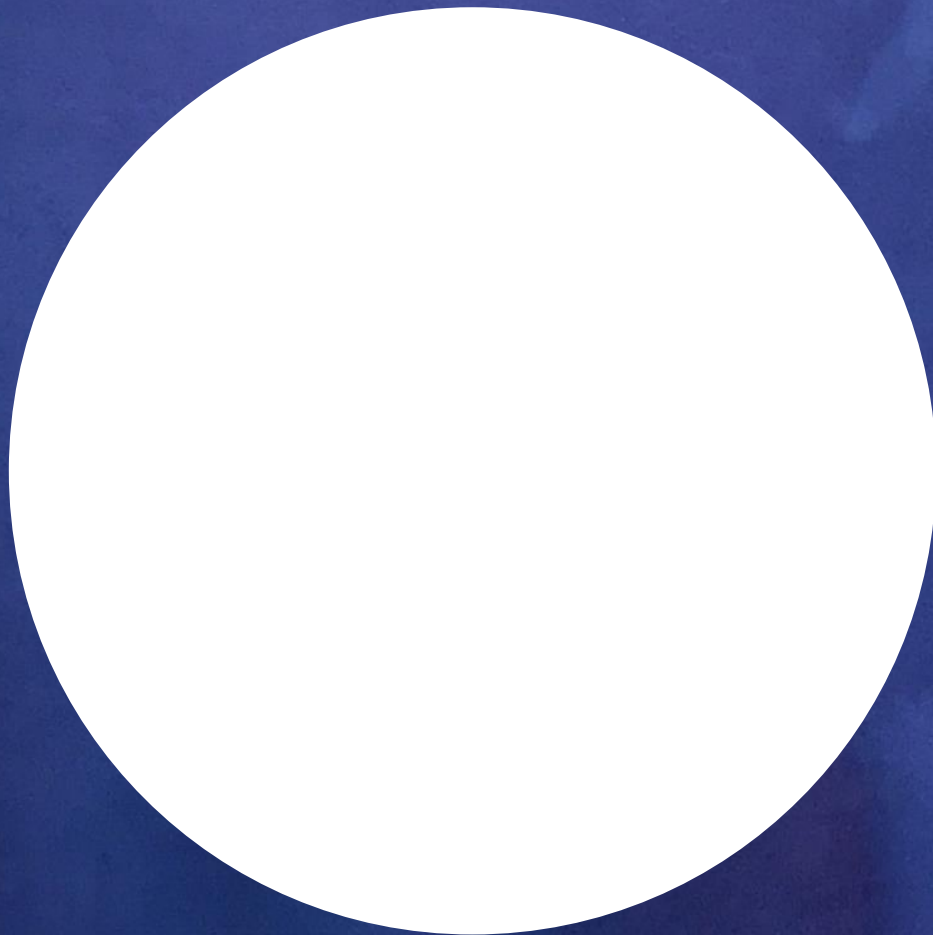


TOKENIZED ECOSYSTEMS

THE DESIGN OF A TOKENIZED ECOSYSTEMS ASSESSMENT TOOL: A DESIGN SCIENCE APPROACH

Abe Scholte

Master Thesis Report



Gartner

 **TU Delft**

TOKENIZED ECOSYSTEMS FOR BUSINESS PROCESSES

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SCIENCE APPROACH

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FOREWORD

The idea for this research started in the midst of the blockchain craze of 2017. I was amazed by the billions of dollars that were raised by blockchain startups, that offered nothing more than a fancy website and a quick-and-dirty business plan; the so-called 'whitepaper'. To me, there was something intriguing about these blockchain startups. Not because most of them were actually shrouded in scams and Ponzi schemes, but because some of them looked at blockchain in an entirely different way than how large existing businesses try to earn money with blockchain technology. These startups used Tokenized Ecosystems in a revolutionary way to decentralize and democratize large centralized businesses with too much power. After multiple conversations with Maarten Kardux, Bart Mellink and David Alessie at Gartner, I decided to research the impact of these potentially transformational blockchain startups on the incumbent businesses. This appeared to be a difficult task, since academic literature on these futuristic blockchain projects, such as Tokenized Ecosystems, was scarce, and businesses had just only started to have an understanding of the basics of blockchain technology. I am very happy I decided to research this topic anyways.

Writing my thesis at Gartner has proven to be one hell of a ride: From visiting an Ethereum developer conference in Paris, attending the largest Blockchain Hackathon in the world, hosting a blockchain workshops to multiple CIOs of large multinationals, to moderating a blockchain roundtable in the Hall of Knights in The Hague. It was an amazing experience that Gartner was always supportive of these activities and I am deeply grateful for this opportunity.

Writing this thesis was also one of the most difficult and mentally challenging things I have ever done. Finishing this thesis was something I could not imagine at certain times and the fact that you are reading this, is because of the massive amounts of help I got from various very special people. I dedicate this thesis to them.

First of all, I would like to thank my first supervisor: **Dr.ir. Zenlin Roosenboom-Kwee**. Because of her unconditional trust in my capabilities, I believed in successfully finishing this thesis. Zenlin's expertise and insights in multiple scientific theories in business management and economy resulted in a much more academically grounded research. I will miss the conversations we had before every meeting; those were a very good base for fruitful discussions. I would also like to thank the chair of my graduation committee: **Prof.dr.ir. Marijn Janssen**. His broad perspectives helped me to 'zoom out' on a regular basis to look at the whole research process. Marijn helped me a lot with keeping track on the reasoning behind every research step and decision.

Also, I want to thank my colleagues at Gartner. People at Gartner are *not* shy and very quick-witted. There was an uncountable amount of moments during lunch and coffee breaks where I had to explain and actually *defend* my research. It was amazing to see how quickly they understood the topics I deemed complex. Especially **ir. Bart Mellink**, my supervisor at Gartner, had an excellent 'bullshit radar'. My discussions with Bart were always extremely valuable, as he would help me to pick out and sharpen my vaguer arguments.

An extraordinary person that deserves special acknowledgement is **ir. David Alessie**, my other supervisor at Gartner. I cannot thank him enough for the enormous dedication and support I received from him. Don't let this young man's age trick you; he has proven to be a very capable mentor. He, although being busy as always, freed up his valuable time to make sure this research was going in the right direction, to help me with planning, to guide brainstorm sessions, to explore opportunities, and to ask me how he could help me

further. Most of all, he made sure my thesis struggles were bearable and celebrated every small achievement. Cheers to you, buddy!

Lastly, I am very grateful for the support of my parents, **Pim** and **Elma**, and my brother **Sil**. You create the atmosphere in which I can excel. I am also very grateful for my friends, who have been very supportive, even though I was not around as much as I used to. Last but not least, I want to thank **Annabel** for being my better half; you help me to be my best.

Thank you all for making this possible!

Abe Scholte - 6th October 2018

SUMMARY

Blockchain technology is an emerging technology that can be defined as a shared, trusted public ledger that users can inspect, but that no single user controls. Blockchain technology can be transformational to a lot of business sectors, but not in the way that most might think. Businesses have attempted to extract value from blockchain technology but failed to do so. In contrast to what most businesses think, blockchain technology is not a one-size-fits-all solution and it might not even play a big part in future paradigms. However, the decentralized and peer-to-peer nature of blockchain *enables* a revolutionary way to look at how business and global economy can be redesigned. In that way, blockchain technology is a trampoline or stepping stone into a new paradigm, and functions from then on merely as a substrate for other technologies and business initiatives.

An overlooked blockchain business initiative is Tokenized Ecosystems. Tokenized Ecosystems are a way to organize a business in a decentralized way, i.e., interconnected collaborative communities will create and sustain business processes, and its members are incentivized through token reward functions. These token reward functions dispense tokens to individuals that are valuable to the business process (by improving code, providing computing power, curating data, etc.; the earned tokens can have monetary value or can for example give rights of some sorts. An example can be found in Filecoin; users can earn filecoins by providing cloud storage to the network with their private computer/server or improve the open-source code. These filecoins can be exchanged for cloud storage rights or for money on a cryptocurrency exchange. The business process has now become a network which nobody in particular owns, but which is owned by everyone holding a token related to that business process. Applying this initiative to incumbent businesses will help them prepare their business for a new blockchain-based paradigm. Otherwise, they will be disrupted by startups that have grown their network with Tokenized Ecosystems in a successful way. However, the problem is that businesses do currently not know how they should react to these startups and to the blockchain business initiative of Tokenized Ecosystems.

This defines the **research problem** of this thesis: *Startups using Tokenized Ecosystems have the potential to disrupt incumbent businesses. Yet, it is unclear for these businesses how they should react.* To respond to this problem, this thesis aims to improve this situation for businesses by making clear how they should react. This describes the **research objective** of this thesis: To improve decision-making of businesses regarding the application of Tokenized Ecosystems to their business processes. Therefore, this thesis presents a structured approach that can help businesses with their decision-making. This results in the following **deliverable**: A demonstration of why Tokenized Ecosystems should be seen as a revolutionary way to redesign business processes, and a novel assessment tool that helps business managers with their decision-making regarding the application of Tokenized Ecosystems to their business processes.

The findings this thesis describes are **scientifically relevant**. This is explained by that fact the topic of the research, Tokenized Ecosystems, is under-researched and novel. Furthermore, this research provides a systematic analysis of when Tokenized Ecosystems can add value to business processes. First of all, it provides a way to analyse the maturity of the innovation of Tokenized Ecosystems using the perspective of the Diffusion of Innovations. Second, it provides a way to analyse the organizational fit and business process fit between Tokenized Ecosystems and a business. This is a known field of research for IT innovations, but not for blockchain technologies and innovations, let alone for Tokenized Ecosystems.

