopting DLPs. The following persons participated:

- Mirjam Plooij, Policy Maker, Retail payments policy department, De Nederlandsche Bank

- Melanie Hekwolter of Hekhuis, Trainee, Retail payments policy department, De Nederlandsche Bank

DLP providers

Most knowledge and competences in DLP shall be found at the DLP providers. In this case, the most profound DLPs are invited for an interview which try to facilitate interbank payments with a DLP. Note that Bitcoin is not included, as Bitcoin's perspective is to enable payments without third parties as banks. Two DLPs did participate: Ripple Labs and Hyper. Stellar and Open Transactions did not respond. The following persons are interviewed. Next to this, the CEO from Epiphyte is interviewed, which business tries to bridge the gap between established banking systems and cryptography solutions. Epiphyte does also provide DLP-alike services, although it is not a DLP as it does not provide a proprietary ledger. The following persons participated:

- Welly Sculley, Head of Business Development, Ripple Labs
- Edan Yago, CEO, Epiphyte
- Daniel Feichtinger and Dan O'Prey, CTO and CEO, Hyperledger

Consultants

Consultants have as job to research a particular subject and give advisory about a potential implication or implementation. Key issue for a consultant to be interviewed is that he should be working in a DLP relevant sector and had sufficient knowledge of the technology. The following person participated:

- Robert Jan Vrolijk, independent payment consultant

Futurologist

Futurologists do not forecast the future, but research the future. Futurologists identify current and future trends and research whether consequences of particular lines through history are continued in the future. The futurologist who participated had good understanding of the Bitcoin and the blockchain technology. The following person participated:

- Paul Ostendorf, Futurologist, Neoversum

Table 8.1 below summarizes the interviewed stakeholders and experts.

nr.	Participant	Code	Company	Job title	Date
1	Rob Guikers	RG	Jibes, Rabobank NL	Technical Innovator	21-01-2015
2	Daniel Hes	DH	Ordina, Rabobank NL	Payment Consultant	21-01-2015, 28-01-2015
3	Edan Yago	EY	Epiphyte	CEO of Epiphyte	03-02-2015, 14-02-2015
4	Sander Reerink	SR	Rabobank NL	Compliance Officer	10-02-2015
5	Evert Fekkes	EF	Rabobank NL	Business Information Manager, participant in W3C	11-02-2015
6	Welly Sculley	WS	Ripple Labs, developers of the Ripple protocol	Head of Business Development	11-02-2015, 23-02-2015
7	Kanika Dua	KD	Rabobank International	Global Network Director	18-02-2015
8	Daniel Feichtinger, Dan O'Prey	Hyp	Hyper, creators of Hyperledger	CTO and CEO	18-02-2015, 26-02-2015
9	Roy Duffels	RD	Rabobank NL	Innovation manager	23-02-2015
10	Robert Jan Vrolijk	RJV	independent	Payment consultant	24-02-2015
11	Paul Ostendorf	PO	Neoversum	Futurologist	25-02-2015
12	Jochem Baars	JB	Rabobank NL	Strategy & Innovation Manager	03-03-2015
13	Mirjam Plooij, Melanie Hekwolter of Hekhuis	DNB	De Nederlandsche Bank	Policy maker and Trainee, Retail payments policy department	04-03-2015
14	Eric van Vuuren	EV	Equens	Business Developer Advisor at Corporate Strategy	16-03-2015

Table 8.1 Interviewed stakeholders and experts

8.3 Trends

Many global and fintech trends are of importance nowadays, but not all trends are relevant to the scope. Some trends do currently impact the adoption of DLPs for interbank payments but might in the future be of less importance, other trends are now loosely coupled to DLPs but might in the future be of great importance. After the first few interviews, it became clear that there are two types of trends. The first type is the global trend, which describe global events and developments which might in the future direct the adoption of DLPs. These trends are not specifically related to DLPs. The second type is the DLP specific trend. This type of trend is about events and developments directly related to DLPs and which have a direct impact on the adoption of DLPs.

As described in the methodology in chapter 7, all trends discussed below are mutually thought of and agreed upon by all involved stakeholders and experts.

Global trends

Trend 1.1. Privacy

Privacy is the ability of an individual to seclude (information about) himself, thereby expressing himself selectively. One's privacy is harmed if more information about him is spread than he has (in)directly agreed upon, and given the digitization of the past few decades there are countless ways to harm one's privacy. The privacy trend is also a follow up from the Big Data trend. Big Data is the gathering and connecting terabytes of available data in order to draw conclusions based on aggregate values. With the focus on Big Data, more data itself has been captured and connected, and with certain queries it might be possible to link data to one individual or a group of individuals. If this is the case, privacy is harmed. The Dutch MKB-trends (MKB = Small Medium Enterprises), include the trend 'from privacy to trust' in their trend list for 2015 (Dutch Network Group, 2015). As important privacy is in the Netherlands, it is surprising how indulgent other countries are towards the use of privacy-sensitive data. In the spring of 2014, there was a huge debate in the Netherlands about the ING bank, which wanted to enable advertising opportunities to clients based on their payment history. Many protests resulted in rejecting this plan, although according an article of De Correspondent (2014), the Bank of America and HSBC already accept that third parties advertise to the bank's clients based on their payment history. Therefore it is not sure to what extent this is an international trend.

Future DLPs thus need to be able to accept different privacy modes for different countries, or the level of privacy of the most privacy-protecting country needs to be honored. Financial transactions should be private, but not anonymous according legal frameworks, although the so-called freedom fighters vote against this and desire the continuous possibility of anonymous payments.

Feedback participants

Rob and Melanie & Mirjam mentioned the privacy paradox. On the one hand, people tend to publish more and more private sensitive information about themselves, while on the other hand critical debates emerge once a certain company wants to use this information, as seen in the example of ING. To illustrate the first, Venmo is a highly used app which shares all your payment activities (for example splitting a bill) with your friends. Quartz (2014) reports comments of over-30s to this mass publication of financial transactions. The sharing of this information illustrates the first leg of the paradox, the noise made about it by others illustrates the contradicting second leg.

An interesting philosophical question asked by Roy and Paul is if private citizens have the right to do anonymous transactions. Cash payments for example, is a current way of paying anonymously; only the sender and the receiver will know about it. But with the current decrease of cash transactions, cash might not be used that much anymore in the future, which can automatically reduce the options to anonymously transact. Paul gave as example the tokenization feature of Apple Pay, which allows users to pay a merchant without providing payment information. In this case some regulatory instance might always be able to see one's transactions, but merchants or other beneficiaries not. As Robert Jan pointed out, massive use of a DLP might decrease the shadow economy, which has its positive and negative consequences.

Trend 1.2. Digital Identity

Closely related to privacy, is the (digital) identity of end-users of blockchain technologies. Privacy determines what parts of one's identity needs to be hidden or not available, while identity is about authentication and

authorization. A trend of the last years is the understanding that passwords are perceived as the weakest element in our digital security, and authentication needs to be based on biometric identities, as finger prints, voice or face recognition (Digital Trends, 2013). Passwords can get hacked or stolen in batches of millions, and are therefore not secure anymore. This trend indicates that future technologies will more and more rely on other, more reliable authentication mechanisms. Therefore, it might be crucial if these technologies solely rely on traditional passwords or secret keys, or also have the possibility to include other (biometric) authentication mechanisms.

A recent interesting development is the creation of the Windhover Principles, by 21 top Bitcoin and digital currency companies. These Windhover Principles address digital identity, trust and open data, and can act as a sort of standard framework for the involved parties. Some participating parties are BitPay, Bitstamp, Epiphyte, Ripple Labs, SnapSwap and Swarm (ID3, 2014). "The next phase of Internet growth requires a re-tooling, with identity and trust at the foundation, to bring the ownership and control of personal data back to the individual. Doing so will spawn a new stage of collaboration and open data exchange," said ID3 Managing Director Dan Harple. There are four leading principles in the Windhover Principles framework:

- Individuals and groups should have control of their digital personal identities and personal data.
- Enhancing/improving personal privacy while promoting effective governance and accommodating legitimate auditing and enforcement needs.
- An effective, autonomous identity system reiteratively furthers trust, security, governance, accountability and privacy.
- An inclusive, open source methodology to build systems that embody these principles.

Future identity devices should be as accessible and mobile as possible. In that perspective, the chance is present that ultimate identification takes place through mobile phones, as this is most often carried on by individuals and can be relatively easily equipped with multiple authentication mechanisms.

Feedback participants
Welly said that an open source protocol such as Ripple can easily accommodate existing regulatory requirements, and that offering a trustworthy digital identity helps financial institutions and their customers to easily comply with regulations. In answer to concerns that a DLP such as Ripple could benefit criminals, Welly compared DLPs with the telephone. It is true that the introduction of the telephone allowed easier communication for everyone, including evil-doers, but it also created a new, more transparent way to monitor all phone communications. Similarly, DLPs can offer great transparency over financial transactions for law-enforcement officials. Paul discussed the resistance to new biometrical identification methods as the finger print or iris scans and agreed that one technology in itself may likely not work for 100 %. But, combining several biometrical identification technologies should deliver an almost perfect authentication system. Dan & Daniel assumed that there would come universal ways of identifying individuals, in order to be able to globally offer and adopt certain digital platforms.

Trend 1.3. Change of traditional banking models
According to The American Banker (2014a), traditional banking models will be under an even greater threat in 2015. This is closely related to the current decline of brick and mortar banks, mentioned in a trends and developments list of the Dutch site Banken.nl (2014). In a report of the Dutch newspaper NRC Handelsblad (2013) is reported that after the financial crisis in 2008, 46.000 jobs in the banking and insurance sector have been lost. In a time period from 2000 to 2013, 31 % of the employees lost their job in this sector. A more recent news article (De Telegraaf, 2014) reports that thousands more jobs will disappear at the major Dutch banks. The cause for these job and branch reduction is an end result of the globalization and digitization of our world. Most banking activities (doing payments, lending money, advice for mortgages) can nowadays be carried out online using straight through processing and automated decision making procedures, which makes local bank offices increasingly redundant. Also, current IT-solutions enable mobile payments, web-based payments and other services which replace employees which former took care of these activities. According a report of Accenture (2013) about Banking in the year 2020, disruptive change is coming for financial institutions. Figure 8.1 below present these expected disruptive changes.

Figure 8.1 Disruptive factors are impacting banks from all sides. Source: Accenture (2013)

The continued consolidation, the digital inside and outside and the subdued economic outlook are al represented in this third trend: a change in the traditional banking model. Other disruptive factors are discussed in some trends below.

Feedback participants

Daniel H. stated that as a result of this globalization, it is increasingly more difficult to be unique as a bank. This might result in a massive consolidation, which in turn might result in a decrease of internationally placed offices by multinationals. One reason for a multinational to have an office in an abroad country is to be able to do fast and cheap financial transactions. With the use of DLPs, this reason may disappear. According Edan and Paul, this means also that payment margins keep decreasing. Multiple participants indicated that banks currently lose money from facilitating payments, and need to change in this. Or a bank should find a new role with a better business case, or a bank will eventually have to withdraw from the payments industry and earn its profits with other products, according Robert Jan. In reaction on this, Welly adds that although these payments margins decrease, due to the intensive use of a DLP the total amount of transactions might increase which can lead to a better business case for the banks involved. A comparison is drawn with Uber, the platform which connects non-official taxi drivers to the taxi-desiring citizens, which led to a significant increase of the total taxi service-market.

Evert stated that the dynamics of the European payments have changed. First mainly national actors played a role in the payments industry, currently all actors are at least active in multiple countries (for example European area). In the future only global players may remain. This corresponds with Jochem's words, who sketches the uncertainty consolidation versus variation. Or a few big global players will be responsible for the whole financial industry, or the future financial sector consists of many small actors which offer a specialized service. Eric thinks the future will be more fragmented, because people are better equipped to work with technology and use the means that are for them most convenient and seem most reliable. Everybody has their own values, and therefore many niches will co-exist and result in a variety in financial services.

Trend 1.4a. Strict regulation

The fourth trend addresses changes in regulation, in two aspects. The first aspect concerns a more strict regulation, caused by the financial crisis in 2008. This trend is also mentioned in Figure 8.1 under expanded regulation, conceptualized by the statement that new rules will increase capital requirements and cost the average bank 2.5-3.5 percent in pretax Return on Equity (Accenture, 2013). Banks need more liquidity to be less vulnerable in case of a crisis, and regulators keep this under tight regulation. A direct result from this is the stress test for European banks, initiated in 2010, which simulates how banks would perform in a financial crisis. For 2014, most banks passed. 25 banks failed the test, situated in Italy, Austria, Belgium, Greece, Portugal, Cyprus and Ireland (Elsevier, 2014).

Feedback participants
This trend was first mentioned by Edan, who pointed to the increased capitalization and collateral requirements as a result of the crisis. Kanika confirms this, by appointing counterparty risk and liquidity risk as big topics nowadays. This has as consequence that nostro accounts are less funded. Paul added that the government creates extra rules in order to prevent banks from collapsing.

Trend 1.4b. Regulators push for faster and cheaper payments
The second manner in which regulation forms this trend is noteworthy. Regulators push banks for creating or enabling better services, in this case faster and cheaper payments. An American example of this is the FED, which addressed in a consultation paper (The Federal Reserve Banks, 2013) several gaps, in which the lack of real-time (cross-border) transactions was a significant one. In addition to this, a news article of the American Banker (2014b) stated that the FED pushes ahead for a faster payments initiative, therein describing its mission statement as: "The Fed's goal is to ready the U.S. payment system to meet evolving end-user needs for speed, efficiency and security." This implicates that no longer banks determine what their customers need, but the customers itself, represented by the regulator. In a public comment on this consultation paper from J.P.Morgan Chase & Co (2013), the bank expressed genuine support of technological innovation, but also pointed to the business side and new business cases. To quote:

> *"JPMC is supportive of further innovation around near-real-time payments and wants to see the industry proceed with new solutions that make sense, recognizing that the industry is already at work on several such initiatives. The Federal Reserve can lead the industry dialogue on near-real-time payments innovation which have value to all stakeholders and meet the Federal Reserve's safety and soundness requirements.*
>
> *The industry has long talked about a "FedEx" model, where end users pay different prices for different levels of speed, certainty and information around payments. We believe this is fundamental to the successful implementation of a real-time payments initiative, and that the use cases need to fit into this model, where users will actually be willing to pay for the increased speed they are receiving."* (J.P.Morgan Chase & Co, 2013)

Interesting to see that although this 6th greatest bank in the world is supportive for technological innovations to speed up payments, it points to increased fees earned by banks in trade for fast payments, which still has to be paid by its customers.

On the one hand regulators push for faster and cheaper payments, on the other hand regulators try to lower the thresholds for new companies to join the financial service market. A sign of this changing attitude is the accepted entrance of third parties which perform banking activities, without being a bank. A great example of this is Sofort, which enables bank's customers from about 10 European countries to pay real-time by providing its users a proxy to their bank's banking system. Payment Network AG, the former name of Sofort, issued a complain to the European Commission noting the concern that the market seemed locked for new entrants, thereby creating a monopoly position for banks. After investigation, the EC took the standpoint that there is free entrance to the market, also for non-bank entities (Internetkassa, 2013). This standpoint takes also form in the PSD (Payment Service Directive) regulation, which has a significant section about enabling TPP (Third Party Payments service provider) to carry out banking services. Next to this, PSPs (Payment Service Providers) become increasingly more important and regulation for these parties is also covered in PSD1 and PSD2. The Capital Market Monitor from IFF (2014) cite the 2012 report by the Committee on Payments and Market Infrastructures, which indicates that many countries around the world have been loosening entry barriers and opening the payments market up to nonbank companies in order to encourage efficiency and cost-reduction through greater competition and innovation. This opening of the market leads to new entrants, which is described in trend 1.5.

Feedback participants
Daniel H. mentioned this trend as first, thereby giving the example of Sofort, PSPs and TPPs. Banks do not innovate enough, therefore are intermediary actors entering the market and are thus backed and even encourages by regulators, visualized in the PSD2. Evert stated that once a certain payment product becomes a commodity, it is stripped to its basic functionality, thereby reducing margins. A consequence of reduced income on retail payments is the reduction of the related innovation budget, which can be a cause for partnerships between incumbents and fintech companies. An example of this is the regulating of interchange

fees, in which the European Parliament decided that the fee which an acquirer pays to the issuing party may not be higher than 0,2 % for a debit card. Another example was mentioned by Robert Jan, who stated that with the introduction of SEPA, value dating was no longer allowed by the regulator and money needs to be transferred within one day.

Dan & Daniel emphasized that each country, each state, has different laws which hinders a global payment solution. Thus, in the future a more common set of principles will be agreed upon by most regulations. There will always be extensions, but a universal understanding will emerge for regulating payments. This is confirmed by Kanika, who states that regulators are looking to regulate the payments market by standardization and opening the markets. An illustration of the problem of different regulations is given by Rob, who pointed to a news bulletin that Dutch banks are lobbying against Google and Apple Pay (Z24.nl, 2015). Using Apple Pay may compromise one's privacy and the security of payments, which causes Dutch banks to stand up against these American giants.

An interesting question is who determines the viewpoint of the regulator. Is this the regulator itself, or is this the individual citizen. Paul and Jochem recognize that the pressure comes from the bank's customers, who have an increasing need for real-time payments. It is the task of the regulator to recognize these needs of the customer, and use it to create a framework which allows and stimulates innovative and better payment methods. Once such a framework is in place, which can be the PSD2 or a new PSD3, new entrants or incumbent entrants can launch new payment technologies in which the ultimate beneficiary is the customer. Melanie & Mirjam point out that the call for faster payments comes in several countries from the authorities, but is at least in the Netherlands also originating from societal groups. Examples are the Dutch MOB (Maatschappelijk Overleg Betalingsverkeer; Societal Counsel Payments) and the European Retail Payments Board.

Although Eric confirmed the view that regulators push for faster and cheaper payments, for example by enabling access-to-the-account businesses (Sofort), he claims there is a paradox between rules and regulations banks need to comply on and the needs of the customers. Regulators and banks need to work out how to provide controlled innovation, probably resulting in changes for the current regulatory framework and a change at the bank to try, test, pilot and implement new technologies.