The findings of this thesis also have **managerial relevance**. This is explained by the fact that it provides insights to managers of businesses. First, it provides insights in what Tokenized Ecosystems are and that multiple blockchain related startups organize themselves in that way. Second, it provides insights to managers in whether a business has an organizational or business process fit with Tokenized Ecosystems. Third it provides a high-level overview of Tokenized Ecosystem design options that identify necessary capabilities of a business to be able to design them. Lastly, it will help managers with strategic decisions regarding the application of Tokenized Ecosystems to a business process, because of identified strategic factors, for example that the development of Tokenized Ecosystems should not be internal. Also, this will prevent bad investments if the business is not ready yet and will provide factors that the business needs to have before being ready for that change. All-in-all, this research identifies factors that help managers to assess when the development of Tokenized Ecosystem is a good idea for the business in question.

In order to achieve the research objective, and present the deliverable, the following **main research question** will be answered: *How can an assessment tool improve decision-making by businesses on the application of Tokenized Ecosystems to their business processes?* The research problem, research question and deliverable are illustrated in figure 1.

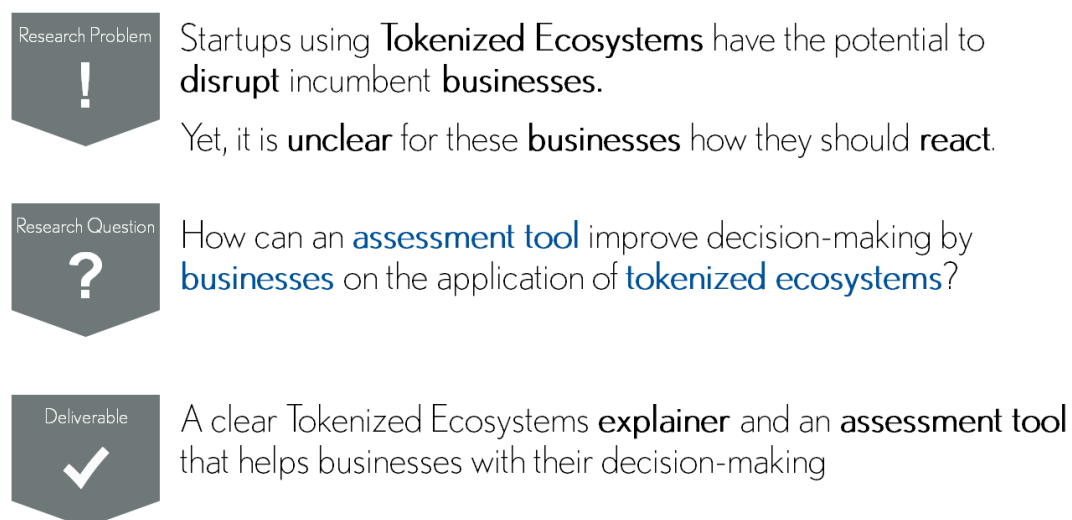


Figure 1: Research Problem, Question, and Deliverable

Although scientific research on the application of blockchain technology is emerging and rapidly increasing, there is no clear focus on the possible business applications of blockchain. Scientific business literature mostly focusses on *how* blockchain technology can work in organizations - like conceptualizing various applications of blockchain technology in business organizations - and not *why* blockchain technology should be adopted in organizations - like discussing the reasoning behind the applications of blockchain technology in business organizations. The motivation or incentives behind implementing blockchain in businesses is hardly researched and thus the actual impact blockchain technology can make on businesses is unclear. Also, very few studies go beyond the application of blockchain technology as record management systems (Li, Marier-Bienvenue, Perron-Brault, Wang, & Paré, 2018). While focussing on Tokenized Ecosystems as a business application beyond blockchain technology as a record management system, the following **three** knowledge gaps appear.

First, the potential disruptiveness of Tokenized Ecosystems is unclear. Startups apply Tokenized Ecosystems in various ways and they may or may not be successful. Startups like Filecoin currently seem

successful (they raised over 200 million dollar as an investment), but it is unclear whether they will exist in a few years' time. Whether the current amount of funding and success actually results in a more profitable business model is unclear. Also, even if the business model of a startup applying Tokenized Ecosystems would be profitable, it is unclear if it will actually disrupt incumbent businesses. **Second**, an approach to assess whether the application of Tokenized Ecosystems within a business aligns with the goals of that business is lacking. In order to assess this alignment, a structural approach is required. This structural approach should be comprised of components that explain whether Tokenized Ecosystems fit with the current business goals and strategy. Also, there should be components that explain whether a business is actually *able* to implement Tokenized Ecosystems, even if its application aligns with the goals and processes of the business. This means that if an organization has a good fit with applying Tokenized Ecosystems to their business processes, it is unclear if their organization is actually ready for that change. **Third**, a high-level overview of the design of a Tokenized Ecosystem is lacking. Before a business can implement a Tokenized Ecosystem, it would be wise to design a minimal and rudimentary version, which allows the business to collect the maximum amount of validated learning with the least effort. Thus, by creating this rudimentary version, businesses allow themselves to test Tokenized Ecosystems with their partners and potential customers without putting in too much effort. However, before a business could design such a test version, a high-level overview of what such a design should look like is required.

This **research methodology** that was used in this thesis is following the Design Science Research Cycles approach. The research consisted of 6 phases: (1) *Problem Exploration*, (2) *Problem Explication*, (3) *Requirements Definition*, (4) *Artefact Design*, (5) *Artefact Demonstration*, and (6) *Conclusion*.

In the **first phase: Problem Exploration**, the problem statement was identified through reviewing both academic and grey literature. In the **second phase: Problem Explication**, the problem was explicated by departing from the knowledge gaps and using academic perspectives to find components that are important for the design of a Tokenized Ecosystems assessment tool. The first knowledge gap - *the potential disruptiveness of Tokenized Ecosystems is unclear* - used the following perspectives: business decentralization trend, value extraction from businesses, Tokenized Ecosystem value to businesses, a thought experiment, desk research and the theory of Diffusion of Innovation. The second knowledge gap - *an approach to assess whether the application of Tokenized Ecosystems within a business aligns with the goals of that business is lacking* - used the following perspectives: The Strategic Alignment Model and the theory of organizational readiness. The third knowledge gap - *a high-level overview of Tokenized Ecosystem design is lacking* - used the following perspectives: a knowledge base, a technology layer, building blocks and design tools.

This second phase identified 4 components that were important for the design of the assessment tool: (1) **Innovation maturity**, the component of the Tokenized Ecosystem assessment framework that determines the innovation maturity. Innovation maturity is defined as the rate of adoption of the innovation, communicated through channels, among members of a social system. (2) **Business Process fit**, the component of the Tokenized Ecosystem assessment framework that determines the business process fit. Business process fit is defined as the degree to which Tokenized Ecosystems can be applicable to a business and can be aligned with its business strategy. (3) **Organizational fit**, the component of the Tokenized Ecosystem assessment framework that determines the organizational fit. Organizational fit is defined as the ability of businesses to apply Tokenized Ecosystem to their business processes and strategy. (4) **Design**, the component of the Tokenized Ecosystem assessment framework that provides a high-level design overview of all options that are required for the design of a Tokenized Ecosystem.

The process of the second phase is illustrated in figure 2.

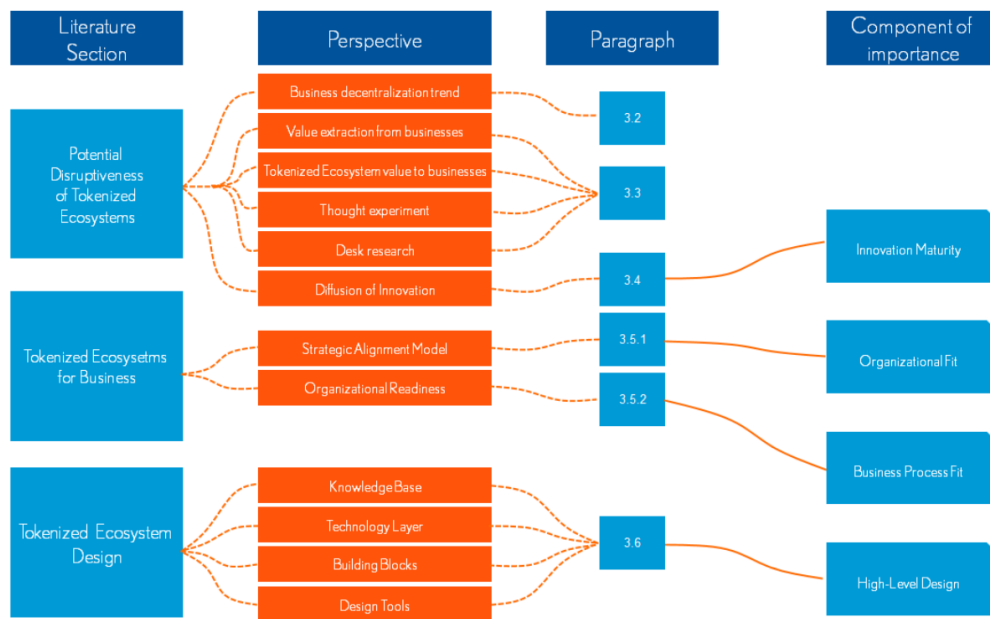


Figure 2: The identification of assessment tool components by departing from the knowledge gaps while using various academic perspectives

In the **third phase: Requirements Definition**, the identified components were assessed on whether they should not only be of importance for the design of the assessment tool, but also requirements. This was determined by a process of concretization: By confronting the components that were identified by academic perspectives with empirical evidence collected through expert interviews, the underlying factors of the components could either be verified (if the factor was similar), specified (if the factor was further defined), or challenged (if an opposing factor was identified). The experts selected for this process were eight of the most outstanding and globally renowned blockchain and tokenization industry experts and thought leaders. This phase confirmed the overarching themes of the components. The process of the third phase is illustrated in figure 3.