Trend 1.5 New entrants

New small entrants

The open source decentralized ledger technology can be used as a basis for multiple innovative payment solutions. As costs of developments are heavily reduced due to the open source nature, new ventures can afford to develop payment applications and bring these to the market. Examples of these new ventures are Ripple Labs, different types of PSPs and TPPs, the above introduced Sofort, and Epiphyte. These new small entrants might develop great systems which have the potential to be mass-adopted. New entrants can focus on various layers of the payment infrastructure, as visualized in Figure 4.2. The trend of emerging new entrants is also presented in Figure 8.1 (Accenture, 2013).

It is hardly possible for these small players to compete in short term with the incumbent players. Therefore, the fastest way to bring their technologies to the market is to collaborate with big incumbent players which take form in fintech investment, which is trend 1.8.

New big entrants

New big entrants are multinational, mostly online, tech companies who can host a – for example – the required rippled server and supporting systems, set up compliance mechanisms, earn trust of its large customer base and market makers, and can consequently act as a bank. As this immediately delivers the opportunity to facilitate near-free, instant and secure transactions, international clients can be attracted, which may walk away from their current bank (Capital Market Monitor from IFF, 2014). According IFF, nonbank companies actively pursuing new technologies that facilitate new digital forms of payment include large tech leaders, such as Facebook, Google and Apple or telecommunication operators such as Vodafone. These new entrants become competitors of banks as they innovate quickly and benefit from key advantages ranging from greater organizational flexibility, specialization, and risk tolerance, as well as fewer regulatory constraints and legacy costs. These big tech companies already have a huge customer base which eases a mass adoption of a new payment technology. Next to this, most relevant big tech companies have a great infrastructure and

architecture in place, which enables them to deliver a completely new service without too much effort and costs.

These new big entrants might be more influential, as they are capable of servicing financial products without the help of important incumbent players. Although, as Apple Pay still collaborates with several Master Card companies and many banks, it may not be likely that new big entrants can be competitive without collaborating with some type of incumbent.

Feedback participants
Daniel H. pointed out that new entrants should not be seen as a threat, but as an opportunity. Instead of rejecting new entrants, banks should embrace these newcomers and try to collaboratively innovate the payments industry. Welly pointed to the opportunity for non-incumbents to be created especially for the new industry (instant payments). In comparison, Facebook did not exist before the Internet, which learns that a new market may lead to new entrants which become market leaders. According Welly, both banks and non-banks might have a part of the pie in the payment infrastructure. Banks are protected by the fact that financial world is the most strictly regulated market in the world, which hinders new entrants to come in. But as described in trend 1.4b, this regulation is becoming less of a burden for new entrants.

Dan & Daniel also mentioned the tendency of large corporations to avoid the bank system altogether. These corporations can implement commodity hardware and function as a bank by themselves, using their supply chain to lend money. An example of this mentioned by Kanika is Traxpay, which facilitates B2B transactions without the use of a bank. This disintermediation might take place on short term and on small scales, but is not likely to be a prevailing business model in the future. If such a model would be massively adopted, the system will grow and get more complex, and will eventually become a bank itself. Melanie & Mirjam brought up platforms as Airbnb and Uber, in which individuals offer each other services as a room or a ride. Both companies are important new entrants in the lodging market and taxi market and have in common that individuals can use each other's services without involvement of intermediary parties, which often cuts costs significantly. The main question which rises is if individuals can pay each other without direct involvement of such an intermediary player. If this is the case, banks might get slowly removed from the payments market. A last alternative for a bank might be to be a main provider of such a platform, but given the troubles big companies have to innovate and the fact that they will be their own competitor, it is not likely that banks will try this business model. Melanie & Mirjam also point out that banks do have the choice now: they are in the market, they are trusted, and they have something to lose.

Dan & Daniel, and Melanie & Mirjam, pointed out that the new entrants are not financial companies going into the technology sector, but technology companies going into the financial sector. Following the words of Robert Jan, Evert and Paul, it is important to differentiate between the type of new entrants: what innovative technology do they offer? Paul sees three types:

- A concept or technology to carry value, for example Bitcoin or gold.
- A technology to transport value, for example Ripple.
- A technology to facilitate payments, for example Apple Pay. This type is merely about the front-end of payments.

New entrants can offer one type of technology, but can also be active in two or three categories. And as each entrant differs in its products and services offers, it is complex to compare new entrants with each other. Jochem recognized in the field of new entrants the concept of unbundling. In past times, it was economically profitable to bundle requests for services or products together. Currently, at is increasingly more possible to connect services of numerous providers with each other without much additional costs, actors in the financial industry might be many, small and varying, each providing one piece of the whole.

Multiple participants addressed the new entrants in front-end innovation, providing convenient and cheap services by user interfaces, and illustrate thereby Apple Pay. According Evert and Robert Jan, Apple Pay is a technology which alters the front-end of payments and thus changes the user experience, but uses the same clearing and settlement mechanisms from the payment cards industry. Future front-end payment methods providers should focus on customer experience and make payments as convenient and fast as possible. Related to this is the omni channel according Robert Jan, which facilitates a fluent transition of the same interface to different devices. Paul indicates that this front-end provider is also the main party to take care of the privacy of

the user, which for example Apple does by tokenization. As Kanika points out, consumer to consumer payments should be facilitated by several proxies and interfaces. For example, payments from Facebook to Facebook account or from telephone number to telephone number.

Eric pointed to the difference between incumbent banks and new fintech entrants: many new entrants target a niche market while incumbent banks need to provide products and services which are accessible and usable for everyone. This makes it complex for a bank to serve niche markets and give these new entrants the opportunity to become market leader in these niche markets, which may eventually replace the current markets. Eric also pointed out that banks and financial institutions are risk-averse, which hinders them to innovate quickly. At some points, incumbents might have to choose between risky innovating to keep its market share, or refuse risky innovations and drop gradually out of the markets.

A sub trend named by Melanie & Mirjam is the increasingly fast development cycles. Multiple examples are known of crowdfunding initiatives which collect millions of dollars in just a few minutes. Next to the nearly instant availability of resources, can talent, knowledge and media attention be found and distributed almost instantaneous which leads to increasingly shorter development cycles. According Paul, innovations increase exponentially. Paul predicts that due to the globalization and digitization, developers can go in depth in knowledge but simultaneously add a multi-disciplinary approach which will lead to exponential rise of new innovations. This sub trend enables that new entrants with great ideas can grow very fast and become a competitor of incumbents within a year.

Trend 1.6 Freedom of choice

Freedom of choice, or customer empowerment as mentioned in Figure 8.1 (Accenture, 2013), means that the individual has the ability and the freedom to choose what services fits him best. No longer banks define for their customers what they need, but customers can choose themselves what they want from which provider.

Feedback participants

Kanika recognized this trend as a generation act. Dan & Daniel see herein the globalization which facilitates that individuals are offered a worldwide range of products and services available, which gives increasingly less power to national leaders as they should now compete internationally. Robert Jan and Melanie & Mirjam addressed the issue that although individuals say that they want freedom of choice, they might need to have a limited set of conditions. Making and analyzing choices must be easy and trustworthy. So, the provider of these choices must be trusted and also open minded to include a variety of choices. As discussed in trend 1.5, banks can choose if they want to operate as a platform facilitating multiple internationally accepted payment methods, or if they want to be a payment provider themselves.

Trend 1.7 Speed and continuous availability

The desire for instant services can be seen as a result of the globalization and digitization of the world, which result in that citizens of developed countries expect everything to be real-time or nearly real-time. With all existing technology in place, customers will more and more expect their financial services to be instant. At least, the user-experience fed by the front-end interface should be instant. Translated to financial terms, this means that payment clearing should be instantaneous, but payment settling may take longer.

Feedback participants

Sander recognizes the STP (Straight Through Processing) as synonym for this trend, and point to the current payments. Years ago, national Dutch payments also took 3 days, but currently the settlement of bulk payments happens four times a day. TARGET2 enables faster European payments, and in the nearby future fast international payments should be enabled. Evert and Robert Jan added that not only payments should speed up, they should also provide continuous availability. Currently payments cannot be retrieved in the weekends or during holidays. Robert Jan also pointed to the current practice of international payments, which is money and time consuming. When 60 dollar is left of a 100 dollar transaction, while this same transaction takes a week time, it is not likely that this will survive on the long term.

According Kanika, the increased need for real-time payments is driven by mobile commerce and the desire of retailers to receive their payments directly. Melanie & Mirjam see the interest in faster payments, and think also that it starts with retail payments. After reforming the retail payments market, this trend may affect interbank payments. Eric points out that customers should be offered a twenty-first century experience, which

is (near) real-time and with great user experience. This means that batch processes might gradually disappear, and replaced my millions of single transactions.

Trend 1.8 Fintech investments

In trend 1.5, new small entrants were discussed. As new small entrants have a hard time to break through due to a lack of resources, organizational infrastructure, IT architecture and reputation, the fastest way and perhaps also best way to be successful is to collaborate with big incumbent players who are themselves not flexible enough to innovate. With these types of collaboration, mass-adoption can easily happen and a technology may become generally accepted if a major player (for example Facebook) offers the new technology to its large customer base. According Accenture in the Capital Market Monitor introduced above, worldwide investment in fintech ventures has grown from $930 million in 2008 to more than $2.97 billion in 2013, an increase of more than 200%.

Feedback participants

Roy stated that there are and will come thousands of fintech startups, which rise is accompanied with significant investments. Currently these startups are still in a niche level and need connections with incumbent players to have a chance to become successful, but this may change in the future.

Trend 1.9 APIs and Open Banking

An application-programming interface (API) is a set of standards programming instructions for accessing a Web-based software application. A company releases its API to the public so that third party software developers can design products that are powered by this companies' service. Open Banking is the result of new entrants and the opening of the payments market by regulators. Actors as Sofort need access to the core banking system in order to deliver services to the banks' own customers, and APIs make this possible. Furthermore, if access to the banking system is given to new entrants, they can create valuable services in which both the new entrant and the incumbent bank are essential. A consequence might be that the bank itself will not participate in the payments market directly, thereby losing its market share, although it might profit from opening up its architecture or retaining customers.

Feedback participants

Evert and Kanika call for standardization of financial transactions and the translation of fintech innovations to a set of usable interfaces. Certain messaging standards need to be agreed upon, for example the ISO 8583 and 20022 standards, to be able to send payment messages internationally to different financial institutions and new technology entrants. As banks will still hold the funds of the customer, authentication and authorization procedures offered by the intermediary player are of crucial importance. Roy highlights the fact that APIs are open source, which give the crowds the opportunity to massively use the opened up system to generate the most valuable services.

According Robert Jan, payments are increasingly taken away from the banks, while banks still need to support their IT infrastructure to provide access to third parties which offer better payment methods. As Daniel H. pointed out, banks are currently fighting to bind a TPP to earn the corresponding fees. As there are currently only a few TPPs and many banks, TPPs have a powerful position which they use to get cheap access to the banking system, while the banks lose money. Daniel H. recommends a long-term collaboration between a bank and a TPP, in order to together create the best and most beneficial services. Paul and Roy pointed out that as the margins will keep decreasing, only global providers of payment solutions will survive. If each single payment only delivers a few cents or even less, only the providers which transact millions of payments can continue their business. If this will happen still depends on the standardization of payment methods. As Paul stated, currently numerous payment methods exist and in the future one or a few payments methods might be left.

Summary of global trends

Table 8.2 below summarizes which trends are mentioned or approved by participants. The column 'Start' represents the trends which were known before the first interview. The following columns represent the naming or approving of trends. A '+' represents that the participant thought by himself of this trend, a 'v' represents that the interviewer mentioned the trend to the participant who approved it. Empty spaces means that the trend was not mentioned, and thus logically not approved. The last two trends were only incorporated by the interviewer after the 9th and 11th interview, and therefore were not discussed earlier during the

interviews. Some trends were successfully rejected by some participants, and therefore not included. On average approved all participants all trends, as all participants recognized all trends, although their opinions about the impact of the trend might differ.

Trends	Start	RG	DH	EY	SR	EF	WS	KD	Hyp	RD	RJV	PO	JB	DNB	EV
1.1. Privacy	+	v	v	v	v	v	v	v	+	v	v	+	v	v	v
1.2. Digital Identity	+	v	v	v	v	v	v	v	v	+	v	+	v	v	v
1.3. Change bank business model	+	v	+	v	+	+	+	+	+	v	+	+	+	+	v
1.4a. Strict reg.				+	+	+	+	+	v	v	v	v	v	v	+
1.4b. Pushing reg.			+	+	v	+	v	+	v	v	+	v	+	v	v
1.5. New entrants	+	v	v	v	+	+	+	+	+	+	+	v	+	+	+
1.6. Freedom of choice		+	v	v	v	v	v	v	v	v	v	v	+	v	
1.7. Speed		+	+	v	+	+	v	+	+	+	+	v	+	+	+
1.8 Fintech investments				+						+	v	v	v	+	+
1.9 Open Banking			+							+			v	v	

Table 8.2 Summarized input and feedback global trends

Some trends are very broad, some trends are very specific. Therefore, it is hard to quantitatively analyze the validity and relevance of each trend specifically. Trends relate to each other, which is visualized in the concept mapping in paragraph 8.6. As Jochem started, trend 9 is the consequence of 6, 7 and 4, 5 is the consequence of 9 and 8 and 3 are consequences of 5. As most trends depend in some form on each other, no comments are made about the relevance of these trends although all qualitative findings will be incorporated in the uncertainties, and ultimately the scenarios.

Rejected trends

Some more trends were mentioned by participants, but rejected from this overview as they have low relevance with the subject. These trends were: Internet of Things (Rob), Smart systems and fear of smart systems (Rob), awareness safety and behavior of money (Daniel H.), Big Data & Personalization (Daniel H.), payments used for political sanctioning (Edan), Mobile Banking (Sander, Evert), Separation within Bitcoin industry (Hyperledger), Reorganization of digital back-ends banks (Hyperledger).

The trend 'shift of trust' was mentioned by Rob Guikers and incorporated in the model, but later on rejected by Welly Sculley. A shift of trust refers to the assumed general opinion that users have less trust in central institutions or actors, but are more likely to trust the decentralized mass. This trend is eventually not included, as Welly pointed out that although decentralized systems gain a lot of popularity, users itself will always want a central actor which they can call for help, or blame, once unexpected activities occur. The discussion stays by the fact whether these central actors are merely enablers and platform providers such as Uber, or if these central actors are powerful and makes the choices for its client themselves.

DLP Specific Trends

Trend 2.1. The rise of blockchain applications

Bitcoin is invented in 2008 by Satoshi Nakamoto (Wiatr, 2014). Currently, start of 2015 there are 488 different types of crypto currencies (Coinmarketcap, 2015). Most of them still rely on the Bitcoin mining, but some also created their own consensus system. In a report from CoinDesk (CoinDesk, January 2015), 19 crypto 2.0 solutions are represented which might breakthrough in 2015. Crypto 2.0 is the application of blockchain or

distributed ledger technology to business cases other than digital currencies and payments (Coindesk, 2014a). The distributed blockchain is used for smart contracts, voting mechanisms, asset trading, stock trading, fundraising, etc. In principle each administration functionality requiring multiple validating and participating actors and trustworthy verification can be set up based on a blockchain, which decreases costs and increases security and reliability. This continuous attention from developers to the blockchain, consensus mechanisms and also crypto currencies ultimately might deliver top notch blockchain applications. As crypto 2.0 applications will not influence financial systems directly, it is expected that the developments of these applications is of most advantage. Different applications learn from each other, sometimes fork (copy open source code, change it slightly and distribute it as a new application) a complete protocol, which improves the quality of these systems which incumbents can use to improve their own systems or partner with these new entrants.

Smart contracts
A current interesting type of a blockchain application, next to the currency-agnostic trading platforms as Ripple, is smart contracts. Smart contracts, or smart programs, are procedures and rules which can be set for different wallets. Note that the concept of a wallet used in this research is simply a private/public key pair, in which the public key is the address of the wallet and the private key is used to sign transactions and transfer ownership of balances held in the wallet. Smart programs can work with different databases/ledgers/DLPs simultaneously, and can therefore be used as a bridge between different DLPs. With smart programs, money and wallet activities can be administered from one user interface. Paying monthly fees, or phone bills, or sending rewards after some criteria has been met can all be implemented into these smart programs. Smart contracts might increase the adoption of blockchain solutions, stimulate regulations and therefore speed up the further development and potential adoption of blockchain solutions for interbank payment purposes. According TheProtocol.tv (2015), the well-known companies IBM and Samsung join forces to come up with a project about smart devices, smart contracts and the blockchain.

Feedback participants
Welly sees these blockchain or ledger applications as The Value Web, or the Internet of Value. These applications should enable that one can transfer value as easy as one transfers information. Paul mentioned that Bitcoin arose at the same moment as the financial crisis, which might have been the perfect moment. The existence of blockchain or ledger applications points to the increasing power of the individual. The current popularity of open source programming and crowdfunding gives individuals the opportunity to come up with better solutions than big incumbent players provide, which empowers the individual. Next to this, Paul sees a greater set of variables and options enriching payments which do not fit in the current payment model. With the use of smart contracts, all sorts of agreements about payment terms, payments and delivery, guarantees can be incorporated into a smart contract.

Trend 2.2 Rise and decline of crypto currencies
Another 'rise' observed is the amount of crypto currencies. Nowadays almost 500 crypto currencies exist, while most of them did not exist 5 years ago. Based on the past, the trend is just the rise of the different crypto currencies, but regarding the future this amount might decline. Although most of these currencies try to become globally accepted by the world, only a few will survive while the rest of them may disappear.

Feedback participants
Sander firstly introduced this trend and pointed out that that many crypto currencies exist due to the ease of creating your own crypto currency. Welly added that the focus should be put on ledger technologies, and that crypto currencies are of inferior importance. Therefore, the amounts of crypto currencies shall decline. In addition, Welly thinks that stores of value as loyalty points might increase and be increasingly used in DLPs. Using DLPs, these stores of values are better spendable, tradable and easy and cheap to manage for the issuer of these stores of value.

Trend 2.3 First regulation of crypto currencies
In the Capital Market Monitoring report from December 2014 of the Institute of International Finance (IIF), attention is given to changing regulations. These changing regulations give more space for new entrants, as to be explained below, but also address the crypto currency and blockchain issues. A recent example of this is the potential regulation of Bitcoin companies. The New York State Department of Financial Services (NYDFS) announced to offer a two-year transitional BitLicense (Financial Times, 2014). This license is particularly useful for small companies which are yet building their operations. Comments from the industry on these licenses are

contradicting. On the one hand, regulation raises trust in crypto currencies and might convince new users to enter the crypto currency world as a customer or a business. On the other hand, action groups have been started, for example the EFF Action (2015), which want to stop the BitLicense as it attacks the privacy and anonymity of future Bitcoin transactions. As also explained in an article of the CNBC (2014) about this regulation, the NYDFS BitLicense requires Bitcoin merchant-payment processing companies to collect personal identifying information on every transaction, which completely deletes anonymity. Banks and governments might see the New York regulators involvement as positive, as other regulators might also develop crypto currency licenses which enables banks to step into the crypto currency business. So far, the Dutch regulator DNB has yet decided to not regulate Bitcoin activities so Bitcoin users should thus accept the risk of losing money. In a recently follow up of their 2012 report on Virtual Currency Schemes (VCS) from the ECB (2015), national responses from EU countries are summarized. In most countries Bitcoin and other crypto currencies are not supervised and not recognized as a payment instruments. Most governments withdraw themselves from Bitcoin activities, a few countries such as France and Luxembourg require companies that want carry out activities in the financial sector by means of a VCS to request authorization or receive a license from a governmental institution.

Feedback participants
Welly commented that not only crypto currencies, but also stores of value need better regulations and need to be taxable. As Welly among others expect, the use and popularity of stored values might increase if DLPs are accepted. Regulators should come up with a framework for holding, trading and reporting private or corporate issued stores of values, in the same manner as done for Electronic Money Institutions (EMIs). Welly also calls for a very strict attitude from regulators, as much value can be lost or stolen due to faulty implementations.. The implementation of strong regulatory procedures requires many resources, for which the incumbents might have a benefit over the new entrants. Dan & Daniel add to this that our notion of what a currency is changes. A currency is currently regarded as fiat money, but might in the future be a collection of fiat currency, virtual currency, crypto currency, a community currency, and stores of value. Customers might want to hold several different currencies in one or more wallets, for example a Starbucks wallet, what will cause a headache for regulators the coming years. Robert Jan added that some Bitcoin companies specifically have as goal to stay invisible and anonymize transactions. Although the Bitcoin itself cannot be regulated, the use of it can be regulated to the extent that Bitcoin facilitating companies accept this regulation. Paul stated that there should come a regulatory framework including a guarantee on financial security, in the same manner that the government now backs all bank accounts until 100.000 Euro. Next to this, there should be guarantees by the provider of the coin or the ledger system against malpractices such as a sudden creating of extra money.

Trend 2.4 DLPs and Retail payments
According 460 experts who thought of trends which will become important in 2020 (Equens, 2014), peer to peer payments will be an important trend from now till 2020. With peer to peer payments, traditional institutions can be bypassed in transacting payments. Giving this possibility of performing payments without intermediaries, new entrants who enable payers to send money without banks become competitors to banks. This can ultimately lead to more consolidation in the banking sector.

Although retail payments are excluded from the scope of this scenario planning, it is useful to keep an eye on this industry. As seen in trend 1.7, there might be a great business case for DLP facilitated retail payments which reduce fees and facilitates nearby real-time payments, which might lead to a great adoption under merchants, customers and payments institutions. This trend will not directly influence the scenarios, but it will influence adoptions rates, extra features, etc.

Feedback participants
Rob recognized this trend and names it as payments 2.0 (Betalen 2.0). Dan & Daniel stated that banks have increasingly less to say in everyday retail payments, this market might become entirely divorced from banks itself. Banks will merely be used to park your money, credit loans, and other financial products. Technology companies pick a specific payment service and offer this service to millions of clients. Banks cannot fight all these technology companies and stay competitive, so banks should strategically choose in what services they want to excel, and what services can be delivered by other companies, facilitated by a bank's API. Melanie & Mirjam foresee that banks will try to keep their market share in payments, to not lose touch with their customers which hinder them to analyze the markets. Next to this, they recognize the great demand of merchants to receive customer payments faster. Daniel H. includes the globalization and consolidation of the

banking and payments sector, and assumes that it is increasingly difficult to be distinguishable. Retail takes also place internationally, and companies as Amazon and Bol.com will have a say in who delivers their payment methods. Robert Jan considers the Bitcoin as a great alternative for future retail payments and will cause the retail market to shaken up.

Trend 2.5 Hacks of crypto currency exchanges

A more negative trend is the high amount of hacks of crypto currency exchanges. The best known example is the hack of Mt. Gox February 2014, by which 350 billion dollars in Bitcoin was stolen (Bright.nl, 2014) and ultimately caused the bankruptcy of Mt. Gox. Another hack occurred at Justcoin, a Norwegian crypto currency exchange, by which a combined value of XRP and STR (Stellars) was stolen with a worth of about 300.000 dollar (Globalcryptonews.com, 2014). The most recent hack was of the Hong Kong exchange MyCoin, which lost 386 million dollars of investors' money (Pando daily, 2015). Reasons of these hacks can be successful exploits of hackers, but also bad company management (named as reason for the collapse of Mt. Gox) or a faulty implementation (the Justcoin incident). If banks thus are to implement crypto currency technology, various security procedures should be in place to reduce the risks stolen value.

Feedback participants

The first participant who mentioned this trend was Sander, who expects that in the future more security hacks will take place. He thinks that if banks get involved, no hacks will take place as banks have a more than average security. If crypto currencies are involved, the worth of stolen assets can be millions.

Kanika, Jochem and Dan & Daniel balances the discussion by stating that each technology network in itself is vulnerable to hacks, thus also a crypto currency platform. A painful example of this is the recent announcement of the hacks of hundreds of banks and financial institutions, in which hundreds of millions are stolen (Security.nl, 2015). Dan & Daniel add to this that people will gradually not use exchanges they have never heard of, and that the amount of hacks will dampen down. In most cases, it is not the fault of the technology, which people needs to become aware of. Eric remembers to the current situation, in which money displayed at someone's bank account is also virtual and banks need also to provide sufficient authorization and security mechanisms to prevent money thefts.

Summary of DLP specific trends

Table 8.3 below summarizes which trends are mentioned or approved by participants. The column 'Start' represents the trends which were known before the first interview. The following columns represent the naming or approving of trends. A '+' represents that the participant thought by himself of this trend, a 'v' represents that the interviewer mentioned the trend to the participant who approved it. Empty spaces means that the trend was not mentioned, and thus logically not approved. On average approved all participants all trends, as all participants recognized all trends, although their opinions about the impact of the trend might differ.

Trends	Start	RG	DH	EY	SR	EF	WS	KD	Hyp	RD	RJV	PO	JB	DNB	EV
2.1. Rise of blockchain applications	+	+	v	v	+	v	+	+	+	v	v	v	+	+	v
2.2. Increase crypto currencies					+	v	+	v	+	v	v	+	v	v	v
2.3. First regulation	+	v	v	v	v	v	+	v	+	v	v	v	+	v	v
2.4. DLP & Retail			+	v	v	v	v	v	v	v	v	v	v	+	v
2.5 Hacks of exch.					+	v	v	v	v	v	v	v	v	v	v

Table 8.3 Summarized input and feedback DLP specific trends

Just as with the table of global trends, no quantitative analysis is made regarding the mentioning or approving of trends. All relevant qualitative data will be (in)directly used in the uncertainties, and ultimately the scenarios.

8.4 Key uncertainties

The key uncertainties in the scope of DLPs and interbank payments are outcomes of variables which cannot be agreed upon by stakeholders and experts and are of significant influence of the future landscape of interbank payments. The uncertainties are iteratively derived in collaboration with the interviewed stakeholders. These outcomes are selected on possibility of occurrence, not on likeliness of occurrence.

Uncertainty 1. How many banks adopt?
One of the most obvious uncertainties is the amount of participating banks. Collaborative adoption of a DLP is of crucial importance for gaining the full benefits mentioned in chapter 5 and 6. As the assumption is that some form of a DLP is accepted by banks, the outcome that no banks adopt is not an option.

The identified possible outcomes are:

- Only a few small banks adopt;
- Some small banks and big banks adopt;
- All banks adopt. Small banks might outsource technology implementation to big banks.

A related interesting question is, if there is such a thing as a critical mass. According common view, critical mass arises if a certain percentage of the potential adopters have adopted the new product, service or technology, thereby enabling significant efficiency benefits as many participants use the same concept and non-adopters might be attracted through the obvious benefits experienced by known adopters. Regarding DLPs, the critical mass might be very low. If for example each monetary region only has one Ripple-enabled bank, these banks can function as hubs between these regions, thereby already speeding up current correspondent banking networks.

Feedback participants
A related uncertainty mentioned by Jochem, which is closely related to the adoption uncertainty, is incremental versus radical adoption. The example given was of the mobile phone, which was over years incrementally adopted. With the launch of the iPhone, there was a radical adoption of smartphones. This uncertainty is not included in the set of uncertainties, as it merely indicates different forms of adoption and not different outcomes of adoption. A consequence of incremental versus radical adoption can be that one certain providers' product is radically adopted becomes the market leader. Another aspect Jochem mentioned was about the geography of adopters. Does it concern mainly banks for certain world areas, or is adoption internationally spread?

Eric stated that the greatest motivation to adopt will be found among small banks, as they need to pay most for and profit least from the current correspondent banking setup. Eric also pointed to the fact, that in case of Ripple, the presence of sufficient market makers is crucial. Most banks do not have an extensive international reach and are mainly present in one or a few countries. Especially for cross-currency transactions, banks might be too small to fund both legs of a transaction; they have not enough liquidity in both currencies. In this case, the market maker role will surpass banks and come in the hands of non-banking multinationals and investors with enough multi-currency liquidity to fund the network.

Uncertainty 2. Who is the technology implementer?
Next to the question how many banks adopt a DLP, the question arises if each bank manually implements the technology necessary to participate, or if (known) third parties will take care of this implementation. In case of the latter, the logical option is that a third party implements the technology and enables its members – the participating banks – by means of a proxy to do transactions by means of the decentralized ledger. Note that this uncertainty does not address what actor holds the wallet functionality, but what actor implements the technology. In case of Ripple, this means implementing the rippled and gatewayd server.

The identified possible outcomes are:

- Central banks implement the technology;
- Third parties as SWIFT or Equens implement the technology;
- Banks implement the technology themselves;

- All types of non-financial firms (supermarket, Starbucks, real estate company) implement the technology.

The implementing actor should be trusted and accepted by its members to be the technology implementer, and regulation should accept that these actors implement the technology. Consequences of each outcome can be significant. Note that the technology provider, which thus can be an intermediary party, implements the technology and will be main targets of hacking activities. The more actors are needed to implement the technology, the more the technology needs to be safe, secure and user friendly. If the technology is very complex to successfully implement and there are thousands of technology implementers, mistakes will be made which can lead to the loss of millions, which in turns reduces overall trust in the technology.

The technology provider is also the actor responsible for a continuously functioning system. These actors can in turn shift this responsibility to an IT consulting company who will install the technology for them, but the responsibility stays in between them. This actor, the 'technology installer', is not further explored, as it does not influence the ultimate scenarios.

Feedback participants
Edan does nog agree with this uncertainty, as it would be a shame to place this decentralized ledger technology into a centralized collaboration, when for example if central banks adopt it. Distributed ledgers are defined to create consensus without a central actor, and if you do agree on a central actor you do not need the decentralized technology anymore. Evert agreed that it is a new market, important for all actors but also quite complex. New regulation is needed and many risks can be identified. Therefore there is a need to implement it by a central actor, in order to take collaboratively the risk and responsibility. In turn Roy stated that because regulations supervise the system, they cannot implement it themselves. Regarding intermediaries, Kanika thinks that SWIFT will have to adopt something like Ripple or develop its own solution, in order to stay in the market.

Feedback from participants on the fourth outcome, that each willing business implements the technology, is highly contrasting. Interesting to see if that most bank employees reject this possibility due to complexity in supervision, while the non-bank participants ultimately vote for this most decentralized option. Dan & Daniel indicate that as the decentralized consensus technology is inherently trusted, mostly fully transparent and open source, it is easier for new entrants be become a trusted party due to their use of this technology. This increases chances for the fourth option. They say that on the other hand, people do not like a massive turnover in the financial world. Consumers will have a hard time to divorce from banks and trust unknown technology. Summarizing one can say that banks are highly and safe settled in the financial infrastructure, but they need to adopt these technologies to stay there. Jochem contradicts to this by saying that consumer trust does not depend on brand but on the services provided.

Paul thinks that we should desire an as decentralized possible structure, if possible. Payments are a massively used service, and can therefore be decentralized to business and individual level. More complex financial products should still be facilitated by banks. Paul's thought on this are further described in the consistency check of the scenarios in paragraph 8.8.

Melanie & Mirjam indicate that the technology implementer, if centralized, can also be the actor who sets up the legal framework, under supervision of the regulator. The actors involved usually have the most in-depth knowledge, which might get the time and space from regulators to come up with their own proposal of a legal framework. Eric points out that the technology implementer is also the one who determines what actors may use its wallets, and is therefore a powerful stakeholder.

Eric also states that there is a difference in simply implementing the technology to use, or also integrating it in the back-office of the provider. The implementation should also address messaging functionalities and connections with messaging networks. Also, the current legacy systems work with batches and it might not be possible to change these systems to single payment transactions, which might cause the development of whole new banking platforms.

Uncertainty 3. Is participation centrally regulated?

Currently DLPs are distributed, which means that anyone have access to the technology. This has as consequence that criminals or terrorists can also create wallets and run validating nodes. The network in itself cannot be withdrawn from unwanted participants, therefore some sort of policy might be needed to ensure that participating banks only transact with trusted financial institutions. AML, KYC and other compliance regulations might be only enforceable if there is an inner network within the DLP network which only consists of trusted and supervised participants, such as banks.

The identified possible outcomes are:

- Centralized participation. Multiple actors – for example national central banks – jointly agree on a compliance framework for participating financial institutions. Once these rules are met, a bank can be included in a whitelist and may get approved to do transactions via the DLP, under the restriction that it can only do business with other white list-approved financial institutions. This creates a closed network within the DLP itself. Use of a black list is also possible, although this is more complex as it is very easy to generate a new wallet address.
- Decentralized participation. Each bank determines on its own with whom it does business via the DLP. As regulators can check the books of a bank, it can verify with what wallet addresses a bank does business with, although this still needs a mapping of the name of the financial institutions to its wallet addresses. The mechanism of trust lines (in Ripple) is essential for disabling transactions to flow through not-trusted participants.

Feedback participants
Rob questions if this central participation takes place by one central party, which may be a joint venture of all participating banks or governing central banks, or if it takes place in a collaborate fashion among banks or central banks. Edan thinks that for example China, America and Russia never will agree upon one central actor. There will come a situation similar to the current one, central continental actors can collaborate but are independent. Rob thinks it is not of great importance, as the settlement of money still occurs through traditional systems which have their own control mechanisms in place. Dan & Daniel think it will end up in mix of both outcomes. There may be for example restrictions to send money to countries as Russia, included in an (inter)national whitelist or blacklist, but banks can still determine with whom they want to exchange payments through a DLP. It is the same situation as nowadays with correspondent banking: some banks can be forbidden to exchange with by the regulator, and otherwise banks can find themselves their correspondent banking partners.

Paul asks if governments are supervising use of a DLP actively of passively. A comparison can be drawn with the World Wide Web. Due to the Internet, each individual has the possibility to reach the whole world by simply creating a website. This facilitated a more distributed setup of sharing and obtaining knowledge. Regulators have a passive attitude, and do not supervise each website. The passive attitude of governments becomes visible if some law or court judgement determines that some website should be taken offline, which can be empowered by the hosting provider of that website. Jochem follows up with the question if banks or regulators have the duty to monitor payment transactions. Regulators thus have at least two tasks: allowing participation, and monitoring transactions. This uncertainty addresses the first task, while the second task is simplified by use of a DLP. Dan & Daniel agree on the latter, and foresee that regulators might benefit from several characteristics of a DLP. Once all transaction information is available online and in the same standard, it eases and automates regulation and improves transaction visibility for regulators.

Eric states that regulators can influence risks and benefits by stimulating, or forcing, stakeholders to offer certain products, services or margins which might lead to profitable business case of other stakeholders. Regulators need to take a public standpoint regarding the use and offering of DLP functionalities and change regulations if it gets accepted in any form. Eric also states that money movement (clearing & settlement) is the strongest regulated industry, and builds on trust, guarantees and reciprocal dependencies. Maybe low value payments can get regulated, but before high value DLP payments get regulated the new technologies need to prove themselves and a regulatory culture change needs to happen.

Uncertainty 4. Is the DLP centrally distributed?
Most DLPs are currently open source, which means that no individual or company is responsible for maintaining the protocol and solving bugs. This can be problematic, as when bugs are discovered in the system, it is not certain if the platform creator or other parties are willing to create a patch (software update).

Therefore, it might be likely that organizations will be created which sell commercial distributions of platform to corporate entities, including maintenance services. A clear distinction must be made between the protocol (a set of rules which forms a standardized format) and the supporting systems. In case of Ripple, the protocol is RTXP and basically defines what wallets are and how payments can be cleared between two wallets. A supporting system consists of the software needed to become a validating node in the Ripple network and to become a gateway server. This supporting software is critical, as a faulty implementation can lead to hacks. A comparison can be drawn with email. The protocol is SMTP which allows different email providers (Hotmail, Yahoo, etc.) to communicate in a standardized way with each other. The supporting system is the SMTP server itself, which can be retrieved from different providers, for example Postfix (IBM), Groupwise (Novell) of the Microsoft Exchange Server. This uncertainty addresses the provider of the supporting system, while the 5th uncertainty addresses differences in standards distributed.