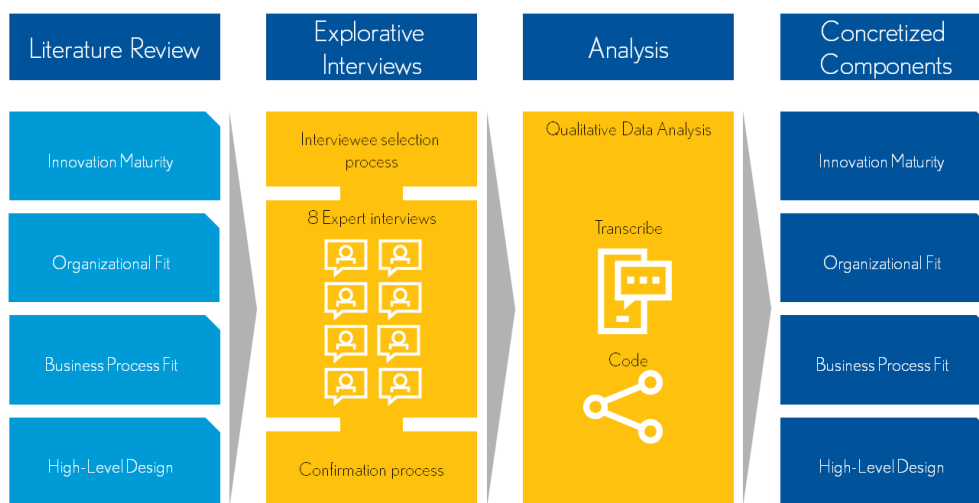


Figure 3: The concretization of assessment tool components by confronting them with empirical evidence collected through expert interviews.

The components that were found to be of importance for the assessment were concretized into the requirements of the design of the assessment tool. The requirements for the design of the Tokenized Ecosystem assessment tool are as follows:

Innovation Maturity: The Tokenized Ecosystem assessment tool must be able to determine the technological maturity, which is based on the *complexity, compatibility, scalability, transaction volume* and *energy usage* of the technology, and the ecosystem maturity, based on the *enterprise readiness, interoperability capabilities, cross-functional knowledge competencies* and *diffused sense of importance* within the ecosystem, involved in markets potentially being disrupted by Tokenized Ecosystems.

Business Process Fit: The Tokenized Ecosystem assessment tool must be able to determine the business process fit regarding the application of Tokenized Ecosystems, which is based on the *internal- and external strategy* and the *internal- and external infrastructure*.

Organizational Fit: The Tokenized Ecosystem assessment tool must be able to determine the organizational fit regarding the application of Tokenized Ecosystems, which is based on the *individual psychological factors, individual structural factors, organizational psychological factors* and *organizational structural factors*.

High-Level Design: The Tokenized Ecosystem assessment tool must be able to provide a high-level design overview of Tokenized Ecosystems in order to develop a Minimum Viable Product. This consists of a *knowledge base, a technology layer, building blocks and design tools*.

In the **fourth phase: Artefact Design**, the design of Tokenized Ecosystems assessment tool is described. The design followed a bottom-up iterative design approach. This iterative approach consisted of multiple cycles between designing a version of the assessment tool on the one hand and evaluating it by confronting it with academic, and empirical data on the other. This process started during the second phase: Problem Explication, and design iterations happened from then on. Every iteration produced a slightly improved version of the tool.

The final version of the Tokenized Ecosystem assessment tool consists of three steps that will guide a user through an assessment process that determines whether a specific business should apply Tokenized Ecosystem to its business processes. The tool is created for business representatives that have to decide on the application of Tokenized Ecosystems to their business processes. To gain the most insights from this assessment tool, all three steps should be taken in sequence. Otherwise, if the business has been using the tool before, it could redo a single step in order to update previous results. The three steps of the Tokenized Ecosystems assessment tool will determine the *innovation maturity* of Tokenized Ecosystems, whether there is a *fit with the business*, and demonstrate a *high-level design overview* of Tokenized Ecosystems. Every step from the assessment tool renders additional insight to the user regarding whether a business should pursue applying Tokenized Ecosystems to its business processes.

Step 1: Determine the innovation maturity of Tokenized Ecosystems

The first step requires the user to collect information regarding the current state of innovation maturity of Tokenized Ecosystems. This input is required in order to assess the ecosystem maturity and technological maturity of Tokenized Ecosystems. The technological maturity of Tokenized Ecosystems is based on its *complexity, compatibility, scalability, transaction volume* and *energy usage*. The ecosystem maturity is based on the *enterprise readiness, interoperability capabilities, cross-functional knowledge competencies*

and *diffused sense of importance* within the ecosystem, involved in markets potentially being disrupted by Tokenized Ecosystems. This step of the tool provides an insight to the user what the situation is regarding the innovation maturity of Tokenized Ecosystems. This insight provides the opportunity for the user to better assess the potential value of applying Tokenized Ecosystems to their own business processes, and whether the business which the user represents should incorporate the technology. This first step also informs the user about whether or not he should continue with the assessment tool. If the tool shows that Tokenized Ecosystems are currently mature, he should continue with the following step. Otherwise, if the tool shows that Tokenized Ecosystems show no innovation maturity, the user is informed that he could still continue with the following steps of the tool, but that the tool will not confirm that the business in question should pursue Tokenized Ecosystems and that following the next steps of the tool is merely an exercise that provides additional insight.

Step 2: Determine the fit with Tokenized Ecosystems

The second step also requires the user to collect information, but this times it is regarding whether he considers there to be a business process and organizational fit between the business and Tokenized Ecosystems. The business process fit regarding the application of Tokenized Ecosystems is based on the *internal- and external strategy* and the *internal- and external infrastructure* of the business in question. The organizational fit regarding the application of Tokenized Ecosystems is based on the *individual psychological factors, individual structural factors, organizational psychological factors and organizational structural factors* of the business in questions

Step 3: Outline a high-level overview for a Tokenized Ecosystem design

This step demonstrates a high-level design overview of the design of Tokenized Ecosystems so that the user will gain insights in all the competencies that are required to develop a rudimentary/test version of a Tokenized Ecosystem.

An overview of the three steps of the Tokenized Ecosystem assessment tool are illustrated in figure 4.

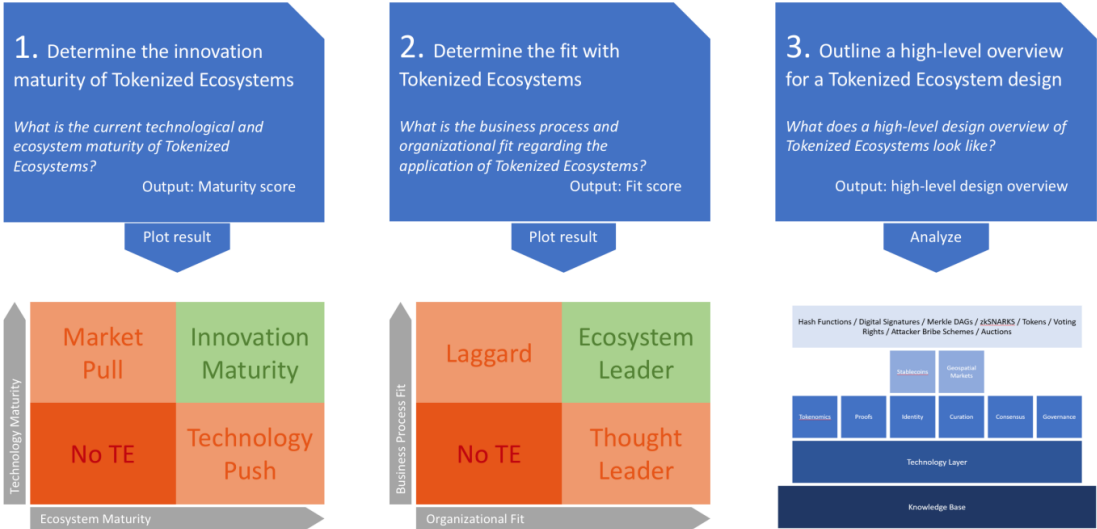


Figure 4: The three steps of the Tokenized Ecosystem assessment tool

In the **fifth phase: Artefact Demonstration**, the effectiveness, the efficiency and the workings of the blockchain assessment tool was demonstrated. This was done by conducting a case study; during a desk research, the value of Tokenized Ecosystems was assessed regarding the case. The case involved a

business that was interested in applying Tokenized Ecosystems to their business processes. During this demonstration phase, the context of usage of the tool was defined: Who should use the tool and within which business (sector) should it be used? The tool was also assessed on **effectiveness** - the degree to which the outcomes of an assessment by use of the tool improve decision-making regarding the application of Tokenized Ecosystems to their business processes, and on **efficiency** - the degree to which use of the tool requires an acceptable amount of time, and human, material, and financial resources. Outcomes of this evaluation were that the tool was found to be both effective and efficient within the described context.