The different outcomes break down by patching rules. For example, the Ripple protocol has a current patching procedure that 80 % of the validating nodes need to accept the proposed change to accept this change. Banking entities might not be comfortable with this, as this means that if 80 % of unknown entities accept a certain change; they have basically no choice then to accept this change to keep connected. They can reject the change, but as this results in solely following the previous ledger, they cannot transfer anymore with the other participants.

The identified possible outcomes are:

- Participating banks collectively set up a joint venture which develops and distributes a proprietary own platform.
- Participating banks buy use of a DLP from a corporate software company, including services as maintenance and indemnification issues. This will involve contractual agreements. This distributor should have adequate financial means in order to compensate adopters if a distribution contains bugs which lead to discontinuity or a loss of (virtual) money. This platform can be open source (like Red Hat) or closed source (like Oracle).
- Participating banks use the freely provided software developed by the open source community, and trust the community and platform developers to patch the system if needed. This will not involve contractual agreements.

Feedback participants
Daniel H. thinks that it is not for banks to make this choice, but that banks will be told by regulators what form to choose. Rob indicated that banks should trust the provider of these platforms, which might be only possible if enough indemnification services and maintenance possibilities are in place in order to move responsibility to the platform provider.

Rob stated that the third option is more critical, as no one assures that if there is a critical bug, it will be fixed. Another point is that how more owners and members such a platform has, the longer it takes to verify proposed changes with all developers. Also, if a platform is open source it might take very long to create consensus among the high amount and variety of developers. A closed source distribution from one single provider will reach faster consensus, and is thus more flexible. Edan expects there will be companies that provide proprietary services on top of the open source model, which can be a mix of the second and third outcome. An example of this is the products of his company Epiphyte, which deliver solutions which may use the underlying open source Bitcoin or Ripple protocol.

Evert adds that the first and second outcome can take place by third party auditors who check and control the most recent open source distributions. A platform distribution by a corporate (jointly owned) company can include just code audit, but it can also involve own development. The open source movement is important for the quality development of the system and this should be reduces as less as possible. Paul also confirms that the open source movement is the best guarantee against system vulnerabilities: the more people (can) check the code, the fewer bugs it will contain. Rob indicates that ownership is also important. In the first outcome, banks do own the platform. In the second outcome, the platform providers own the platform while in the third outcome no one owns the platform. A comparison can be made with SWIFT and Equens, both important actors in the current payment industry. SWIFT is mutually owned by all banks, while Equens is independent and offers it services to banks.

Dan & Daniel add that in the first outcome, banks can adopt and customize existing platform, or they can rebuild a platform from scratch. Noteworthy is that if a group of banks jointly supervises a company which distributes a platform for its members, the international representation of its members is important. If it only includes for example American and EU banks, the Chinese and Russian banks might choose to create their own joint venture which develops and distributes a platform in which they have all power. Robert Jan adds to this, that when for example Ripple Labs is acquired by a collection of banks, other banks will refuse to adopt Ripple as they then heavily depend on the actions and vision of this collection of banks. Banks do not want to depend on each other. How this evolves can heavily depend on Ripple Labs, as they are now a major actor in this field. If Ripple Labs for example starts to ask fees or demands services, for example for becoming a validating node, it can drive potential adopters away which then will form their own platform distribution.

Melanie & Mirjam wonder how much validating nodes there should be, in order to have a completely decentralized network. And, how can one guarantee that there will be enough validating nodes in the future to keep the network running smoothly. The more decentralized the infrastructure setup, the higher the chance that there are enough nodes, but the lower the guarantee that there are enough nodes. This uncertainty can be simply but costly covered by running a certain amount of nodes yourself as adopter.

Eric states that currently Earthport is such a vendor, and that it is important for participating banks to determine how much influence they have on the used protocol. Therefore, is a first distribution of a protocol adopted or will participants wait until a version is more stable version ran smoothly for some time. In this case, outcome 2 and 3 can happen simultaneously whereby the open source movement develops the protocol and tests new functionalities and vendors use a previous protocol version.

Uncertainty 5. Do multiple standards co-exist?
Uncertainty 4 addressed the centralization and influence structure of the distributer of the DLP, the supporting system used for communicating and sending transactions in the network. The hidden assumption in this uncertainty was that one standard exists which each different platform distributers uses as foundation for the system. This uncertainty questions that assumption: do multiple standards co-exist? If multiple standards do co-exist, it is of critical importance that these standards can be at least partially transformed to each other. If not, global use cannot be guaranteed. A standard is regarded to be simply the set of rules and practices needed to design sending payments. This can be simply a set of variables, their input and meaning, including regulatory and legal consequences of variables' outputs. An example of co-existing standards is that America adopts the Ripple standard, Europe develops a Ripple 2.0 and uses this standard, while Russia and China use a Hyperledger standard. It increases complexity significantly, but as long as standards are transformable a global success is still possible.

The identified possible outcomes are:

- There is one standard, which results in one connected whole with global reach.
- There are multiple standards and thus multiple ledgers, which should be connected by a central party. Central banks can play for hub and thereby accepting the multiple standards.

Feedback participants
Daniel H. brought up the topic of differences in regulation among countries worldwide. Regulation can force DLPs to break down in multiple variants, as some countries desire a specific functionality that other countries refuse to accept. Eric confirms this and states that technically connecting multiple clusters which all run their own standard is not the difficulty, but harmonizing regulation is. Guarantees, payment finality (transaction is legally final, regardless if it has already been settled/transferred) and the underlying moving of fiat money are important subjects in this. Daniel H. and Rob conclude that if only Dutch or European banks adopt such a standard, regulation becomes much easier as the European Bank will be the single main regulator. Paul stated that the more different platforms and standards, the more complex the whole and the less adoption will occur

Dan & Daniel call for a common set of principles to which all can adopt, although there will always be extensions. If there is not a universal understanding of the ground rules of payments, it is hard to come up with one payment protocol for global use. Rob adds that the accepted standard should thus have sufficient functionality to enable basic transaction functionality. Once payments via DLPs are globally accepted, additional standards can emerge for using DLPs for other use cases. Edan and Melanie & Mirjam agree on this by stating that DLPs will break down based on use cases. Banks may use for example Ripple for their

international payments, but may adopt Stellar for retail payments. The basic can involve sending payments, while extensions can arise about stock options, smart contracts, derivatives, etc. Dan & Daniel question if there will come a universal protocol that underpins all, or if there will come a background protocol that is used for synchronizing different interfaces from different ledgers. The difficulty is that there are multiple financial products, all with different functionalities and requirements, which might be impossible to combine in one single protocol. Therefore Hyperledger contains multiple ledgers in multiple consensus pools which can have different properties and functionalities.

Evert stated that a mutually accepted scheme should emerge, with clear rules, a legal system, arbitration and appointing some company or group who maintains the standard. According Evert multiple schemes need to co-exist, else one scheme would have a monopoly position. The uncertainty in this is if the standard becomes publicly available and under maintenance of a global institution as the W3C, or if this standard becomes the main selling point of a single platform distributer. In case of MasterCard, this company made one general card which replaced all other shop-specific cards. This was a great innovation, but if only MasterCard would exist it would have a monopoly position. Together with American Express and Visa, these three players dominate the market and compete with each other, which is acceptable for regulators. The question merely is, is if a DLP provider (and thus an issuer of a payments standard) gets adopted whether other competing standards need to co-exist. This will depend on the vulnerability of standard specifics and the resulting power of the company which created the standard. Roy categorizes this as if standards arise from a public non-profit community as W3C, or from a commercial company as Ripple Labs. In case of the second, the commercial company has as main interest to earn profits, which gives them a vested interest according Dan & Daniel. If thus Ripple Labs or Hyper wants to create a globally adopted standard, they should clearly separate among standard development and platform development. Robert Jan gave the example of SWIFT, for which there are also no competitors. Breaking point in here is that SWIFT is mutually owned by its members, and thus has no vested interest itself to develop the protocol in a specific way

Melanie & Mirjam recognized co-existing standards as a sort of layered system. In case of Ripple, all banks could become gateways, but are themselves also connected to national or continental gateways. Only these gateways might be connected with each other, which creates two different layers in the system in which a Dutch bank will not be able to transfer funds to an Asian bank without transferring these funds through the Dutch/European and Asian gateway. This seems more complex, but as these transfers happen automatically and simultaneously, it will probably not delay the transaction.

Uncertainty 6. Who holds wallets?
Closely related to the second uncertainty (technology implementer), is the wallet owner. The wallet owner is the person or individual who holds the wallet and can make use of its functionality. The definition of a wallet used in this research is the combination of the public and private keys which enables users to hold assets and liabilities on the ledger and trade them. Often, the wallet is accompanied by wallet software which had the private key incorporated as it is a hard task to enter the random string of characters manually. This uncertainty solely addresses who holds the wallets, thus stores the private keys. Whether the wallet holder provides this private key to the end-user, is a choice of the wallet holder. An important distinction is that wallet access is different than proxy access. The wallet owner should be a sort of member of the technology implementer. Therefore, wallet access might give solely access to the wallet, while proxy access might give access the whole (banking) system. To make the distinction with the payment options an individual can have, the term Payment Channel is introduced which is defined as the ways in which an individual can do his payments. Examples are Internetbankieren, iDEAL or crypto currencies. The first is by bank account, the second is offered by Payment Institutions and uses in the back-end the bank account, while only the third uses the so-called wallet.

The identified possible outcomes are:

- Central banks hold the wallets, and provide a proxy to banks;
- Trusted intermediaries as SWIFT or Equens hold the wallets and provide a proxy to banks;
- Banks hold wallets and may or may not provide a proxy to its clients to use the wallets;
- Individuals hold wallets themselves, which may be funded by several companies and financial institutions.

Feedback participants
Daniel H. stated that the fourth outcome results from trend 1.6 about freedom of choice and complicates supervision for regulators. Evert adds that there is strong regulation in place for holding assets for a client, which creates a high barrier for companies to try holding assets for its clients. Welly and Rob add that customers should be able to hold multiple assets as fiat money, stores of value but also crypto currencies. A wallet should thus provide several payment methods.

Rob stated that the wallet holder should trust the technology and the wallet provider. Currently the attention shifts from individual-level to bank-level, visualizing banks as wallet owners but also wallet providers. Roy pointed to the difference in Stellar and Ripple, in which Stellar is meant for the individual, while Ripple focusses on (central) banks or intermediaries. Melanie & Mirjam add that if a wallet is meant for the private individual, it should be very user friendly and simple. It helps also if the government backs the money put in digital wallets. A consequence of this is that regulators will require more supervision and monitoring.

Dan & Daniel appoint the technology implementer as the actor who holds the private keys necessary to work with the wallets. This actor can give its members, the wallet holders, in two ways access to their own wallets: by providing the key directly, or providing proxy access with additional authentication mechanisms. Banks can be the provider of a full payment solution, or the bank only holds the keys and the funds while third parties deliver the necessary services and user interface. Dan & Daniel think that although most DLP providers assume that their users are happy managing secret keys, people do not care about these key pairs. Individuals themselves will not accept the burden of holding a secret key, thus another party has to manage that for them. Therefore, a wallet should be put behind traditional access control and secured by other identification mechanisms, for example biometrical identification as mentioned at trend 1.2. Dan & Daniel think there might be a mix of the third and fourth outcome, in which the bank (or another company) holds the wallets, but allows clients to use some functionality of these wallets themselves.

Jochem discussed the amount of Payment Channels the end-user will hold. Currently, users have different debit and credit payments cards and even more payment accounts such as PayPal. Seen from an efficiency and user friendliness view, ultimately each individual will hold one single payment solution which might include multiple currencies, assets and contains multiple payment methods. Users can hold in this 'collecting' payment solution one or more payment channels (issued by a bank, a normal bank account) and one or more store of value accounts. This payment solution might be provided by a front-end provider, which is included in uncertainty 11. Evert thinks that proxy access will be an increasingly important in the future. If the end-user holds only one wallet, it will need to access all his assets and payment methods by means of a proxy which may be implemented through APIs.

Eric pointed out that the acceptation and willingness of the individual is one of the greatest uncertainties. Consumers want their money to be stored in one place. From that place they need to be able to use it, real-time and in a secure way. The trade-off to make is convenience versus safety, which are currently each other's opposite. The first actor which provides a safe and convenience payment option, with sufficient reach, might become market leader. Eric also mentions the current Millennials generation which might accept Facebook or Google as payment providers if these companies give the same guarantees. A complete alternative circuit might evolve, but this requires more devotion of consumers to adopt and use non- or less regulated systems.

Uncertainty 7. How many virtual currencies are used?
Although a virtual currency is often defined as a Bitcoin (thus a crypto currency), this thesis uses the concept of a virtual currency as an IOU (I Owe You). A person who holds virtual currencies, holds these by the issuer of this currency and can exchange it at all times back at the issuer for fiat money. The main difference with a crypto currency is that a crypto currency is globally exchangeable at exchanges, and has thus also a globally accepted value, while virtual currencies are only exchangeable at the gateway who issued it. To make it more complex, it is also possible to issue a coin with a multiple gateways, thereby creating a shared virtual currency. The Dutch banks could for example issue the Gulden, which can be bought and sold at each Dutch gateway. This uncertainty addresses how many virtual currencies are issued into the network.

The identified possible outcomes are:
- A few main fiat currencies as EUR, USD are represented by virtual currencies.
- The G20 fiat currencies are represented by virtual currencies.

- All currencies are represented by virtual currencies.

Feedback participants
Evert thinks that the amount of virtual currencies relates to the organization of market makers and the choices of gateways, and that it will follow the market. A noteworthy point is that the total liquidity of the treasure desk of a banks needs to be divided over all channels, thus using a DLP might decrease the liquidity usable for other treasury desk activities. Dan & Daniel think that also some native fiat currencies can go fully digital. Currently there is discussion about this in Ecuador and Canada to create a native digital money scheme. In this case, just as with the Gulden example described above, a virtual currency should be redeemable by all national gateways.

Jochem hints on an index currency which value should be determined as an average of a great amount of different fiat currencies. This would reduce the volatility risk. Robert Jan brought up a forum topic of XRPtalk.org in which the possibility was discussed that the Federal Reserve (regulator of USA banks) launches its own crypto currency. In this manner, this so-called Fedcoin would be a virtual currency, but exchangeable by all American banks, or it would be a crypto currency with a fixed exchange rate with the USD.

Eric states that the amount of virtual currencies is important for the reach of a network from a customer's perspective. If reach is not achieved, people will not feel the added value of the services as the need to use many different services in parallel. Also, the amount of virtual currencies is closely related to the general adoption of financial institutions. Eric thinks that consumers have no need to hold multiple currencies, as opposite to trend 1.6 freedom of choice, but that multinationals and corporates might have this need. Also, inhabitants of corrupt or weak economy countries might want to hold their money in other currencies, too better ensure the value of their money.

Uncertainty 8. Are crypto currencies used?
The origin of the whole DLP industry started with crypto currencies, but more and more signs appear that the crypto currency will be of less importance than previously assumed, as described in trend 2.2. Crypto currencies have an extreme volatile worth, have no counter value except for the worth of the trust of its users, are relatively easy to steal and can be used anonymously, which is not supported by regulators. This uncertainty questions whether crypto currencies are still used in the ultimate DLP. Important to note, is that when using crypto currencies, value stays in the network and the crypto currency can be seen as an asset, while virtual currencies are backed in fiat money by local gateways. This means that the value of these virtual currencies is kept outside the network, and therefore less easy to steal once private keys are compromised; underlying settlement mechanisms and trust relationships determine to what extent fiat money can be stolen once virtual currencies are stolen.

The identified possible outcomes are:
- Crypto currencies are heavily used (example: Bitcoin).
- Crypto currencies have a limited use case (example: Ripple, Epiphyte).
- Crypto currencies are not included in the DLP (example: Hyperledger, Open Transactions).

Feedback participants
Edan points to the holder of the asset. If a bank holds crypto currencies, the bank holds the risk, but if the customer holds the crypto currencies than this customer is at risk. Furthermore, Edan proposes to ignore the term 'crypto currencies', as a currency is something which can denominate the price of everything else. Welly states that XRP is not intended to be used as a currency but rather to enable the movement of fiat currencies. Edan opts for not including virtual currencies on DLPS, because these are still vulnerable to irreversible destruction and fraud. If something goes wrong, millions of these virtually represented fiat currencies can be stolen. Fiat currencies should be kept on secure and proprietary owned ledgers. Banks need to use this technology to clear, and use traditional means to settle transactions.

Evert predicts that there will come a market for non-regulated crypto currencies, which is now the case with the Bitcoin and all altcoins, but the question remains if these markets become significant. If these markets reach a certain level, governments might try to create their own crypto currency in order to keep control over the market. Furthermore Evert adds that once payment enablers can real-time pay with crypto currencies and

simultaneously trade these crypto currencies from and to a fiat currency, the volatility risk will be reduced to zero. Roy thinks that the use of crypto currency helps for enabling micro payments.

Paul expressed his concerns about the current crypto currency. The amount of each crypto currency is preliminary defined by a number (Ripple, exactly 100 billion XRPs) or by mathematical algorithm (Bitcoin, about 21 million BTC). Our monetary system is based on growth, which includes also the growth of money. Central instances should have the possibility to increase or decrease the amount of a currency in circulation, and this is not possible with crypto currencies. The total amount of crypto currencies should be able to grow, which is the case with Stellar by a protocol defined increase of 1 % of the STR (the Stellar coin) each year. These concerns are valid in a system in which the crypto currency becomes a major currency, not in a system in which crypto currencies are used as transport mechanisms for fiat currencies.

Jochem thinks that eventually there will be no need for a crypto currency. He draws the comparison with the Linden dollar which was used in Second Life, which ultimately failed due to a bank run. A critical point in crypto currencies is that there is no counter value, and with virtual currencies the counter value is only guaranteed by one gateway or exchange. If something happens which lowers the trust in such a currency, a bank run – or gateway run – might happen in which the smart traders earns a lot of money while the average user loses money. Another use case mentioned by Jochem is to use a crypto currency in a barter network or in a local area, in order to stimulate amount of the internal transactions among a group of participants.

In a follow up of the privacy trend, Eric mentions crypto currencies as the equivalent of cash on the Internet, which is at the same time immediate, private and globally redeemable.