In the **sixth phase: Conclusion**, the research was concluded by answering the main research question and by providing an overview of the assessment tool. This thesis draws **scientific conclusions**: Current innovation theories like the Strategic Alignment Model, the theory of innovation diffusion, and technological maturity are only applicable in a limited way when assessing the possibility of applying Tokenized Ecosystem to business processes. Concurrently, ecosystem maturity - which is based on the *enterprise readiness, interoperability capabilities, cross-functional knowledge competencies* and *diffused sense of importance* within the ecosystem - plays a critically important role when assessing the possibility of applying Tokenized Ecosystems to business processes. Also, this thesis describes Tokenized Ecosystems as a melting pot of a plethora of various disciplines, theories, technologies, and design tools. This thesis produces a systematic overview which classifies and categorizes these in a high-level design overview for Tokenized Ecosystems. This thesis also draws **managerial conclusions**: The organizational readiness of a business plays a very important role in assessing the possibilities of applying Tokenized Ecosystems to business processes. Also, businesses should follow a systematic process when identifying possibility of applying Tokenized Ecosystems to their business processes. Furthermore, businesses should proceed with caution when deciding on investing in Tokenized Ecosystems and blockchain technology projects especially. There is no guarantee in a return of investment in the short run. However, businesses should be aware of the chance of being disrupted by startups that have successfully applied Tokenized Ecosystems to their business processes. Thus, businesses *must* constantly investigate the disruptive potential of Tokenized Ecosystems and act accordingly.

Keywords: *Blockchain, Design Science, Tokenized Ecosystems, Business IT Strategy, Technology Assessment Tool*

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PROBLEM IDENTIFICATION

GOAL

Explore the problem and define the knowledge gaps. Describe the research objective and propose the main research question.

PROCESS

An (grey) literature review was conducted into how businesses have tried to extract value from blockchain business initiatives. One category of blockchain business initiatives (Tokenized Ecosystems) was found to be unexplored. By reviewing what is currently known about the actual potential of Tokenized Ecosystems, four knowledge gaps appeared. These knowledge gaps were assessed, and a research objective was defined that could tackle these knowledge gaps. Also, the research questions were constructed.

KEY RESULTS

- The research problem was defined: Startups that develop Tokenized Ecosystems show potential to disrupt the incumbent businesses. However, it is unclear for these incumbent businesses how to react to this.
- Three knowledge gaps were identified: (1) Unclear about the potential disruptiveness of Tokenized; (2) A lack of an approach to assess whether the application of Tokenized Ecosystems aligns with the incumbent business, and (3) A lack of a high-level design overview of Tokenized Ecosystems.
- The academic and managerial relevance was described
- The main research question was provided:

How can an assessment tool improve decision-making by businesses on the application of Tokenized Ecosystems?

**Tokenized
Ecosystems: the
unexplored
blockchain business
initiative**



1. PROBLEM IDENTIFICATION

This chapter will describe the problem statement. First, the relevancy of blockchain technology for businesses will be explained in 1.1. Then, how businesses have tried to extract value from blockchain is described in 1.2. In 1.3, the research problem is defined and in 1.4 the research question will be provided. This chapter will provide an outline of this thesis in 1.5.

1.1 BLOCKCHAIN: A NEW PARADIGM

Blockchain is a technology that can potentially disrupt businesses and public institutions in various sectors. This section describes why blockchain technology is relevant in 1.1.1. It then continues by providing an explanation of its potential disruptiveness in 1.1.2. A definition of blockchain technology is given for this thesis in 1.1.3.

1.1.1 THE RELEVANCE OF BLOCKCHAIN TECHNOLOGY

Blockchain technology has caught the attention of many business and public institution leaders. In 2017, one of the most put forward technologies in the news was blockchain (Forbes, 2017). Also, 'Bitcoin' (the most well-known application of blockchain technology) was the second most searched term in global news on Google in 2017, according to Google Trends (Google, 2017). Blockchain technology has been among the biggest buzzwords of past years and offers the promise to radically transform business and society. A glance over the webpages from the world's leading business consultancy firms shows their belief in the potential of blockchain technology to transform businesses as we know them. For example, Deloitte states they believe in the potential of blockchain technology, and that it can transform virtually any business sectors (Deloitte, 2018). Also, McKinsey states that blockchain can revolutionize the world economy (McKinsey, 2018). Furthermore, the term "blockchain" has been the number 1 search term within the research database of Gartner in 2017. Gartner states that CIOs should begin to embrace blockchain for exploring strategic business initiatives but must avoid falling for the hype (Gartner, 2018d). All over the globe the technology has caught the attention of industry leaders, governments and regular citizens. Trillions of dollars have been invested in a future with blockchain and there seems to be a never-ending desire for more blockchain developers (Morabito, 2017).

1.1.2 THE POTENTIAL DISRUPTIVENESS OF BLOCKCHAIN TECHNOLOGY

The reason why there is so much enthusiasm (and hype) around blockchain is its potential disruptiveness. The disruption of blockchain lies in the fact that it is basically a database that works like a network. Blockchain experts call this "decentralization." Decentralization offers the promise of nearly friction-free cooperation between members of complex networks that can add value to each member by enabling collaboration without central authorities and middle men (Gupta, 2017a). According to CB Insight, a big data analytics company that researches emerging technologies, blockchain can be transformational to 42 different business sectors, ranging from banking and charity to supply chain management (CBI, 2018). However, Nowinski & Kozma (2017) argue that it is important to understand in what ways blockchain technology can disrupt businesses and identify three ways in which business models can be affected by blockchain technology (Nowinski, 2017):

- 1: Blockchain technology affects business models by authenticating traded goods.
"Traded goods can be interpreted in a wider sense, including any tangible or intangible goods or services that are subject to a business transaction. If these goods are complex or their authenticity cannot be immediately validated, if consumption involves profound perceptual

elements, or related brand values are high, the need for authentication is strong, hence there is a business case for disruptive business models using blockchain technology.” (Nowinski, 2017)

- 2: Blockchain technology affects business models by facilitating disintermediation.
“The presence of intermediaries introduces inefficiencies when industries are complex, customer needs diverse and suppliers numerous. In such instances, especially when the transaction size is relatively small, blockchain technology can generate business which would be unfeasible in the presence of intermediaries and the costs which they generate. Through the democratic nature of the blockchain technology, providing wide and direct access to service providers to a large number of potential users, the business case for disruptive blockchain applications is strong.” (Nowinski, 2017)
- 3: Blockchain technology affects business models by improving operational efficiency.
“Blockchain solutions increase operational efficiency in various ways and in various industries. One of the outcomes is shortening time for transaction execution as exemplified by cases from financial and real estate industries. Another outcome is the decline in operational costs which facilitates small size transactions.” (Nowinski, 2017)

Because blockchain technology is an emerging technology, there is little to no consensus on its actual definition. The next section describes the definition that will be used throughout this thesis.

1.1.3 DEFINING BLOCKCHAIN

Generally speaking, blockchain makes up a distributed ledger, the control of which may be dispersed among different computers in the network, thus eliminating the need for trust towards a single administrator of such a ledger. In other words, blockchain is “a distributed database comprising records of transactions that are shared among participating parties” (Zhao, 2016). “The blockchain is an incorruptible digital ledger of economic transactions that can be programmed to record not just financial transactions but virtually everything of value” (Tapscott, 2016). Blockchain technology provides an alternative mechanism for authenticating assets used in the transaction, and thus can be regarded as an alternative to any centralized exchange system relying on a single institution, such as, for example, a central bank, a stock exchange or a clearing house. As Nowinski & Kozma (2017) explain: “blockchain technology substitutes for the trust which under the central exchange system stems from the role of these institutions. As a database which offers “data security, transparency and integrity, anti-tampering and anti-forgery, high efficiency, low cost” (Zhu, 2016), it can be potentially applied in numerous business activities which involve data exchange and require security. Certain prominent authors, like (Iansiti, 2017) liken blockchain technology to the TCP/IP protocol which allowed the development of the Internet as we know it (Nowinski, 2017).

In essence, blockchain is a shared, trusted public ledger that users can inspect, but that no single user controls. This ledger is a constantly growing list of transactions of theoretically any kind (for example: a money transaction, a transaction of ownership, a transaction of obligation, etc.). Every participant of a blockchain (called a node) keeps a record of the same ledger as everyone else and they record only the valid transactions through a consensus mechanism. Once consensus about new transactions is reached, they are written in an immutable way on the ledger.

Four main characteristics

Blockchain technology can be framed as a trust machine because it is a system in which multiple actors have mutual trust, without them knowing each other's identity and without direct communication. This is because blockchain is (1) decentralized, (2) distributed, (3) append-only, and (4) uses a consensus mechanism (Gartner, 2018a).

1. The blockchain is decentralized, because the transactions are stored and copied on multiple nodes instead of on a central database. The main benefit is that there is no single point of failure. Meaning, if a single node fails (the participant becomes malicious, his computer gets hacked, has no power, etc.), the network can rely on the other nodes.
2. The blockchain is distributed, because all transactions and its data are shared with all peers on the network. The benefit of this is that the data becomes transparent; anyone can track and verify its integrity and provenance.
3. The blockchain is append-only, because once data is stored on the blockchain, it cannot be removed or altered: it is read-only. The benefit is that data has a higher integrity on the blockchain because readers are sure that the data has not been tampered with and is the same as how the writer stored it on the blockchain.
4. The blockchain uses a consensus mechanism, because such a mechanism decides on a single, shared truth. This truth is which transactions actually happened and the consensus mechanism makes sure that all peers agree on this truth, without them having to know or trust each other personally. The benefit of this is that it democratizes the ecosystem as anyone in it makes the decisions and there is no need to trust any third party to secure a transaction anymore; you just have to trust the mathematically proven crypto-graphical protocol on which the blockchain is built. But trusting it is apparent since the protocol and its algorithms are completely open source.

These four main blockchain characteristics are illustrated in figure 5.





| The blockchain is characterized as: | This has the following benefit: |
|--|--|
|  Decentralized — Assets are stored and copied on multiple nodes, instead of a central database | There is no single point of failure. If 1 node fails (hacked, no energy, bankrupt, broken, etc.), the network can rely on the other nodes |
|  A Distributed Ledger — Assets are shared with peers in the network | Data becomes transparent, anyone can track and verify assets and data |
|  Append-only — Data once stored on the blockchain, cannot be removed or altered, only read | Data has integrity. Readers now for sure the data has not been tampered with and is the same as how the writer stored it on the blockchain |
|  Using a consensus mechanism — A mechanism through which consensus is reached through the network, without the peers having to know or trust other peers | This democratizes the ecosystem as anyone in it make the decisions. Power has decentralized |

Figure 5: The four main blockchain characteristics and their benefits

Three main representations of value

Blockchain technology enables peer to peer transaction of value. This value can be represented in tokens (Hacker, 2017). These tokens can represent value in three main ways: 1) a (crypto) currency, 2) a (tokenized) security or 3) a utility token (Benoliel, 2017).

1. Cryptocurrencies are digital currencies like in which encryption techniques are used to regulate the generation of units of currency and verify the transfer of funds. They are operating independently of a central bank and can be used as the digital version of regular fiat currency. They are meant to function as a means of payment for goods or services external to the platform. Cryptocurrencies can be traded interchangeably with regular fiat cash like dollars on cryptocurrency exchanges (with regards to exchange fees and rates) (Benoliel, 2017). An example of a cryptocurrency is Bitcoin, the most well-known cryptocurrency.
2. Tokenized Securities are tokens that represent shares of a business or a tradable financial asset. Any physical or virtual assets (such as houses, cars, debts and loans) makes use of tokenized securities and promises future cashflow (Benoliel, 2017). The idea is that investors can buy (parts of) an asset in the form of tokens, to sell them later on with profit. People with assets (like a house) are now able to 'liquefy' these assets by turning the ownership rights of that asset, i.e., that house (which is different from actually living in that house), into tokens and selling it for money. The token can track who owns what part of what share.
3. The utility tokens are services or units of services that can be purchased. They are vested with a certain functionality and can be used as a key or digital coupon to access a certain service in the future. The main difference with cryptocurrencies is that a utility token only provides access to function provided directly by the token issuer, and cryptocurrencies enable users to pay for goods external to the platform as well. However, it is possible to trade utility tokens for cryptocurrencies (Benoliel, 2017). An example of a utility token is Filecoin, a token that grants investors access to a future decentralized platform that provides cloud storage on the blockchain. Filecoins can be earned by providing cloud storage and spent to gain access to cloud storage (Filecoin, 2017).

1.2 BLOCKCHAIN FOR BUSINESSES: A SUBSTRATE FOR FUTURE TECHNOLOGIES

Despite the hype, blockchain technology functions merely as a substrate for other (future) technologies and business initiatives. This will be explained by demonstrating how businesses have attempted to extract value from blockchain in 1.2.1. Then, in 1.2.2, it is brought forward that this is actually hard to do. Finally, Tokenized Ecosystems is introduced as an unexplored blockchain business initiative in 1.2.3.

1.2.1 BUSINESSES' ATTEMPT TO EXTRACT VALUE FROM BLOCKCHAIN

Blockchain technology offers the promise to being valuable to many different business sectors. Businesses try to extract value from seven elements of blockchain technology that can act as value drivers. This means that if such an element is incorporated correctly in a project, that element will provide a certain benefit to that project. The elements are: 1) the creation or representation of digital assets; 2) payment tokens; 3) a distributed ledger of records; 4) the immutability of records; 5) the traceability of records; 6) a consensus mechanism; and 7) smart contracts (Gartner, 2018b). When looking at most business initiatives and assess which value driver they included, four main categories of blockchain business initiatives emerge: record keeper; efficiency play; digital asset market; and blockchain disruptor (see figure 6). This process is further described in chapter 3.3.1.

| Value Driver / Category | Record Keeper | Efficiency Play | Digital Asset Market | Blockchain Disruptor |
|---------------------------------------|---------------|-----------------|----------------------|----------------------|
| Digital asset creation/representation | | | Yes | |
| Payment token | | | Yes | Yes |
| Distributed ledger of records | | Yes | Yes | Yes |
| Immutability of records | Yes | Yes | Yes | Yes |
| Traceability of records | Yes | Yes | Yes | Yes |
| Consensus mechanism | | Yes | Yes | Yes |
| Smart contracts | | Sometimes | Sometimes | Sometimes |

Figure 6: Blockchain business initiative categories (Gartner, 2018b)

The first two business initiatives can be considered as cost reducing approaches that rely on incremental innovation and improvements of current business processes. Most incumbent businesses experiment with these types of business initiatives and have a hard time extracting value from it, because it is not obvious how and where it will offer better value than current enterprise technologies. Also, some businesses see blockchain technology as a one-size-fits-all solution (Brandon, 2016). Furthermore, they are reluctant towards decentralizations and open sourcing, two key elements related to blockchain technology.

The last two business initiatives are rarely seen within the incumbent business and rather in startups and scale-ups. This is because if the incumbent business wants to fully leverage blockchain technology, they have to change core processes, models and systems. This is difficult for business to do, because changing them comes with a large risk. Startups and scale-ups on the other hand are built up with these newer core processes, models and systems baked into them.

1.2.2 THE DIFFICULTY OF EXTRACTING VALUE FROM BLOCKCHAIN

Businesses have attempted to extract value from blockchain technology; unfortunately, no incumbent business has succeeded to launch a profitable business case on blockchain technology. Many business leaders risk overestimating the short-term benefits of blockchain as a technology for helping their business to differentiate and win (Gartner, 2018e). Since about 2012, various technology evangelists have given the impression that blockchain is not only new, but that it is one technology solution that can be applied to solve a multitude of business problems. Further, they expect solutions to occur fairly quickly, easily and with no side effects and significantly improved cost structures (Gartner, 2018e). This prospect has proven to be false, given the inability of businesses to launch successful blockchain business initiatives. An assessment of possible reasons of this failure will be described in the theoretical background chapter at 3.3.1.

Despite the problems mentioned above, the decentralized and peer-to-peer nature of blockchain *enables* a revolutionary way to look at how business and global economy can be redesigned. In that way, blockchain technology is a trampoline or stepping stone into a new paradigm, and functions from then on merely as a substrate for other technologies and business initiatives.

1.2.3 TOKENIZED ECOSYSTEMS: THE UNEXPLORED BLOCKCHAIN BUSINESS INITIATIVE

An unexplored blockchain business initiative within the “Blockchain Disruptor” category that functions as such a substrate, is ‘Tokenized Ecosystems’. Applying this initiative to incumbent businesses will help them prepare their business for a new blockchain-based paradigm. Tokenized Ecosystems are a way to organize a business in a decentralized way, i.e., a community will create and sustain business processes, and its members are incentivized through token reward functions. Individuals can earn tokens by being valuable to the business process; these tokens can have monetary value or can for example give rights of some sorts. The business process has now become a network which nobody in particular owns, but which is owned by everyone holding a token related to that business process. With Tokenized Ecosystems, business can decentralize some (or all) of their business operations. A community behind the business operation will run and sustain it as a network. Members of this community are incentivized to do so through token reward functions. Tokenized Ecosystems consist of multiple tokens of several archetypes (currency, security, utility). The main benefit of Tokenized Ecosystems is that they use network effects to their benefit. For centralized business, a larger network means a larger marginal cost of (maintaining the) infrastructure. For a decentralized business (with a Tokenized Ecosystem), a larger network means a lower marginal cost of (maintaining the) infrastructure, because the network *is* maintaining the infrastructure.

Applying this initiative to incumbent businesses will help them prepare their business for a new blockchain-based paradigm. Otherwise, they will be disrupted by startups that have potentially deployed Tokenized Ecosystems in a successful way. However, the problem is that businesses do currently not know how they should react to these startups and to the blockchain business initiative of Tokenized Ecosystems.

1.3 THE RESEARCH PROBLEM

This section defines the research problem this thesis aims to tackle. Furthermore, the identified knowledge gaps will be described in 1.3.1. This will be followed by explaining the scientific and managerial relevance of this research in 1.3.2 and 1.3.3, respectively.