Uncertainty 9. What are additional use cases?
A very broad uncertainty is about additional use cases. The use case researched in this thesis is interbank payments, but there are plenty more use cases thinkable. A great second use case is retail payments, but also micro payments, smart contracts (payments), stock exchanges or a market place can be incorporated in the functionality of a DLP. As discussed by uncertainty 5, different use cases might be a reason that multiple standards will co-exist. An important distinction need to be made between a use case and a business case. A use case presents the functionality offered by the system or technique which is beneficial for the user, while a business case presents the value proposition of the provider of the system or technique. The use case defines how it is used, the business case defines how the provider can profit from it.

Many outcomes can be defined, due to the multiplicity and diversity of business cases. To simplify, only the following outcomes are taken into consideration:

- The only use case is interbank payments.
- The use cases are interbank payments and retail payments.
- There is a variety of use cases, such as interbank payments, retail payments, crowdfunding, securities, selling computational power, sharing internet connections, sale of concert tickets, smart contracts, car hiring, etc.

Feedback participants
Evert questions the margins each involved actor should get. In order to have a sustainable model, each actor should earn a certain margin. Banks do currently not profit enough from payments, which makes the current situation less sustainable and a better business case should be found. Robert Jan thinks that banks (and regulators) can save costs on compliance and monitoring activities, as all transactions are publicly available and automatically controllable.

Roy proposes a business model evolving from the Internet of Thinks using micro and nano payments. Fees will decrease to (fraction) of cents, but once it is massively adopted the provider can still be profitable. An industry example is an online newspaper in which readers have to pay 1 cent for reading an article. Edan thinks that different use cases need different tradeoffs. For example, the example of a DLP facilitating reading news articles for a cent should work real-time, while compliance is less important. A DLP facilitating interbank payments have stricter requirements for compliance and trustworthiness, but have less need for a real-time solution.

Robert Jan points to the Ripple roles of the gateway and market maker, which might not be that beneficial. Market makers should bring liquidity into the network, which costs a lot but might not result in a profit from forex fees. This can be solved with periodically fees for each gateway a market maker is connected to, which should take place by contracts.

Paul reminds to the current situation and the current channels. Once a DLP becomes a serious alternative, traditional channels will innovate their services in order to stay competitive.

Jochem discusses the use case of hyper liquidity, in which users receive and pay real-time. One can receive daily its salary and pay for television by minute. Money is then directly available, which reduces the need for credit in moments of scarcity. It brings more money in circulation, which is eventually profitable for the economy and for banks.

Eric mentions smart contracts, and the possibility to have multiple stakeholders sign a transaction before it is send. This might be very helpful in processes in which a variety of stakeholders need to agree on a specific plan, contract or (set of) payments, such a complicated procuration processes.

Welly and Kanika do not directly point to another use case, but to another geographical market: third world payments. Technologies such as Bitcoin and Ripple can be used in third world countries to simplify payments and get around corrupt governmental institutions. Also, as these countries have not exhaustive legacy systems in place due to their lack of development, back-office integration can be surpassed and brand-new payment systems can be implemented, enabling these countries to leapfrog to the most innovative payment structure and enabling DLP providers to have a great and easy to implement pilot.

Uncertainty 10. What is the publicity of the ledger?
A main difference between the various ledger platforms is the amount and publicity of the ledger. As the amount of ledgers differs due multiple reasons as different use cases, co-existing standards and choice of provider, this uncertainty only addresses the publicity and transparency of the ledger. Important to note is that the ledger is by definition decentralized, which means that each individual can download, maintain and validate a truthful copy of the ledger, unless authentication procedures are used to validate the validators.

The identified possible outcomes are:

- A semi-public ledger. All transactions (single or batched) are stored publicly on the ledger, transaction information is stored in additional databases with access procedures in place to only provide access to the sender and receiver bank for transaction information. This ledger is readable for everyone.
- An internal ledger. All transactions are only visible for participating banks. Transactions information can be open, or also secured in off-ledger databases. This ledger is readable for everyone with provided access to download, maintain and validate the ledger.

A public ledger in which all transactions (single or batched) and transaction information is stored publicly on the ledger is not a possibility, as this is too privacy sensitive. All forms of hidden or secured ledgers in which multiple parties, which do not have to trust each other, can access all (encrypted) transaction information which is stored on the ledger are rejected, as this information gets never deleted and if the used encryption method is cracked, all transaction information is accessible from all participating actors. Therefore, transaction information should be kept off ledger in databases which can update encryption technology is needed.

Consequences of this uncertainty are if the technology implementers need to host a secured database with their own transactions, or if key management procedures need to be installed by the DLP provider/creator and used by the wallet holder. This key management can take place centralized (by a central organization like SWIFT) or decentralized (each bank on its own). Most important relevance is that if the wallet holder organization is big enough, a semi-public ledger is fine as there are too much members which reduces the chance that a transaction can be mapped to an individual. If a wallet holder is small, transactions can be linked to private individuals, which harms one's privacy. This is also moderated by the design choice if transactions are (partly) batched and if transactions are easily identifiable. For example, a weekly transfer of 8.7 Congolese Francs is better identifiable than a transaction of 10 EUR.

Feedback participants
Sander highlights the possibility of batching transactions, which reduces the chance that single transactions can be found. Eric adds that a situation can arise when the identity of the wallet holders is known, all DLP transactions of a bank are known. This can hypothetically lead to a bank run, when massively funds are redrawn from a specific bank and this is publicly visible.

Evert agrees that a side channel is needed with detailed transaction information, as there should be no risk that transaction information is readable for non-authorized users. Kanika thinks that the current openness of the Ripple ledger needs to change, in order for more adoption to happen. Melanie & Mirjam question the power of secret services, for example what the NSA can do access transaction information. This concern can be taken away by taking transaction information offline, as information stored in for example European databases is not accessible by non-European authorities.

Uncertainty 11. Front-end provider
The front-end provider is the actor who provides the user interface to the end-user. Currently, banks provide the user interface to the bank accounts of their customers, in the Netherlands called "Internetbankieren". Next to this, the joint venture of Dutch banks Currence provides the protocol of iDEAL whereas the banks themselves provide the technology using this protocol, which merchants and shoppers can use to pay online for their orders. As people usually tend to make use of the most convenient way of paying, payment front-end providers may consolidate into one or a few main stream providers of user interface which can be used for a variety of financial services. This front-end, the user interface, should be convenient and interoperable with all types of financial institutions. This user interface might get by means of APIs access to the funds stored in a bank account, to loyalty points stored in a shopping wallet, to insurance payments, automatic payments and a stock trading wallet. Reconciliation and supervising roles will take place at the wallet holder.

As a follow up of trend 1.2 digital identity, this front-end provider is firstly responsible of authenticating the end-user and connecting this authentication and authorization to the various wallets this end-user can access through its user interface. It is still possible to force authentication also by APIs, but as multiple funds and payment options are included, this increases complexity and will not be desired by the user.

The following outcomes are identified:
- A Payment Institution becomes a main front-end provider.
- Banks become their own front-end provider. This is the current situation, but does not yet include interoperability with other wallets, bank accounts, stock accounts, etc.
- Big (tech) companies as Facebook, Google, PayPal or Amazon become the main front-end provider.

Feedback participants
Eric stated that one of the main conditions is that the authentication mechanism needs to be accepted and adopted by a massive crowd, therefore big tech companies can have a benefit as they have already a huge member base. Small companies will have more troubles to gain such a great customer base. The party who delivers the most convenient payment methods will be favorable, unless fraud occurs in which the customers or regulators might lose faith in this (type of) front-end provider.

Relating to trend 1.5 about the new entrants, multiple participants addressed new entrants in front-end innovation, providing convenient and cheap services by user interfaces, and illustrate thereby Apple Pay. According Evert and Robert Jan, Apple Pay is a technology which alters the front-end of payments and thus changes the user experience, but uses the same clearing and settlement mechanisms from the payment cards industry. Future front-end payment methods providers should focus on customer experience and make payments as convenient and fast as possible. Related to this is the omni channel according Robert Jan, which facilitates a fluent transition of the same interface to different devices. Paul indicates that this front-end provider is also the main party to take care of the privacy of the user, which for example Apple does by tokenization. As Kanika points out, consumer to consumer payments should be facilitated by several proxies and interfaces. For example, payments from Facebook to Facebook account or from telephone number to telephone number.

Kanika disintermediates the different roles needed to provide a payment solution, and expects that front-end ownership of a payment method will not be from banks, but from internationally known companies as Apple,

Google and PayPal. The infrastructure can be based on the technology companies like Ripple. Banks can then stay involved to implement this technology and deliver suitable APIs to the front-end payment method providers. In this case, the back-end is connected to the savings account of each individual.

Rejected uncertainties
Some uncertainties were rejected because they implicated one of the assumptions, where too closely related to other uncertainties, were too Ripple-specific or which impact did not seem that great. The uncertainties rejected were: availability market maker (Rob), if banks become their own market maker (Rob), scalability when taking a DLP in production (Rob), ledger forks (Rob), complete regulator friendly functionality of DLP (Rob), the type of DLP which is adopted (Edan), the timing of announcements of DLPs which can influence adoption (Edan), the value and distribution of XRP (Evert, Robert Jan).

Summary of uncertainties
Table 8.4 below summarizes which uncertainties are mentioned or approved by participants. The column 'Start' represents the uncertainties which were identified before the first interview. The following columns represent the naming or approving of uncertainties. A '+' represents that the participant thought by him or herself of this uncertainty, a 'v' represents that the interviewer mentioned the uncertainty to the participant who approved it. Empty spaces means that the uncertainty was not mentioned, and thus logically not approved. A '-' means that the participant rejected the uncertainty.

Individual Uncertainty	Start	RG	DH	EY	SR	EF	~~WS~~	KD	Hyp	RD	RJV	PO	JB	DNB	EV
1. Adoption	+	v	v	v	v	v		v	v	v	v	v	+	v	v
2. Technology implementer	+	+	+	-	+	+		+	+	+	+	+	+	+	+
3. Centralized regulation	+	v	+	v	v	+		v	v	v	v	+	v	+	v
4. Centralized distribution		+	v	v	v	v		+	v	+	+	v	v	v	v
5. Co-existing standards	+	+	+	+	v	+		v	+	v	v	v	+	+	v
6. Wallet owner		+	v	v	v	v		v	+	+	v	+	+	+	v
7. Virtual currencies			+	v	v	v		v	+	v	+	v	v	v	v
8. Crypto currencies			+	v	v	v		v	+	+	+	v	v	+	v
9. Additional use cases	+	+	+	+	+			+	+	+	+	+	v	+	v
10. Publicity ledger					+	+		+		+		+	v	+	+
11. Front-end provider															v

Table 8.4 Summarized input and feedback uncertainties

Welly did not respond to the uncertainties and dynamics due to the overlaps with the strategy of Ripple Labs, which is private information. Furthermore, the uncertainty about the technology provider, as a potential intermediate player, was mentioned most often, followed with the additional use cases. Participants did not mention exactly the uncertainty with corresponding outcomes, but the interviewer translated each mentioned uncertainty to an existing or new uncertainty, or rejected it.

8.5 Dynamics

Dynamics are the events and processes an actor can undertake in order to try to steer into some scenarios. In contrast with the trends and uncertainties which cannot be influenced by single actors, the dynamics represent

future activities of a (group of) large international bank(s) which may influence the outcomes of uncertainties, which eventually influences the scenarios.

In the same manner as with the trends and uncertainties, the dynamics presented below are iteratively updated after interviews with the participants. The participant was asked for the dynamics he or she could think of, after which the most up to date dynamics were presented. As these dynamics are straightforward in nature, not all dynamics are consistently verified. If objections or improvements of presented dynamics are made, these are incorporated in the ultimate dynamics. Therefore, the feedback of participants on all dynamics is not directly included. Important input or feedback given by the participants who did not fit in a particular dynamic is discussed in a summarizing feedback paragraph. The dynamics are categorized into three categories: Acquire knowledge, Collaboration and Strategy.

Acquire knowledge

Dynamic 1. Understand the technology

Banks and other stakeholders of a DLP adoption should acquire knowledge in order to understand the technology and its possible applications. Business people should understand the business concepts and realize that a massive industry change might occur, while IT architects should make themselves familiar with the technology to anticipate on potential future architecture changes in their system. Knowledge is key, and determines if DLPs stay in a technology niche, or if they get globally accepted.

Dynamic 2. Experiment with the technology

Next to acquiring knowledge, best way to get a deep understanding of the technology is to experiment. This can take various forms: a code test, a proof of concept, implementing the technology for an internal less sensitive use case, implementing the technology for an internal relevant use case as payment between branches, do a pilot with minimum exposure or set up a test transaction environment with other banks. All these experiments can take place with existing DLPs as Ripple, but banks can also develop their own DLP and eventually create their own crypto currency or issue their own virtual currency. Given that other banks will not be eager to use a DLP developed by a single competitive bank, it is not likely that such a DLP will be globally adopted, but it gives great experience with the technology.

System moderators and IT personnel could work on their existing systems to make them suitable for a potential DLP implementation, and some connections should also be made upfront with authentication and authorization systems. An idea is to present the use cases of a DLP by gamification in order to stimulate personnel to process the technology themselves and come up with technology and business applications.

Multiple participants addressed the outdated legacy systems of financial institutions, which make it complex to innovate IT. The legacy system is a limiting factor and might be a significant hindrance by testing or implementing a DLP.

Collaboration

Dynamic 3. Collaborate with banks and other financial institutions

A dynamic often mentioned and approved by participants was collaboration with other banks. One bank itself cannot make the technology beneficial; the more banks adopt to a certain DLP, and thus a certain payment standard, the more efficiency will be reached. These banks should have different excelling points in order to benefit from each other's advanced technology, global partnerships or compliance finesse.

Banks can also collaborate with PSPs, TPPs, clearing houses and SWIFT for understanding the technology together and perhaps come up with a mutually beneficial business case. Conferences are an excellent place to share information on standing points and to start long-term information exchange collaboration. All interested and involved parties can agree on a business protocol about sharing and distribution knowledge in order to get fast a deep understanding of the technology and its applications. The more parties involved, the higher the chance it can be of importance in a shaken up financial industry.

Dynamic 4. Collaborate with startups

Banks can also collaborate with startups and DLP providers. Banks can run validating nodes to operate in the network of a DLP, banks can become a member or advisor of the source code of the system, applications can be written which run on top of the protocol, discussions can be initiated to explore the technology and future applications.

The more beneficial and disruptive the technology seems, the more startups will be created with their own distinctive service offering. Banks can strategically invest in these startups to create a mutually beneficial partnership, in which the investing bank can be the supporter and first adopter of an innovative financial service. Banks can also set up a creation platform in which startups can work together with a bank to develop innovative financial products, which may work on top of a DLP. Startups can use the organizational maturity and client base of a bank, while banks profit from the out-of-the-box innovative developments of these startups.

Dynamic 5. Include regulators
Regulators can stimulate or forbid use of DLPs, and are therefore important to keep in the loop. Banks should have frequent discussions with regulators about the newest state of the art DLP technology and implications of implementing such a platform. Regulators need to work on a regulatory framework which may enable banks to run pilots and eventually adopt a form of a DLP. This regulatory framework should address the identification duty, compliance aspects and consumers protection. As a follow up on trend 1.4a that regulators push for faster and cheaper payments, regulators may increasingly require banks and other financial institutions to facilitate near real-time payments which may stimulate force them to adopt DLPs.

Dynamic 6. Help standardization
As indicated in uncertainty 5, it is unlikely that a payment standard will be chosen which is issued by one single company with the interest of making profit out of it. Therefore, global organizations such as W3C, ISO and ANSI X9, whose only interest is better efficiency in the (web) payments industry, should take up this discussion and come up with a standard which multiple DLP providers (see uncertainty 4) can implement in order to distribute a complete DLP environment.

Strategy

Dynamic 7. Develop business cases
All disruptive technology applications set aside, DLP adopting participants need a business case. In the worst case scenario this business case is no more than customer retention, but there are many possibilities to position the bank somewhere in the chain where various benefits can be realized. Banks should start talking to their clients to understand their needs for fast and cheap interbank payments, but also about other use cases. In this a use case is more important than a business case, as the DLP technology and applications might shake up the financial architecture in such a way that business cases are not predictable. To compare, if people are asked to think of business cases for a World Wide Web in 1990, not many useful revenue models would be thought of.

Next to the benefits, a bank should make calculated risks analyses for some scenarios. These analyses can be used to create mitigating factors which slowly may evolve into a regulatory framework including legal consequences, in which the voice of the regulator should also be included. Regulatory frameworks may be accompanied with different types of contracts between the bank and its clients, banks and a gateway, a gateway and its market maker, a bank and the technology implementer and technology installer and between a bank and the platform provider. Responsibility and indemnification clauses will be very important in these contracts.

Furthermore, once a bank agrees on a set of possible scenarios, strategic choices needs to be made to steer into a certain scenario and prevent from going into scenarios which are detrimental for a bank.

Dynamic 8. Initiate attitude change inside and outside bank
Partly overlapping other dynamics, banks should stimulate an attitude and culture change within and outside of the bank. There are many misunderstandings about DLPS and crypto currencies, in which the more negative properties of the latter create resistance towards the former and everything related to it, which gives unjust prejudices regarding this technology. Future scenarios should be sketched, technology should be simply

explained in order to create a support base within the bank. To draw a comparison with the current situation, every employee who knows SWIFT should also get familiar with DLPs.

Banks should also publicly reveal their interest and research into these technologies to prepare a mind shift by its customers. Banks need to lobby publicly for advanced regulation for crypto and/or virtual currencies and the use of DLPs and can run focus groups with its clients to better understand the customer's needs and expectations.

Rejected dynamics
No dynamics mentioned were rejected. Although named dynamics did not always fit in the final model of dynamics, there was enough overlap to include the participant's contribution to a certain dynamic.

General feedback participants
This paragraph includes some general comments participants made after naming their own dynamics and reading the current dynamics. Edan thinks that all dynamics are important, but that the main point is to get your hands dirty and start experimenting. Sander recognizes a pressure which can come to the current financial architecture which may lead to more STP processing from banks, resulting in faster payments by traditional means. Evert questions the added value of DLPs and wonders, as there are sufficient real-time payment systems, if with these systems the end-to-end user experience can be made real-time.

Eric adds that collaboration with other banks is important to reach a sufficient reach. If a DLP should be implemented in the Netherlands, at least the five largest banks need to be involved. If there is a cross-currency proposition, a sufficient amount of banks from all over the world needs to participate.

Jochem and Kanika strongly vote against doing nothing. If a bank does not keep a close eye on developments in this disruptive industry, it might get behind and get surpassed by new adopting entrants. A clear strategy is needed. To stay involved, banks should address people and resources to this subject which investigate, test and communicate with other instances. Welly thinks that the bank is in a similar position than the telephone companies before VoIP was introduced. Banks now still have the opportunity to innovate and stay main players in the payments industry, but it may be expected that banks will be too big and inert to innovate, thereby giving room to new entrants. Roy expects some teething problems which will arise if a DLP is thoroughly tested or taken into production, but these problems do not mean that the technology in itself is not valuable. Just as with the hacks of crypto currency exchanges, described in trend 2.5, this only describes a risky characteristic of a crypto currency and does not mean that the technology is not trustworthy.

Jochem points to the retail payment method iDEAL, which is collaboratively developed and implemented by Dutch banks. This is the main reason that other payment methods as PayPal and credit cards are not highly adopted in the Netherlands. The banks developed iDEAL, although in the end the PSPs became the provider. Banks should try to secure a beneficial role in a future payment architecture including a DLP, or banks should launch their own payment methods which deliver the same benefits as a DLP.

Summary of dynamics
Table 8.5 summarizes the dynamics mentioned by the participants. As described above, the dynamics are not consistently validated as this is not of much added value. The column 'Start' represents the dynamic which were identified before the first interview. The following columns represent the naming of the dynamics. A '+' represents that the participant thought by him or herself of this dynamic, an empty spaces means that the dynamic was not mentioned.

Dynamics	Start	RG	DH	EY	SR	EF	~~WS~~	KD	Hyp	RD	RJV	PO	JB	DNB	EV
1. Acquire knowledge			+			+		+	+	+	+		+		+
2. Experiment	+	+	+		+	+		+	+	+	+	+	+	+	
3. Collaborate banks	+		+			+		+		+	+	+		+	+
4. Collaborate startups		+	+			+			+		+				
5. Collaborate regulators	+	+	+			+					+	+	+	+	+
6. Public opinion	+														
7. Business case	+		+		+	+		+		+	+		+	+	
8. Attitude change			+								+				+

Table 8.5 Summarized input and feedback dynamics

The most mentioned dynamics are testing and experimenting with DLPs. Furthermore, acquiring knowledge and collaborating in any form with other banks are mentioned often. From the strategy category, working on a business case is often mentioned.

8.6 Concept mapping

Figure 8.2 below indicate what relations exist among the trends, uncertainties and dynamics. The concept mapping is described by Bhattacherjee (2012) as a graphical representation of concepts and relationships between those concepts by using boxes and arrows. This concept mapping is a follow up of the open coding methodology used, which is mainly about identifying concepts and key issued related to the phenomenon of interest. During the description of the trends, uncertainties and dynamics, sometimes interdependences are hinted at. This concept mapping tries to visualize most important interdependencies and relations in order to create a chain of evidence (Yin, 2013) and enable the reader to put each section in context with other sections. For visibility purposes, the trends are not sorted by number.

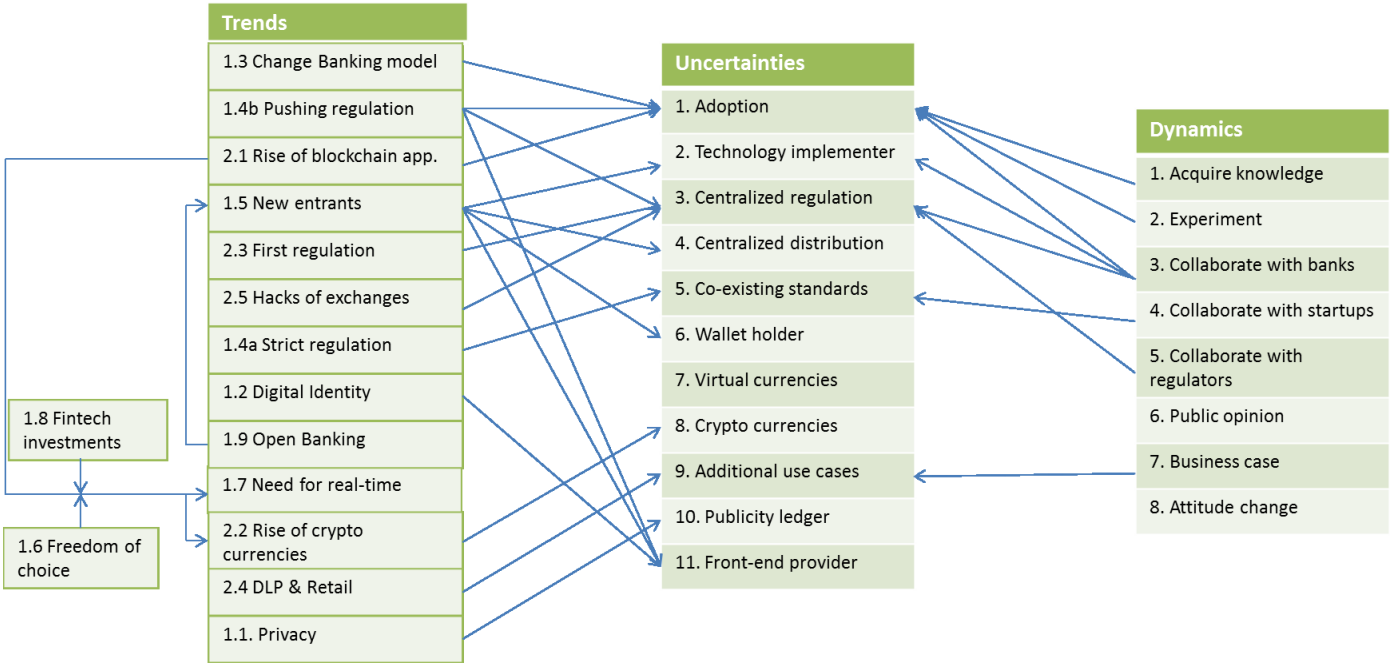


Figure 8.2 Mapping of trends, uncertainties and dynamics

Figure 8.2 only represents the most obvious and important relationships because technically spoken each concept (trend, uncertainty or dynamic) is caused by multiple other concepts, and in turns influences other concepts. Most important is the presented continuity throughout this research, which is visualized by the multitude of relations. The figure above confirms that all trends, uncertainties and most dynamics are relevant and need to be incorporated in the scenario planning. Some dynamics are not related, as they have slightly different perspective as they concern mainly the activities a (group of) actor(s) can undertake, which may be less related to the implementation of a DLP itself. Most important uncertainties seem adoption and regulation.

8.7 Scenarios

This paragraph describes how the scenarios were created. Firstly, the participants were asked what uncertainties were relevant and what relevant uncertainties could be coupled with each other. After this, some uncertainties were rejected and the uncertainties left are coupled with each other. Because every uncertainty mapping makes sense, but some make more sense than others, all possible scenario planning are tested in order to choose the best visualizing scenario planning.

Feedback participants

A common reaction of participants was that a scenario planning was too complex to create. Starting with 4 and ending with 11 uncertainties, the amount of possible scenarios was too complex and the process of creating scenarios was too time consuming. Therefore, after the first few interviews participants were asked to choose relevant uncertainties, reject other uncertainties, and indicate which uncertainties would fit best to make a scenario planning. Some general comments of participants are discussed below, followed by a table which presents their feedback on uncertainties matching.

Paul stated that uncertainties could maybe be merged to come up with a simpler model. Scenarios should be simple to understand and help visualizing the future. Jochem adds that scenarios should be MECE (Mutually Exclusive and Collectively Exhaustive), which means that overlap should be reduced and all scenarios resulting of two plotted uncertainties should be strong, logical and covering. It is thus important to revise the uncertainties and reduce overlap. Jochem also added that some main and sub scenarios could be created, as uncertainties differ in perspective, for example macro or meso level. Melanie & Mirjam indicated that probably all scenarios may co-exist at the beginning, but eventually scenarios will fall off. For example, banks, firms and clearing houses can simultaneously implement DLP technology, but standardization and adoption will ultimately decide which type of technology implementer is most beneficial for the new financial structure. Table 8.6 summarizes the uncertainty matching and remarks from participants on the scenario planning.

Participant	Uncertainties matched	Remarks
RG	2 & 5	Most important: are banks included or excluded? Is there a central or decentralized organization structure?
DH	2 & 6	Yes: 1, 2, 5. No: 3 (not dependent), 4 (not of significant influence)
EY	1, 5 & 8	-
SR	-	-
EF	1 & 5, 6 & 2	No: 7
WS	-	-
KD	3 & 5, 2 & 4, 1 & 6	No: 7, 8. Important is 9, but does not have to be coupled.
Hyp	5 & 8, 4 & 6 (2), 1 & 7	Matching of 3 and 9 is also possible. Regulation for different use cases. Some assets/use cases may come under more regulatory scrutiny than others.
RD	4 & 2, 1 & 3	No: 7. Yes: 5
RJV	1 & 3, 2 & 4	No: 7, 6, 5 (here comes only 1 network), 8. Yes: 1,2,3. Maybe: 4. Not certain about 9
PO	-	No: 7. Makes no scenario planning as everything is somehow connected.
JB	1 & 5, 3 & 4	6 & 2 are closely related, 9 is important but uncertain impact. 5 is important. 7, 8 and 6 are less interesting.

DNB	-	No: 7, 8. Yes: 3, 4 and 2. 6 closely related to 2. 1 and 9 fit all.
EV	1, 3, 4	-

Table 8.6 Uncertainty matching and scenario planning input participants

Less relevant uncertainties

This section discusses what uncertainties all considered less relevant for the scenario planning, based on feedback of the participants and a thorough analysis which took place by describing all possible scenarios following by choosing the most relevant couplings. By analyzing which uncertainties should be rejected, three criteria are followed. The first is that the uncertainty has significant influence on the future architecture of the interbank payments industry. Second, that the outcomes of that uncertainty are distinctive enough. Third, that if outcomes differ, scenarios should also differ. This means that for that uncertainty, a relevant other uncertainty needs to be found which results in scenario planning in which all scenarios are significantly different. A scenario planning should consist of scenarios which all make sense and are valid and relevant options.

An example of a valid scenario planning which makes no sense is the combination of uncertainty 10 about the ledger publicity and uncertainty 4 about platform distribution. Whether the ledger is internal, hidden and protected with key exchanges or if the ledger is semi-public with supporting databases for privacy sensitive transaction information, has nothing to do with the type of distribution of the DLP. Both uncertainties are valid and important, all outcomes can co-exist, but there is no relevance.

Below uncertainties are described which are rejected from the final scenario planning.

3. Centralized regulation
Most feedback of participants on this uncertainty indicates that there will be a mix of both outcomes. Centralized institutions might arise, although there will never be one central institution with authority. Or multiple (continental) powerful authorities arise, or one powerless authority arises which has an advisory function. Centralized black or white lists might emerge, but on the other hand banks are probably enabled to choose other banks as trusted gateways or market makers. As this uncertainty does not deliver distinctive outcomes, it is rejected from the final scenarios.

4. Centralized distribution
The question of the distribution of a DLP happens by a joint venture of (central) banks, corporate vendors or by the open source community is of significant influence of future scenarios, but does not match with other uncertainties. When coupling this uncertainty with all other uncertainties, the outcome of this distribution uncertainty is not relevant.

7. Virtual currencies
This uncertainty was the most rejected by the participants. The amount of virtual currencies will follow the market and is a result of the adoption uncertainty.

8. Crypto currencies
This uncertainty is second most rejected. Use of crypto currencies has its consequences regarding security, volatility risk, etc., and the outcomes are distinctive enough, but matching this uncertainty with other uncertainties is not synergetic and relevant.

9. Additional use cases
Addressing potential additional use cases is of a different form that other uncertainties. Its outcomes are unlimited; at least more than 10 different use cases can be identified. It could result in DLPs with increased functionality suitable for multiple use cases or it could result in co-existing DLPs targeting different use cases and thus different markets. As this uncertainty is partly the cause for the uncertainty 5, it can be rejected. Also, as this uncertainty addresses use cases, it is a substitute of the scope which is about only one use case, and therefore makes it difficult to couple as relevance will be found on a more meta-level.

10. Publicity ledger
Consequences of this uncertainty are if gateways need to host a secured database with their own transactions, or if key management procedures need to be installed by the DLP provider/creator and used by the wallet

holder. This key management can take place centrally (central organization like SWIFT) or decentralized (each bank on its own). Most important relevance is that if the wallet holder organization is big enough, a semi-public ledger is fine as all transactions can be send and received by one wallet, reducing privacy issues. If a wallet holder is small, transactions might be linkable to private individuals. These consequences are not very influential on the future architecture of interbank payments, and are therefore rejected.

11. Front-end provider
The front-end provider needs to access the wallet owner's systems by APIs; the wallet owner delivers a proxy to the front-end provider. In case of Ripple, the front-end provider can only provide access to a Ripple wallet, or the front-end can provide access to the API of the wallet holder (in this case the bank). Although the front-end provider is an interesting role, its connections with the other stakeholders are relatively loosely coupled and more important, within the chosen time frame it is not thinkable that there might arise a few front-ends which are massively used. Within 3-5 years, there will be still a variation of thousands of payment front-ends which are not yet made interoperable.

Table 8.7 below summarizes what uncertainties are rejected based on which criteria.

	Criteria 1. Significant influence	Criteria 2. Distinctive outcomes	Criteria 3. Matching relevance
3. Centralized regulation	v	-	v
4. Centralized distribution	v	v	-
7. Virtual currencies	-	v	-
8. Crypto currencies	-	v	-
9. Additional use cases	v	-	v
10. Publicity ledger	-	v	v
11. Front-end provider	-	v	v

Table 8.7 Rejecting of uncertainties based on three criteria

Matching of uncertainties

After rejecting previously discussed uncertainties, four uncertainties are left: 1 (adoption), 2 (technology implementer), 5 (co-existing standards) and 6 (wallet holder). The participants have mentioned most possible combinations for these uncertainties, which did not deliver any superior combination. During the interviews regarding these four uncertainties, two main conclusions were drawn. The first was that 1 (Adoption) could be coupled with most uncertainties and be still relevant. The second was that 2 (Technology implementer) and 6 (Technology provider) have a lot in common, as if some outcome of the first is reached, particular outcomes of the latter are not possible anymore. Therefore, the iteratively derived scenario planning consists of matching 1 and 5, and 6 and 2.

Initial scenarios

Scenario planning I. Adoption versus Co-existing standards
Figure 8.3 below presents the scenario planning which couples adoption to the potential co-existence of DLP standards. As explained in the introduction of this paragraph, simplicity is important and therefore the three outcomes of adoption are reduced to two outcomes: a few small banks, or all banks.

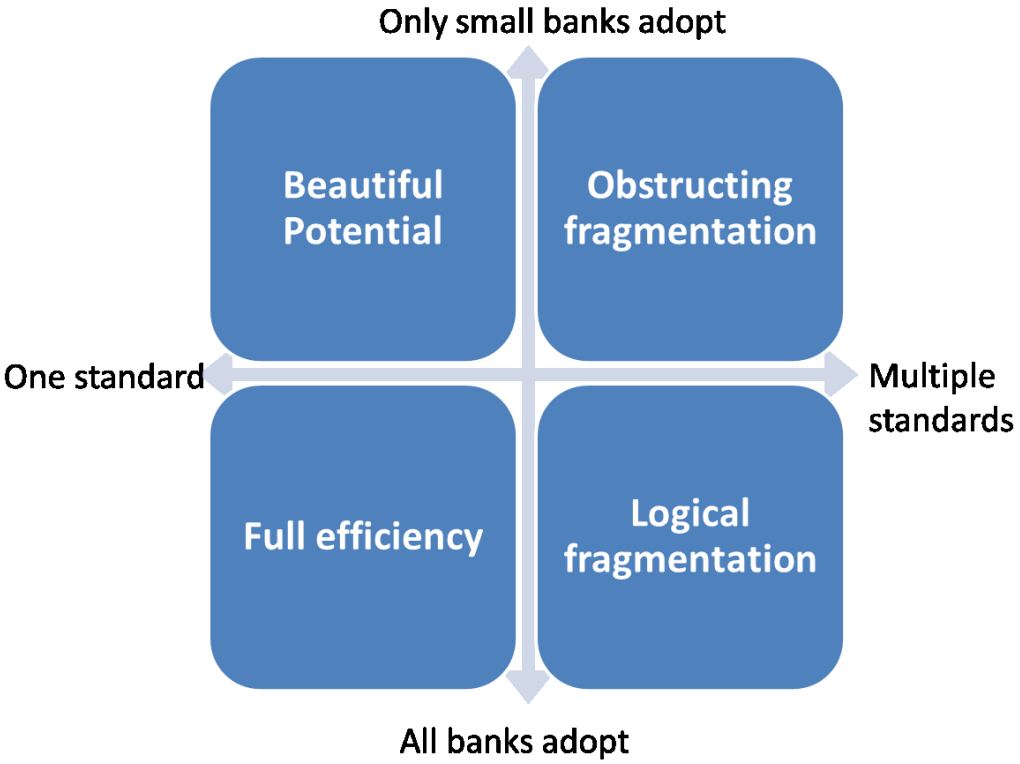


Figure 8.3 Scenario planning I – Adoption versus Co-existing standards

Figure 8.3 presents four scenarios which are all significantly different and MECE. If only small banks adopt, reach and efficiency is obstructing when multiple standards co-exist, which means that most participating banks also need to have standard transform procedures in place. Different standards do not only mean more technological complexity, but also from a regulatory perspective it hinders fast and efficient payments. On the other end of the spectrum, if all banks adopt it would be reach almost a 100 % efficiency if participating banks can agree on one standard, although it is logical that multiple standards will arise. This can be due to different use cases or due to political borders. Identifying factors for raising awareness which scenario might form the future are: adoption small banks, adoption big banks, availability of standards, tendency for agreements on overarching standards, activities and results from standardization companies.