The definition of the **research problem** of this thesis is as follows: Startups using Tokenized Ecosystems have the potential to disrupt incumbent businesses. Yet, it is unclear for these businesses how they should react. To respond to this problem, this thesis aims to improve this situation for businesses by making clear how they should react. This defines the **research objective** of this thesis: To improve decision-making of businesses regarding the application of Tokenized Ecosystems to their business processes. Therefore, this thesis presents a structured approach that can help businesses with their decision-making. This results in the following **deliverable**: A clear Tokenized Ecosystem explainer and an assessment tool that helps businesses with their decision-making regarding the application of Tokenized Ecosystems to their business processes.

Although scientific research on the application of blockchain technology is emerging and rapidly increasing, there is no focus on the possible business applications of blockchain. Scientific business literature mostly focusses on *how* blockchain technology can work in organizations and not *why* blockchain technology should be adopted in organizations. The motivation or incentives behind implementing blockchain in businesses are hardly researched and thus the actual impact blockchain technology can make on businesses is unclear. Also, very few studies go beyond the application of blockchain technology as record management systems (Li, Marier-Bienvenue, Perron-Brault, Wang, & Paré, 2018). While focussing on Tokenized Ecosystems as a business application beyond blockchain technology as a record management system, three knowledge gaps appear.

1.3.1 KNOWLEDGE GAPS

Although scientific research on the application of blockchain technology is emerging and rapidly increasing, three knowledge gaps appear:

First, the potential disruptiveness of Tokenized Ecosystems is unclear. Startups apply Tokenized Ecosystems in various ways and they may or may not be successful. Whether this actually results in a more profitable business model is unclear. Also, even if the business model of a startup applying Tokenized Ecosystems would be profitable, it is unclear if it will actually disrupt incumbent businesses.

Second, an approach to assess whether the application of Tokenized Ecosystems within a business aligns with the goals of that business is lacking. In order to assess this alignment, a structural approach is required. This structural approach should be comprised of components that explain whether Tokenized Ecosystems fit with the current business goals and strategy. Also, there should be components that explain whether a business is actually *able* to implement Tokenized Ecosystems, even if its application aligns with the goals and processes of the business.

Third, a high-level overview of Tokenized Ecosystem design is lacking. Before a business can implement a Tokenized Ecosystem, it would be wise to design a minimal and rudimentary version, which allows the business to collect the maximum amount of validated learning with the least effort. Thus, by creating this rudimentary version, businesses allow themselves to test Tokenized Ecosystems with their partners and potential customers without putting in too much effort. However, before a business could design such a test version, a high-level overview of what such a design should look like is required. Tokenized Ecosystems can change from use-case to use-case and its design thus changes accordingly.

1.3.2 SCIENTIFIC RELEVANCE

The scientific relevance of this research is foremost explained by that fact the topic of research, Tokenized Ecosystems, is novel. When the term Tokenized Ecosystem is used as a keyword within Google Scholar, only five articles are mentioned, just one of which describes Tokenized Ecosystems within the framework of applying blockchain technology to business processes. When the term is used as a keyword within Scopus, no articles are mentioned. Other attempts to find academic papers on the topic (by using similar keywords like *business decentralization*, *business process tokenization*, *multi-token economies*, etc) have also been unsuccessful. Apparently, this topic is scientifically under-researched and is academically novel.

Furthermore, this research provides a systematic analysis of when Tokenized Ecosystems can add value to business processes. First of all, it provides a way to analyse the maturity of the innovation of Tokenized Ecosystems using the perspective of the Diffusion of Innovations. Second, it provides a way to analyse the organizational fit and business process fit between Tokenized Ecosystems and a business. This is a known field of research for IT innovations, but not for blockchain technologies and innovations, let alone for Tokenized Ecosystems.

1.3.3 MANAGERIAL RELEVANCE

The managerial relevance of this research is explained by the fact that it provides insights to managers of businesses. First, it provides insights in what Tokenized Ecosystems are and that multiple blockchain related startups organize themselves in that way. Second, it provides insights to managers in whether a business has an organizational or business process fit with Tokenized Ecosystems. Third it provides a high-level overview of Tokenized Ecosystem design options that identify necessary capabilities of a business to be

able to design them. Lastly, it will help managers with strategic decisions regarding the application of Tokenized Ecosystems to a business process, because of identified strategic factors, for example that the development of Tokenized Ecosystems should not be internal. All in all, this will prevent bad investments if the business is not ready yet and will provide factors that the business needs to have before being ready for that change. Also, this research identifies factors that help managers to assess when the development of Tokenized Ecosystem is a good idea for the business in question.

1.4 RESEARCH QUESTIONS

In order to achieve the research objective (to improve decision-making of businesses regarding the application of Tokenized Ecosystems to their business processes), and present the deliverable, the following **main research question** will be answered:

How can an assessment tool improve decision-making by businesses on the application of Tokenized Ecosystems?

The research problem, research question and deliverable are illustrated in figure 4.

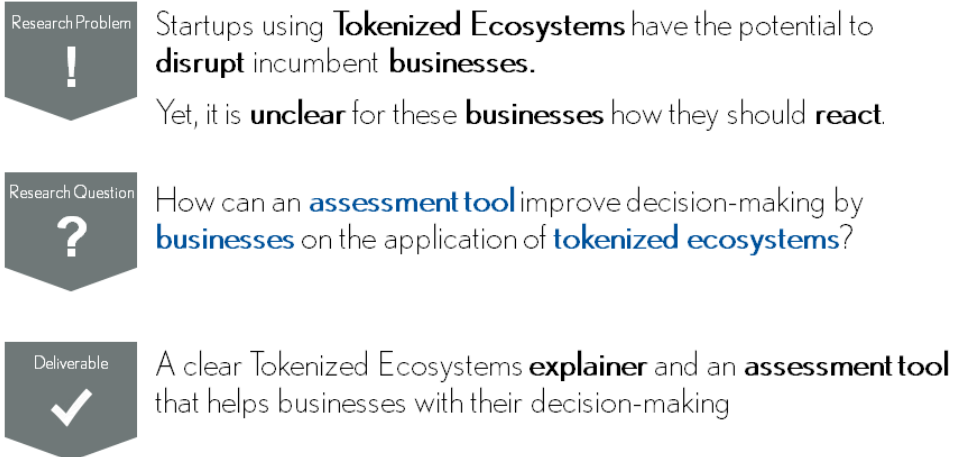


Figure 7: Research Problem, Question, and Deliverable

The following sub-questions will help answer the main research question, and correspond to the Design Science approach that is used to develop the blockchain assessment tool in this research:

1. WHAT IS CURRENTLY KNOWN ABOUT THE POTENTIAL VALUE OF APPLYING TOKENIZED ECOSYSTEMS TO EXISTING BUSINESS PROCESSES?
2. WHAT COMPONENTS SHOULD THE TOKENIZED ECOSYSTEM ASSESSMENT TOOL FOR BUSINESSES ENCOMPASS?
3. WHAT ARE THE REQUIREMENTS FOR A TOKENIZED ECOSYSTEM ASSESSMENT TOOL THAT REGARDS THE APPLICATION OF TOKENIZED ECOSYSTEM TO BUSINESS PROCESSES?
4. HOW DOES A TOKENIZED ECOSYSTEM ASSESSMENT TOOL FOR BUSINESSES LOOK LIKE?
5. HOW CAN A TOKENIZED ECOSYSTEM ASSESSMENT TOOL BE DEMONSTRATED?

1.5 THESIS OUTLINE

As will be described in chapter 2 This research will be based on Design Science and will use the Design Science Research Method Process Model (DSRM) to use a structured approach to answer the five research questions, the main research question and design the Tokenized Ecosystem assessment tool. **Chapter 2** will describe the methodologies used in this research. The goal of that chapter is to describe the research approach, the research methods and research strategies. **Chapter 3** will describe the theoretical background. The goal of that chapter is to explore the knowledge gaps and to find the components of importance for the design of the Tokenized Ecosystem assessment tool. That chapter will answer research questions 1 and 2. **Chapter 4** will describe the definition of requirements. The goal of that chapter is to concretize the found components and to propose requirements for the design of the Tokenized Ecosystem assessment tool. That chapter will answer research question 3. **Chapter 5** will describe the design of the Tokenized Ecosystem assessment tool, which is also the goal of that chapter. That chapter will answer research question 4. **Chapter 6** will describe the demonstration of the Tokenized Ecosystem assessment tool. The goal of that chapter is to demonstrate the workings, the efficiency and effectiveness of the Tokenized Ecosystem assessment tool. That chapter will answer research question 5. **Chapter 7** will describe the conclusions of this research. The goal of that chapter is to present the conclusions, reflect on the research outcomes and to recommend future research. The outline of this thesis is summarized in figure 4 (next page).



Figure 8: The outline of this thesis

METHODOLOGIES

GOAL

Describe the research approach and how the research was conducted in several research phases. Describe the research methods and strategies used

PROCESS

This chapter will describe the research methods the researcher has followed in order to answer the research questions. First, the research approach will be discussed. Then, the research phases are described. Then the data collection methods, and the data analysis methods are explained. Finally, an overview of all methods per research phase is presented.

KEY RESULTS

- This research will be based on Design Science and will use the Design Science Research Method Process Model
- The research will use the Design Science Research Cycles approach.
- The research consists of 5 phases: (1) *Problem Exploration*, (2) *Problem Explication*, (3) *Requirements Definition*, (4) *Design* and (5) *Conclusion*.
- A research strategy and methodology are chosen for every phase, and the data collection method and data analysis method are described.

**“We always overestimate
change in the next two
years and underestimate
the change in the next
10. Don’t let yourself be
lulled into inaction”**

Bill Gates, Founder of Microsoft



2. METHODOLOGIES

This chapter will describe the research methods the researcher has followed in order to answer the research questions. First, the research approach will be discussed in 2.1. Then, the research phases are described in 2.2. In 2.3, the data collection methods, and in 2.4 the data analysis methods are explained. This chapter will be concluded in 2.5.

2.1 RESEARCH APPROACH

This research will be based on Design Science and will use the Design Science Research Method Process Model (DSRM) for Information Systems (IS) Research (Peppers, 2007), described in 2.1.1. Furthermore, the research will use the Design Science Research Cycle approach (Hevner, 2007), described in 2.1.2.

2.1.1 THE DSRM PROCESS MODEL

The DSRM Process Model consists of six activities in a nominal sequence. The process is illustrated in figure 9.

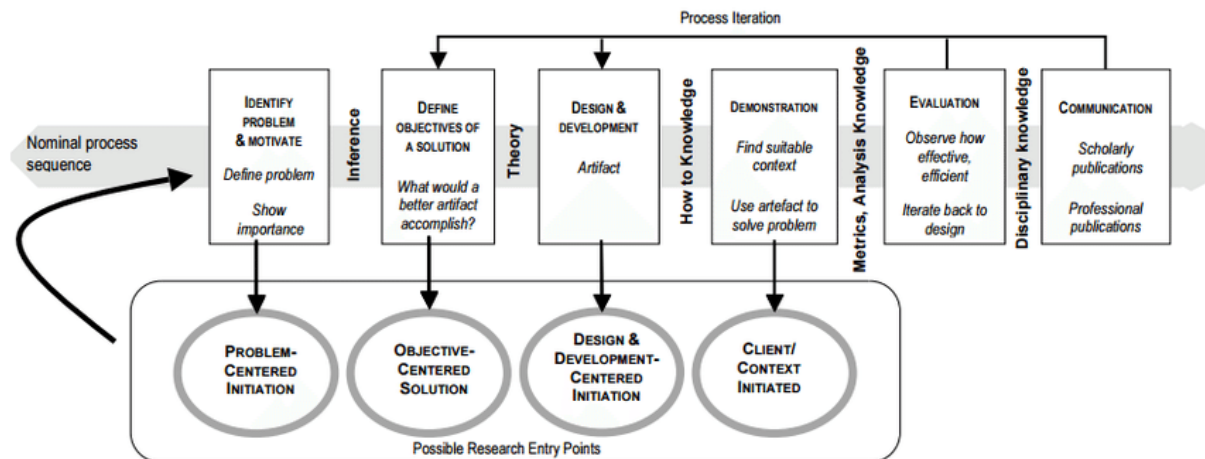


Figure 9: The DSRM Process Model

Problem Identification and motivation. First, the research problem is defined, and the value of a solution is justified. This definition of the research problem should conceptualize the problem in such a way that a solution can capture its complexity. The objective is to motivate the researchers and the audience to pursue the solution and its acceptance.

Resources required: Knowledge of the state of the problem and the importance of its solution.

Define the objectives for a solution. With the problem definition we can derive the objectives of a solution and knowledge of what solution is possible and feasible. These objectives can be quantitative or qualitative. This step is done rationally.

Resources required: Knowledge of the state of problems and current solutions and their efficacy.

Design and development. In this step an artifact is created. An artifact is a potential construct, model, method or “new properties of technical, social, and/or informational resources”. This activity is about determining the desired functionality and its architecture and then creating the artifact.

Resources required: Knowledge of theory that can be brought to bear in a solution.

Demonstration. In this step the use of the artifact is demonstrated to solve one or more instances of the problem by experimentation, simulation, case study, proof, or other appropriate activity.

Resources required: Knowledge of how to use the artifact to solve the problem.

Evaluation. In the evaluation stop the artifact should be observed and measured with regards how well the artifact supports the solution to the problem. It encompasses a comparison between the objectives and the actual observed results. At this moment researchers can choose to iterate back to phase 3 to try to improve the effectiveness.

Resources required: Knowledge of relevant metrics and analysis techniques.

Communication. Finally, the problem and its importance, the artifact, its utility and novelty, the rigor of its design and its effectiveness should be communicated to researchers and other relevant audiences such as practicing professionals, when appropriate.

Resources required: Knowledge of the disciplinary culture.

Within the DSRM Process Model, researchers can start at any step. Since the idea for the research resulted from observation of the problem, this thesis starts at step 1: Problem Identification and Motivation.

2.1.2 THE DESIGN SCIENCE RESEARCH CYCLE APPROACH

The Design Science Method as developed by Hevner, is constructed by three cycles: the relevance cycle, the rigor cycle and the design cycle, see figure 10.

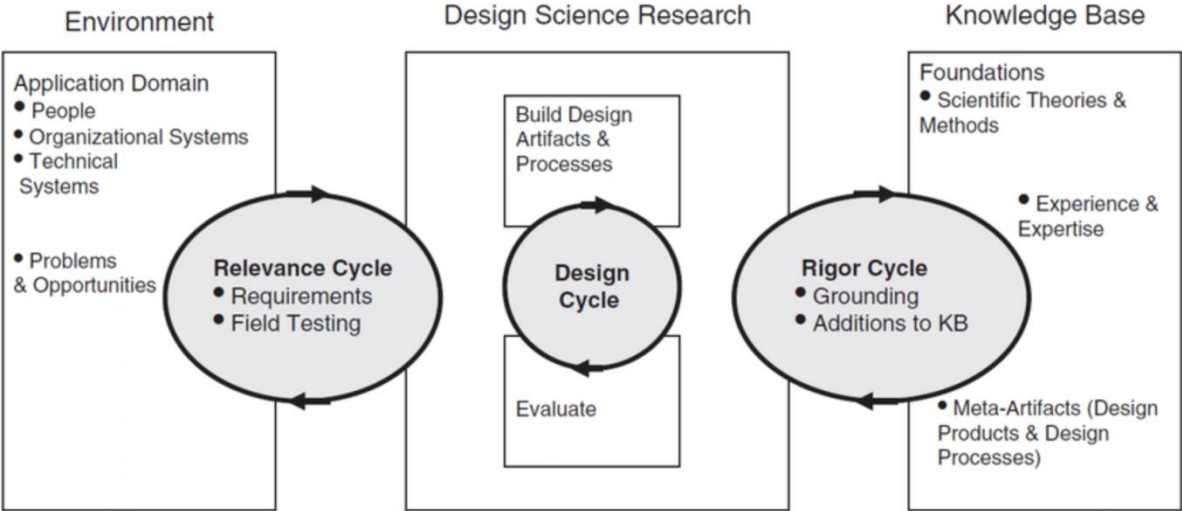


Figure 10: The Design Science Research Cycles

The Relevance Cycle. Because the intention of the research is to improve the current environment, the relevance cycle makes sure that the artifacts created within the Design Science Research are aligned with the problems of the environment. The relevance cycle concerns the empirical part of the study.

The Rigor Cycle. Design Science draws from a knowledge base of existing methods and theories and thus the rigor cycle makes sure new theories are built on top of the old ones. In this cycle, new theories will fill up the knowledge gaps from the current literature

The Design Cycle. The design cycle will use the knowledge gained from the rigor and relevance cycle to design an artifact. This is a cycle in itself, since it is iterating from designing the artifact and evaluating it.

2.2 RESEARCH PHASES

This research consists of 5 phases, according to the Design Science approach and can be seen in figure 11. Every phase is preceded by resources that can be seen as the input, and every phase produces deliverables as outputs. This is done by answering the research questions with the research activity of that phase. The phases are described below:

2.2.1 PHASE 1: PROBLEM EXPLORATION

This first phase explores the problem. This step is described in Chapter 1: Problem Identification. This chapter will identify the current knowledge gaps in literature about Tokenized Ecosystems.

2.2.2 PHASE 2: PROBLEM EXPLICATION

The second research phase deals with the problem explication, it will do this in two parts. It will first explicate the problem by making clear what is currently known about applying Tokenized Ecosystems to business processes. It will then further explicate the problem statement by identifying the components that are of importance for a Tokenized Ecosystem assessment tool.

The first part of this phase aims to answer the first research question: *What is currently known about the potential value of applying Tokenized Ecosystems to existing business processes?*

Because this is a very broad question, the first part of this research phase is split up into four stages with a different methodology each. The four stages are: (1) determine how incumbent businesses have attempted to extract value from blockchain technology, (2) explain how Tokenized Ecosystems can add value to incumbent businesses, (3) conducting a thought experiment by theoretically apply a Tokenized Ecosystem to a known incumbent business, and (4) conducting a desk research to find potential businesses that can be disrupted by Tokenized Ecosystems.

Stage 1: Determine how incumbent businesses have attempted to extract value from blockchain technology

In order to answer the first research question, a better understanding of how businesses have attempted to extract value from blockchain technology is required, because blockchain technology is foundational to Tokenized Ecosystems.

First, a literature review was conducted that focused on finding the key factors within blockchain technology that businesses can potentially extract value from. Also, by looking at 'grey' literature, examples of relevant blockchain business initiatives were collected. Each example of blockchain business initiative was then explored to find out what value drivers were used by those initiatives. Categories of blockchain business initiatives were formed by examining the list of value drivers per blockchain business initiative. These

categories showed the current understanding of blockchain technology by businesses and showed that one category in particular was relatively unexplored: blockchain technology as disruptor. A detailed description of this process is provided in 3.3.1. The data collection method is described in 2.3.1.