Scenario Planning II. Technology implementer versus Wallet holder

Figure 8.4 below presents the scenario planning which couples the technology implementer to the wallet holder. The technology implementer is the actor who implements the software, becomes a validating node and functions as a gateway. This gateway issues wallets, which it can provide to its members, the wallet holders. Therefore, the technology implementer is higher in formality and responsibility than the wallet owner. A simpler version of this coupling is to differ only between with and without intermediaries. Although this increases simplicity, it neglects the more long-term view of some participants that also non-financial firms as supermarkets or big tech companies can implement the technology and enable their customers to holds wallets. As each of the four outcomes on both uncertainties is distinctive enough, this model does not have to be simplified.

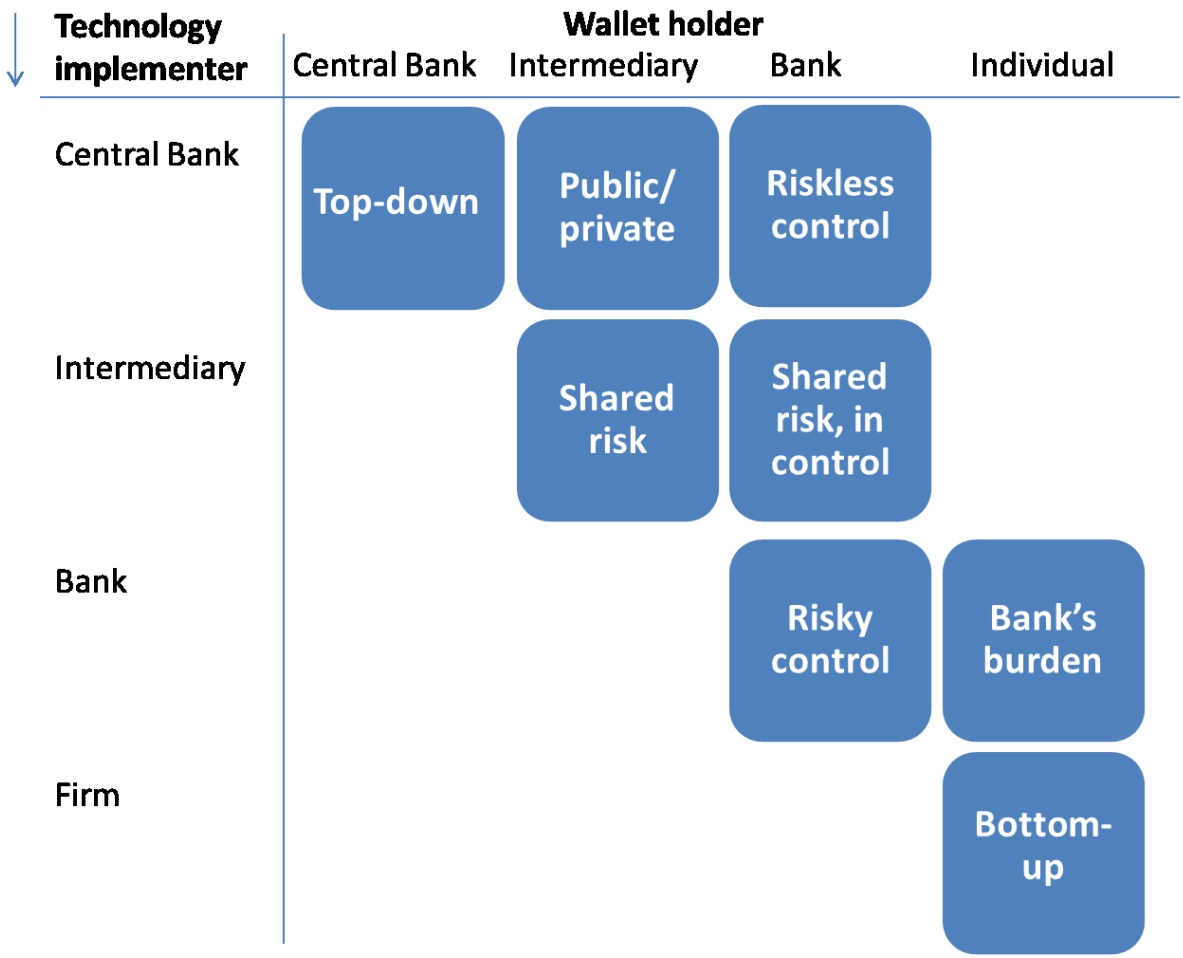


Figure 8.4 Scenario planning II. Technology implementer versus Wallet holder

A first observation is that many scenarios fall off. This is important, as this means that when one particular actor seems to fill the position of a wallet holder or technology implementer, there are fewer possibilities available for the other of the two. For example, if the central bank holds wallet, it will not depend on a single bank to provide its wallet. The scenarios presented in the first three rows and columns are on short term more likely, while the scenarios in which new non-financial firms and private individuals participate seem less likely on the short term, but might become possible on the mid long term. If each customer gets its own wallet, banks will have to carry the burden of compliance and supervision, as their customers are enabled to perform risky activities as executing privacy sensitive transactions, partly anonymous transactions or they might expose themselves to (crypto) currency volatility. Identifying factors for raising awareness which scenario might form the future are: involvement central banks and incumbent intermediaries, focus of regulatory frameworks, the needs of the customer and the degree of implementation risks.

8.8 Consistency & Plausibility

The scenario planning steps as stated by Schoemaker (1995) determine that general scenario themes should be created, followed by a consistency and plausibility check. After this verification, scenarios should be updated and finalized. For readability, the section with finalized scenarios is removed and the initial scenarios are iteratively finalized and the final model is above described. To clarify what consistency and plausibility issues helped forming the scenarios, this paragraph determines some additional insights which improved and confirmed both scenario planning.

Schoemaker (1995) mentioned three tests of internal consistencies. The first is if the scenarios fit the chosen time frame. Second, do scenarios combine outcomes of uncertainties that indeed go together? And third, are major powerful stakeholders placed in positions they do not like and who presumable might change the end scenario? All three tests are carried out in this paragraph.

Used assumptions

Often the discussion with participants shifted towards the general question if DLPs become accepted and what significant factors should be influencing this potential adoption. The assumptions used were important for defining the scope of this scenario planning and proved beneficial in structuring the uncertainties. The most implausible issues in this scenario planning concern these assumptions, which confirm the necessity of these assumptions. The truth of these assumptions can absolutely not be determined upfront, and therefore these assumptions are used as design choices to enable only a certain type of scenarios: the scenarios in which a certain form of a well-functioning and scalable DLP is adopted by banks, under allowance of regulators.

Timeframe

The timeframe of the trends, uncertainties and dynamics is consistent, but not exclusively. Some trends are currently important but might be of less importance in a few years, for example trend 1.4a strict regulation. Other trends are currently less important, but might keep its relevance for 20 years, for example trend 6 freedom of choice. The same counts for uncertainties and dynamics, as all outcomes and activities can be known or carried out within 5 years, but they probably keep their relevance for the long term. For example uncertainty 5 about co-existing standards. The first 10 year there might be several competing standards, after which the more mature DLP industry mutually agrees on one standard. In this case, the uncertainty surely does fit within the timeframe, but it still has an equally significant influence after the chosen timeframe.

Plausible combinations of uncertainty outcomes

An important test for both selecting uncertainties for creating scenarios and for validating scenarios is if the combinations of the different outcomes of the two selected uncertainties make sense and are valid. Regarding the validity, both scenario planning have plausible combinations. In scenario planning I, if adoption is high the likeliness for multiple standards is also high. But, one standard is also plausible as participating or interesting parties might agree on a single standard before starting implementation. Also, if adoption is low, small banks are still able to choose their own standard in the hope that this standard becomes the best adopted. All four scenarios are thus possible and plausible.

In scenario planning II, many scenarios are removed as the technology implementer can decide to whom it issues wallets. Scenarios are removed due to very low likeliness (central banks do not hold wallets offered by banks) or validity (it is not logical that individuals hold wallets issued by central banks). The scenarios left are valid and have a certain likeliness.

Attitude stakeholders

Negative business case for banks

A question which can be asked is if it is plausible that, if DLPs get accepted, only (a few) small banks will use it. A conclusion some participants draw was that banks actually do not want to use a DLP. Terms as crypto currencies, anonymous transactions, decentralized architecture, ledger publicity, and compliancy issues do withhold banks to enthusiastically embrace this technology. If a bank would adopt, it would require much resources to acquire the necessary knowledge, run multiple test and solve the various compliancy and risk issues. And for what? The ultimate beneficiary is the customer, which can send and receive real-time against very small costs. The most obvious business case for a bank is customer retention, and a bank should be willing to adopt for this purpose. But, considering the various risks and the lack of a profitable business case banks will not adopt too easily. If big banks mutually agree to not adopt this technology, it will only be adopted among small banks which do not profit from correspondent banking. But, if one or more big banks adopt, other big banks also need to adopt to retain their (international) customers and global adoption might get accelerated. This discussion reflects in the two simplified outcomes of the adoption uncertainty and proves that both outcomes are plausible. Furthermore, this paragraph presents the potential attitude of a main stakeholder, the bank, which is the main driver behind the uncertainty adoption.

Other stakeholders

To determine if all stakeholders can and will accept potential scenarios, a list is made about all assumed future stakeholders in the production and use of a DLP. In the trends, uncertainties and dynamics, multiple different

future stakeholders are mentioned, and without a clear overview it is hard to indicate whether all stakeholders are incorporated and thus if their power and interest is properly included. The following stakeholders regarding the production and use of a DLP are identified:

1. The DLP provider. Example: Ripple Labs, Stellar Development Foundation, Hyper
2. The DLP distributer (uncertainty 4). Example: joint venture of participating banks, corporate vendor, open source committee
3. The DLP implementer (uncertainty 2). Example: (central) bank, intermediary, firm
4. The DLP installer. Example: software company, consulting firm
5. The wallet holder (uncertainty 6). Example: (central) bank, intermediary, individual
6. The front-end provider (uncertainty 11). Example: Payment Institution(s), bank(s), Big tech companies
7. The end-user who performs payments.

A first observation is that all relevant stakeholders are represented in the uncertainties. The DLP distributer, implementer, the wallet holder and front-end provider are included as uncertainty. The DLP provider is rejected due to the uncertainty about future DLPs and the complexity to compare DLPs, the DLP installer is rejected as it does not influence the whole, and the end-user which does not contain an uncertainty.

A related uncertainty presented by Jochem is if the financial industry consolidates or variates. Although this is an interesting uncertainty, it is too broad for this research. Therefore, it can be simply divided into consolidation versus variation for front-end payment providers (for example Apple Pay by Apple, iDEAL by Currence/banks), DLP creators (for example Ripple, Hyperledger) and back-end enabler (for example banks, clearing houses). Although there are more stakeholders as presented above, variation versus consolidation is of less relevance by these stakeholders. In each of the three named categories the industry can consolidate or variate, partly determined by the say of the regulator. On the one hand they can steer into variation as a few big consolidated banks are too big to fail and reduces competition, but on the other hand is a high variety of different providers more difficult to supervise. As this uncertainty is too broad to include as single uncertainty, its aspects are used to form uncertainty 11 (front-end payment provider), uncertainty 5 (co-existing standards resulting from co-existing DLPs) and uncertainty 2 and 6 (role of banks and intermediaries).

To check whether or not the scenarios created summarized this research, Figure 8.5 below has been drafted. In this figure, the rectangles are the stakeholders introduced above while the ovals are relating uncertainties. All uncertainties except for 7 (amount of virtual currencies), 8 (use of crypto currencies) and 9 (additional use cases) are included. Uncertainty 7 and 8 have consequences for their outcomes, but these consequences do not really influence other uncertainties, while 9 is too broad for such a diagram as another use case can involve another set of stakeholders. The boxes with the same color (green and blue) indicate that they these stakeholders role might be fulfilled by the one and the same company. For example, the DLP creator has not a very solid business case, while the DLP distributor and installer do.

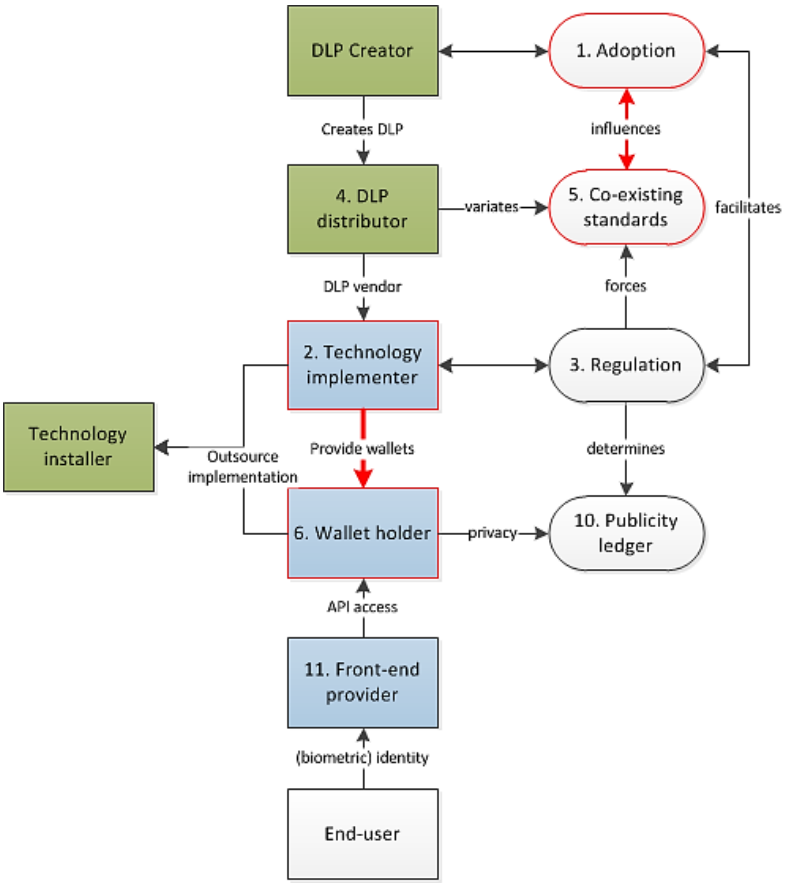


Figure 8.5 Stakeholders and uncertainties overview

When answering the question if the scenarios found cover this research, a negative answer is given. The red boxes and arrows indicate the two scenario planning sets created and it is obvious that the uncertainties which play a role around the adoption of DLPs cover more perspectives than can be shown in both scenario planning. As the type of scenario planning chosen can only couple two uncertainties, it is obvious that it is not possible to create an overarching scenario planning which takes into account all relevant factors.

Banks are trusted

Multiple participants indicated that although the position of banks is increasingly threatened, banks will stay the centralized place which individuals and firms can use to park their money safely. Some participants thought that although banks would ultimately disappear from the payments market, banks will at least be needed to facilitate a connection with a DLP in order to provide access to bank accounts or to enable customers to deposit money in their DLP. This subject indicates that it is necessary to keep both banks and non-banks in the uncertainties, as banks can be a main actor or a background actor but will not become redundant on short term. In all cases, banks will stay relevant and therefore their place in this scenario planning is granted.

From centralizing to decentralizing

During the interview with futurologist Paul Ostendorf, he described a model as presented in Figure 8.6 below.

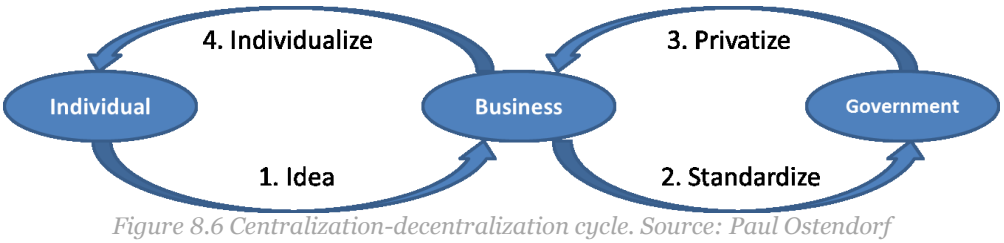


Figure 8.6 Centralization-decentralization cycle. Source: Paul Ostendorf

The model describes what types of actors are involved and what their power and actions are. At first, an individual has an idea and uses this to start a company. If successful and of (inter)national importance, the

government can standardize and/or nationalize the business concept. After some time, when the technology and its standardization have matured, it will get more privatized and some companies become responsible for the technology. These companies or new companies enable the service or product to be individualized, to give the individual the possibility to carry out or use the service or product himself. In history this cycle took about 150 years, but due to globalization and digitization this cycle gets increasingly shorter. Currently, more and more services and products are individualized to empower the individual. An example of this is crowdfunding. In past times, business idea owners should persuade banks in order to receive loans, while crowdfunding platforms enable entrepreneurs to receive loans of millions from thousand different individuals, in minutes. Another example is the 3d printer, which enables customers to manufacture products themselves, which was formerly solely the task of the manufacturing industry. This indicates that the role of the government should carry out an explicit role; an allowing, passive attitude can substitute nationalizing and privatizing activities. A contradicting argument named by Roy is about the Bitcoin, which is more and more centralized due to the high mining costs. Because miners get less profit, a few main providers will be left. This is conceptualized by the fact that the majority of Bitcoin miners currently is provided by a single Swiss company. An effect may occur that the more a service or product use is individualized, the more a few big companies will provide platforms necessary enabling to carry out these services individually. In case of DLPs, is it not the task of the government to nationalize the use of the technology, but to take care of choosing standards and setting up framework conditions in which certain actors and use cases are stimulated, while others restricted.

Regarding scenario planning II, this view proves that the end-used has a legitimate promiment position in this research. Although currently wallet services are offered by DLP creators to individuals, the trend is towards centralizing (maybe nationalizing) wallets, which may be again individualized on the mid-long term.

Type of currencies

To determine whether the different types of currencies are sufficiently covered, Table 8.8 below is produced to sketch the differences between four types of currencies. The main difference is between the crypto currency and the other currencies, as the crypto currency is an asset which has only value within the DLP and is redeemable at all exchanges, which raises hacking consequences. The other three currencies, virtual currency, shared virtual currency and store of value, represent fiat money or stores of value which have their worth outside the DLP, meaning that these liabilities are only redeemable at exchanges which accept them. Regarding the uncertainties, uncertainty 8 addresses crypto currencies, uncertainty 7 addresses virtual currencies, and next to this the so-called Fedcoin has been discussed in the uncertainties. Stores of values are less covered, but are also of less importance in the scope of interbank payment.

Currency	Crypto currency	Virtual currency	Shared virtual currency	Store of value
Example	BTC, XRP	Eur@GatewayA	Fedcoin	Gold, Starbucks loyalty points
Backed and redeemable by	-	GatewayA	Central bank	-
Represents	itself	fiat money	fiat money	ownership of store of value
Amount of currency	by mathematical algorithm or predefined amount	represents amount of fiat money	to be managed by regulator	follows from creation of production
Hacking consequences	high	moderate	moderate	low
Value	in DLP	outside DLP	outside DLP	outside DLP

Table 8.8 Different types of assets and liabilities

8.9. Stakeholder validation

The concept trends, uncertainties, dynamics and scenarios are send to participants for a review. After incorporating their feedback, the scenario planning is made definite. Feedback from the participants did not require significant adoptions, but were merely about recommendations for a greater consistency and straightening some inconsistencies.

Chapter 9. Conclusion

There are three classes of knowledge. Things we know we know, things we know we don't know and things we don't know we don't know (Schoemaker, 1995). This scenario planning research tries to shift from the third class in knowledge, to the first and second class. In this conclusion first the sub research questions and the main research question are answered, following with research limitations and recommendations for future research.

Sub research question 1. What are the factors influencing the successful adoption of a radical IT innovation?
The literature researched provided many results for the organizational adoption or acceptance of radical innovation adoption. Radical or disruptive innovations are innovations which offer a new service or product for internal or external use which ultimately heavily changes the current industry infrastructure and markets. Although organizations preferably adopt radical innovations, they often stick with adopting incremental innovations due a technological or supplier lock in. The S-curve of Foster (1986) shows that first radical innovations suffer from teething problems and unforeseen scalability issues, which enable second movers to more incrementally create the an improved product of service. On the one hand, early adopters gain the most knowledge by continuous development and adoption which enables them to deliver a more diverse set of service innovations to their customers. On the other hand, second movers can quickly catch up to first movers, with a good resource allocation, and can avoid uncertainty risks.

A central but informal culture is best to support the adoption or radical innovations. Centralization of decisions is best as opinions might differ greatly and without a central decision infrastructure, disagreements might cause that no decisions at all are taken. A central corporate mind-set, fed by various employees, should enable further innovation research and adoption. The radical innovation's board orientation, composition and decision process influence the governance of innovation project groups, in which a loosely coupling with the rest of the organization and the diversity of board members might be beneficial for the progress of such a project group. Radical innovations are accompanied by many technological and market uncertainties, which makes it a knowledge intense areas. Therefore, a high degree of informality in process management is advised and knowledge management practices should be implemented to find, collect and retain piles of data, although a formal attitude to stimulate knowledge sharing policies might be beneficial. Market visioning within the company is important to ready the firm for the adoption of radical innovations. There are several vision drivers, executed by multiple roles such as the product champion which leads in vision forming, supported by tools and methods for vision development which ultimately might lead to the acceptance of a vision, resulting in resource allocations to further investigate or adopt a radical innovation. Some contextual factors are also important, such as company turbulence, resource availability, alliances and technology interactions.

New technological regimes incorporating the ecosystem of a radical service or product will incubate and grow in existing regimes, which forms, but also limits the use and functionality of the radical innovation the new regime contains. If a regime breaks out of the old regime this is caused by problems or emerging inefficiencies of the old regime, and a new regime is formed including regulations, stakeholders, traditions, infrastructure, culture, markets and user practices. This existing regime might be altered or even displaced by a new regime which forms itself around the new technology. Regulatory barriers of existing regimes slow these new entrepreneurial entrants to the markets, but incumbents should be aware of potential changes in regulators opinion which may open up a new regime.

Open innovation indicates that some innovation activities for a particular project are shared with other organizations, whereas with closed innovation nothing is shared. The advantage of open innovation is that knowledge can be more easily gathered, risks can be shared and organizations can make use of their complementary assets to improve or stimulate the innovation process. Advantages of closed innovation are that it reduces costs and complexity of collaboration and there is no risk of cheating or opportunism from collaborating ventures. Also, rewards do not have to be shared, and there is no dependence on others. Networks of big incumbents, small entrepreneurs, knowledge centers, universities and regulators can be initiated to stimulate the distribution and acceptance of a new radical innovation. In this, intermediary parties have to take care of beneficial collaboration for all participants, in particular for the small parties.

The most recognized (perceived) adoption factors are: compatibility, relative advantage, complexity, profitability, communicability, divisibility, social approval and triability. These factors in turn influence direct

stakeholder and environment factors as top management support, allocation of resources and industry and regulatory pressure. Furthermore, the biggest hindrance in dealing with radical innovations is the security and compliance of these radically new technologies.

Sub research question 2. How do interbank payments take place nowadays?
Current cross-currency interbank payments take place by correspondent banking, in which a payment flows through multiple banks before it ends up at the beneficiary bank. If the sender and beneficiary bank do not have a trust relation, they will search for a (few) correspondent bank(s) who have their mutual trust to let the payment flow through them. The messaging accompanied by a payment is internationally taken care of by SWIFT. Supporting back-end systems are EURO1, EURO2, STEP1 which together facilitate national, urgent or non-urgent, low or high value, single or batch payments. Real Time Gross Settlement (RTGS) systems are hosted by central banks and take care of urgent high-value payments, in which the central bank acts as trusted market maker. These RTGS have no international reach, correspondent banking is slow (up to 5 business days) and expensive, which gives a great business case for DLPs to break through. Current standards used for payment are ISO 8583 and the more recent ISO 20022, which gets currently massively adopted throughout the world. Many regulations and compliance framework are in place to protect banks and ultimately their customers. Examples of these are Know Your Customer (KYC), Anti-Money Laundering (AML), the Financial Action Task Force (FATF), sanction lists, Payment Service Directive (PSD) I and II and the MOT (reporting unusual transactions). Banks are obligated to regulatory instances to comply to these regulatory frameworks in order to keep their banking license. Multiple different systems are nowadays in place which automatically scan incoming and outgoing transactions. If the corresponding payment information is incorrect or incomplete, a transaction can be put in a queue to be manually verified, or it can be cancelled.

Sub research question 3. What are Decentralized Ledger Platforms?
A crypto currency is a math-based digital asset which is secured and recognizable by mathematical properties. The best known example is the Bitcoin, which is run on a blockchain. Crypto currencies are placed in a decentralized shared ledger and characterized by a public and private key. Crypto currencies can be used as money, but due to high volatility and the possibilities of hackers to steal crypto currencies once a (group of) secret key(s) is stolen, financial institutions and regulators are not benevolent to use or regulate crypto currencies. A Decentralized Ledger Platform (DLP) is the technology which offers one or multiple assets, for example crypto currencies or stores of values, to be traded among all kind of users. The technology is freely usable and each willing user can create an account to hold assets or perform payments. Examples of these platforms are: Ripple, Stellar, Hyperledger and Open Transactions. DLPs have an open architecture, are mostly open source and can be used as a backbone layer in new payment initiatives. These DLPs have various validation mechanisms, such as Proof of Work, Proof of Stake, Proof of Burn, Consensus based on Practical Byzantine Generals Fault.

Sub research question 4. How does the Ripple protocol work?
Ripple is a universal Internet protocol founded in 2012 which enables a low-cost and fast payment system for value transfer. Ripple's technology enables users to exchange money (including fiat currencies, digital currencies, gold, securities, contracts and other items of value) within and across national boundaries. The Ripple protocol can be compared with SMTP, which is the protocol for email that enables different e-mail services (Hotmail, Yahoo, etc.) to communicate regardless of the e-mail service used by the sender or receiver... Ripple holds its own crypto currency, XRP. Ripple Labs, the creator of the Ripple open source protocol, is targeting banks to adopt Ripple as a settlement infrastructure. Ripple offers financial institutions an alternative to correspondent banking, yet itself is not a payment system or clearinghouse. Ripple positions itself as not a competitor to banks, but instead a technology banks can use. The protocol can be seen as the backbone for a new financial architecture, in which on top of the Ripple protocol public or private systems can function which enable financial institutions to use the network in the way it fits them best.

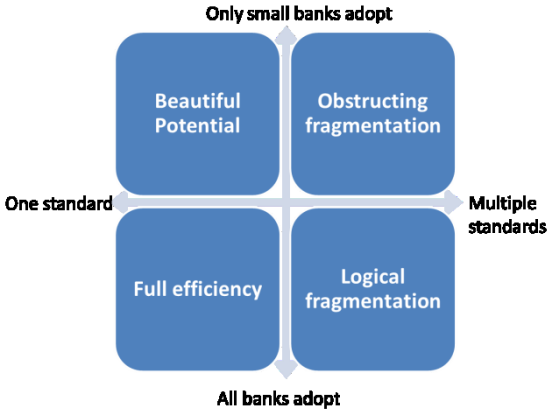
Ripple is operated by a decentralized network of servers running the open source Ripple protocol. The Ripple protocol is designed to transfer any virtual liability, anywhere in the world, within six seconds. These liabilities can represent fiat currencies as Euros, Dollars, Pounds, but also barrels of oil, hours of electricity, services, etc. The word liability is specifically used as almost all "currency" on the Ripple network is a virtual representation of an asset held at a financial institution, except for its native crypto currency XRP. Financial institutions are primary users of Ripple and serve as gateways providing access for funds to enter and exit the network. This means that customers of financial institutions do not need to know anything about Ripple or its protocol,

although for transparency purposes banks can inform their customers. These gateways receive fiat money from their customers and then exchange these funds into virtual money. This virtual money can be used for transactions, and when desired this virtual money can be redeemed at the same gateway for fiat money. The fiat money (for example Euros) is thus kept in a regular bank account, and this amount will be virtually represented on the Ripple network (for example virtual Euros). Note that most value – the fiat money at the gateway – is placed outside the Ripple network, and thus not vulnerable in case Ripple breaks down or gets out of use. Only XRP represents value inside the network, but costs for holding the necessary amount of XRP are very low (currently $100 worth in XRP can be used for about 600.000 single transactions).

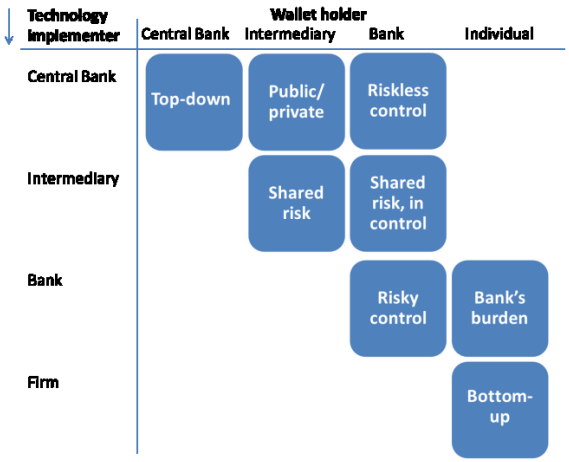
Cross-currency transactions (e.g. EUR/GPB) rely on a party called a Market Maker. Market Makers provide liquidity and execute Forex (foreign exchange) deals for cross-currency transactions via Ripple. These market makers deposit their fiat money in any currency at trusted gateways, in exchange for virtual money issued by these gateways. This depositing will be accompanied by official contracts between both parties. After this funding, market makers can post bids and asks for Forex deals, enabling transactions between Ripple-enabled banks. These forex deals are made when a Ripple user (the bank) wants to make a payment to another user in another currency. The market maker then receives the currency he asked for in the agreed amount and pays the agreed amount in the currency of the bid to the beneficiary. New transactions are verified by decentralized rippled servers, by means of a scientifically proven consensus process. As the Ripple network is decentralized, there is no central operator. This improves the transparency and resilience of the system, but reduces regulatory options as no one regulates Ripple Labs or participating parties yet. Central banks and other supervisory agencies can still set the rules and governance of behavior between banks using Ripple. The parties using Ripple determine the rules and governance they wish to adhere to, which might later on be determined by regulators or a jointly created firm which monitors banks in the Ripple. Regarding a potential DLP implementation, most important is that all necessary compliance systems are already in place. When adopting, mostly the channel through which a payment flows will change.

Sub research question 5. What are the alternative scenarios for Decentralized Ledger Platforms implemented for interbank payments?

A scenario planning is performed by analyzing trends, uncertainties and dynamics. The trends contain current and short term future trends. 9 Global trends are found, such as the new entrants in the payment industry, digital (biometric) identity, privacy awareness and Open Banking initiatives by API access. Also 5 trends are found from a DLP perspective, such as the starting regulation for crypto currencies and hacks of crypto currency exchanges. Uncertainties are analyzed which have a significant influence on the future payment industry. 11 Uncertainties are found which address the role of various stakeholders, adoption, the publicity of the ledger, regulation, co-existing DLP standards, additional use cases and the use of crypto and virtual currencies. In dialogue with 16 interviewed participants and after a thorough analysis, the set of uncertainties adoption versus co-existing standards and technology implementer versus wallet holder are chosen to use for two separate scenario planning sets. The technology implementer is the party who implements the architecture and thus takes all integration and maintenance risk, the wallet holder is the member of the technology implementer which is enabled to use a wallet to do payments. These sets are displayed below.



SP I: Adoption vs. co-existing standards



SP II: Technology implementer vs. wallet holder

A first conclusion is that attention needs to be given to the rate of adopting banks, and if this concerns small or big banks, combined with the adoption of standards. Many standards will exist, but there might be a tendency to evolve towards one standard. The more standards, the more fragmented ledgers and networks are, the more inapprehensible the whole and the more chance for failures, hacks and other risks due to a lack of understanding. Also, different technology implementers and wallet holders might raise simultaneously, in which the incumbent institutions have the chance to provide the same payment instruments as new entrants tend to, thereby securing their role in the future interbank payments industry. Technology implementers only accept certain type of wallet holders, and vice versa, so it might be the question which actor (holder or implementer) first locks in another actor. A last remark is that the ultimate product of this scenario planning has insufficient coverage of the subject. The level of aggregation of all formerly collected knowledge is simply too high, which results in abstract and straightforward scenarios. Most important of the scenario planning was the analysis and discussion of the trends, uncertainties and dynamics, and there is not a particular end-product which can sufficiently visualize or conclude these findings. To create a better overview, additional diagrams were made in the consistency and plausibility paragraph which show the relations among future stakeholders, including some uncertainties. This influence diagram clearly presents what uncertainties are important, and how change in some part of the architecture influences the rest. Another consistency product concerns a separation of four types of value: crypto currencies, virtual currencies, shared virtual currencies and store of values. Risks and use cases differ for each currency

Sub Research Question 6. How should Rabobank Netherlands address these potential scenarios?
The answer for this question is only intended for Rabobank Netherlands, and is answered in chapter 10. This chapter is not available in the public version of this research.

Main research question. What are future scenarios for the implementation of Decentralized Ledger Platforms facilitating interbank payments?
All sub research questions answered, leads this to the main research question. Background knowledge about radical innovation adoption, interbank payments, DLPs and cryptocurrencies is given, visualized by a practical case study of the Ripple protocol. Scenarios are created in collaboration with participants from a variety of industries, and additional diagrams are created to visualize relations and influences in the future payments industry. Stakeholders should be aware of the variety of scenarios and should keep an eye on identifying factors which might give away what directions this payment industry is going.

Conclusions drawn in relation to these scenarios are that the consolidation versus variation of different stakeholders needs to be taken into account. Important stakeholders are the bank, the DLP provider, a front-end provider which provides authentication (by biometric identity, presumably by phone) to the end-user and the technology implementer. There may be much variation in front-end payment services, as currently is the case, but a consolidation in the back-end of financial institutions. Regulators must enable controlled innovation and take care of DLP standardization. Retail payments might be an excellent use cases which precedes interbank payments, thereby creating starting point for DLP-facilitated interbank payments to happen. In the end, consumers might have a hard time breaking from banks and banks should secure that prominent position by creating top notch payment services for their clients, if possible.

Limitations
Note that this research does not predict the future, but investigates the future. Bold claims of the future are made in this conclusion and in the rest of the document, but these claims can be scientifically verified by taking into account a set of main assumptions, from which the most important is that a Decentralized Ledger Platform (DLP) will be adopted by financial institutions. A main limitation is that the scenario planning is performed in a centralized way, in which the researcher interviewed all participants and verified the model by these participants, while the participants could not directly discuss with one another. Double verification partly addresses this limitation. Furthermore, the scope of DLP-facilitated interbank payments is multidisciplinary and requires extensive knowledge in various areas, which none of the participants – including the author – possessed. Another limitation is that this study is highly time dependent as the DLP industry is new and tries to break out a niche and create its own regime. This includes also the changing attitudes of stakeholders, which can turn 180 degrees in a couple of weeks.

Recommendation for future research

Many forms of future research are possible and recommended. To establish findings of this study, research could investigate particular trends or uncertainties, or focus solely on a specific DLP (functionality). Crypto currencies themselves have are currently covered with basic research, but the concept of a DLP not yet. In this, verification and consensus mechanisms are of great importance. On the edge of this study, stakeholders' progress, attitude and developments should be carefully followed as some have the power to steer or avoid certain scenarios. In this, one could investigate answers on the consultation paper initiated by the Federal Reserve, as this gives a great perspective of current state of mind and knowledge of more than 200 American financial institutions or actors in the field. More globally, research can take place regarding the appropriate liberty of money creation, consequences of the increased globalization in the financial industry and the role of regulators. And at last, research should be pointed to the development and improvement of current DLP systems in order to better assess their possibilities to improve the current interbank payment system.

Chapter 10. Recommendation for Rabobank Netherlands

This recommendation is private and is meant only for Rabobank employees.

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