Stage 2: Explain how Tokenized Ecosystems can add value to incumbent businesses

With the 'blockchain technology as disruptor' category being identified as an unexplored blockchain business initiative, it is important to explain how startups have extracted value from Tokenized Ecosystems. Startups have to develop radical innovations, because incumbent businesses are better at incremental innovations. That is why most blockchain startups are within the 'blockchain technology as disruptor' category by developing Tokenized Ecosystems. This stage explains how Tokenized Ecosystems adds value to the business processes of startups. It is done by reviewing 'grey' literature, because at the time of writing, there was practically no literature about how Tokenized Ecosystems are valuable to business processes, so most literature review was conducted on 'grey' literature. A detailed description of this process is provided in 3.3.2. The how the literature was collected and selected is described in 2.3.1.

Stage 3: Conducting a thought experiment by theoretically apply a Tokenized Ecosystem to a known incumbent business

Now that it is clear how Tokenized Ecosystems add value to the business processes of startups, it is important to understand if incumbent businesses can also extract value from it. This is done through a thought experiment. The thought experiment involved choosing a known incumbent business and attempting to apply Tokenized Ecosystems to its business processes. The company "Facebook" was chosen as an incumbent business, because of practical reasons - some thought leaders in the blockchain space were theorizing about putting Facebook on a blockchain. First, Facebook was investigated to explore why some of its business processes are faulty. This was done by reviewing articles that were reflecting on how Facebook is 'broken'. Then, a sketch was made of a Tokenized Ecosystem that replaced those business processes. This was done by using common sense and the then state of knowledge of the researcher. This theoretically showed how Tokenized Ecosystems could add value to the business process of an incumbent business. A detailed description of this process is provided in 3.3.3. How the articles about Facebook were found and selected is described in 2.3.1.

Stage 4: Conducting a desk research to find potential businesses that can be disrupted by Tokenized Ecosystems.

Because Tokenized Ecosystems could theoretically add value to processes of an incumbent business, it is important to know if it could potentially do this to other incumbent businesses as well. Therefore, a desk research was conducted during which multiple business sectors were explored. This was done by selecting a business sector, finding the most relevant businesses within that sector and assess whether Tokenized Ecosystems could add value to their businesses. Again, common sense and the then state of knowledge of the researcher was used. Also, a review of startups attempting to disrupt the incumbent business of a sector was conducted. A detailed description of this process is provided in 3.3.4. How startups were found that could potentially disrupt incumbent businesses is described in 2.3.1.

The second part of this phase aims to answer the second research question: *What components should the Tokenized Ecosystem assessment tool for businesses encompass?*

Because the problem statement implies businesses currently have no way to assess whether they should apply Tokenized Ecosystems to their business processes, it makes sense to investigate the four identified knowledge gaps (see Chapter 1.4.1). This is done by using a relevant academic theory as a lens to look at each knowledge gap. By using these theories and applying them to the novel field of Tokenized Ecosystems, the components that are important to the Tokenized Ecosystem assessment tool can be identified. Why a certain theory is used for a knowledge gap, is explained in Chapter 3: Theoretical Background. How the literature review was found and selected, is described in 2.3.1.

2.2.3 PHASE 3: DEFINE REQUIREMENTS

The third research phase deals with the definition of the requirements. This is done by collecting empirical evidence. According to Johannesson and Perjons, this phase requires the explicated problem as input (Johannesson, 2014). In this case, the inputs will be the components that were found in the previous research phase. This means that the components that were found in the previous research phase will be concretized, because they are now not only have a theoretical basis, but also an empirical basis. These concretized will then be formulated as requirements for the Tokenized Ecosystem assessment tool. The empirical evidence will be found by conducting explorative expert interviews. The experts are leaders within the blockchain space. How experts are exactly defined and selected, is explained in 2.3.1. This research phase aims to answer the third research question: *What are the requirements for a Tokenized Ecosystem assessment tool that regards the application of Tokenized Ecosystem to business processes?*

Expert interviews are a widely used method of collecting data in business research to obtain information on an issue of interest. An interview is a guided, purposeful conversation between two or more people (Sekaran, 2016), p 116. The interview method used is a mixture of structured and unstructured set of questions: a semi-structured interview. The main purpose of unstructured interviews is to explore and probe into the several factors in the situation that might be central to the broad problem area, whereas a structured interview is conducted when it is known what information is needed (Sekaran, 2016), p 115. Unstructured questions were used to probe for new information, structured questions were used to solidify existing knowledge. An interview protocol was used as a guide for these interviews and consisted of four main areas of questions: the expert's personal link with the blockchain space, the potential disruptiveness of Tokenized Ecosystems, the fit between Tokenized Ecosystems and businesses, and Tokenized Ecosystem design.

The interviews were recorded with either an iPhone or a MacBook using their microphone capabilities. How the data from the interview records was analysed is explained in 2.4.

2.2.4 PHASE 4: DESIGN

In this research phase, the defined requirements are used to design the Tokenized Ecosystem assessment tool. This research phase aims to answer the following research question: *How does a Tokenized Ecosystem assessment tool look like?*

This research phase uses a bottom-up design approach. A bottom-up design approach is defined as an incremental approach applicable for the development of qualitatively new systems where their application range and complexity of functions cannot be defined on the base of their future user requirements. This approach works best for the design of a Tokenized Ecosystem assessment tool because the approach has an explorative character and it is relying on the verification of the utility and applicability of new software methods and technologies for never yet implemented particular functions (Gadomski, 1998). Furthermore, the design process follows an iterative approach, during which a design is periodically upgraded with new features, is going through several iterations. Therefore, after new functionality has been introduced, the

resulting system has to be implemented such that additional functionality (Pop, 2004). Also, the formulation of ideas and concepts happened through a consecutive process of divergence and convergence. Divergence and convergence are both important elements of organizational design processes (Visscher, 2009). It is important that these two phases are separated; diverging and converging at the same time does not work, because these phases contradict each other. For each divergence and convergence phase, five guiding principles were used (Wycoff, 2007). A detailed description of this research phase is provided in Chapter 5: Design.

2.2.5 PHASE 5: DEMONSTRATE

This phase describes the fifth phase of this research: Artefact Demonstration. This was done by conducting a case study; during a desk research, the value of Tokenized Ecosystems was assessed regarding the case. The case involved a business that was interested in applying Tokenized Ecosystems to their business processes. During this demonstration phase, the context of usage of the tool was defined: Who should use the tool and within which business (sector) should it be used? The tool was also assessed on effectiveness - the degree to which the outcomes of an assessment by use of the tool improve decision-making regarding the application of Tokenized Ecosystems to their business processes, and on efficiency - the degree to which use of the tool requires an acceptable amount of time, and human, material, and financial resources. Outcomes of this evaluation were that the tool was found to be both effective and efficient within the described context.

2.2.5 PHASE 6: CONCLUDE

The final research phase of this thesis will conclude the research, by answering the main research question: *How can an assessment tool improve decision-making by businesses on the application of tokenized ecosystems?* This question will be answered by answering all research sub-questions. Also, this chapter will reflect on the findings, explicating the limitations of this research and will provide suggestions for future research.

2.3 DATA COLLECTION

2.3.1 LITERATURE REVIEW

To find and collect literature, the following methods were used:

To find the key factors within blockchain technology that businesses can potentially extract value from, as described in 2.2.2, the academic databases Google Scholar and Scopus were used with the following keywords: *Blockchain, Distributed Ledger Technology, Immutability, Traceability, Consensus Mechanism, Smart Contracts, Asset Digitization, Utility Tokens, Cryptocurrency, and Tokenized Security.*

To explain how startups have extracted value from Tokenized Ecosystems, as described in 2.2.2, 'grey' literature was used by reading blogs of blockchain thought leaders, update posts of blockchain projects and other types of online articles. Most articles were found on Medium, an at the time of writing famous online blog platform. There following keywords were used to find relevant articles: *Tokenized Ecosystems, Tokenization, Incentive Structures, Incentive Programs, Token Reward Functions, Aligning incentives, Decentralization, Business Decentralization, Enterprise Tokenization, Token Lexicon, Token Taxonomy, Web 3.0, Decentralized Web, Token Economies, Network Incentives, Work Tokens, Programmable Economy, Token Engineering, Crypto-economics, Decentralized Applications, Tokenomics, Open Network Design, and Reverse ICOs.* Also, articles from the following writers were collected as well, because of their general insights into the disruptiveness of blockchain technology: *Trent McConaghy,*

James Burke, Harry McLaverty, Simon de la Rouviere, Kai Stinchcombe, D. Jozsef, Vitalik Buterin, Jordan Lee, and Viktor Makarskyy.

To find articles about business processes within Facebook that could potentially be disrupted by Tokenized Ecosystems, as described in 2.2.2, newspapers and news websites were scanned using the following keywords: *Facebook Broken, Fix Facebook, Content Moderation, Data Governance, Identity Governance, and Advertising.*

To find startups that could potentially disrupt incumbent businesses in several business sectors, as described in 2.2.2, google searches were conducted with combining the keywords of the business sector in question, and the keyword *Blockchain*. The business sectors chosen were selected on a basis of common sense of what sector could potentially be disrupted by Tokenized Ecosystems. This method produced an overload of startup projects that attempted to disrupt the particular business sector. In order to mitigate the overwhelming amount of results, a selection process skimmed the amount down to a few projects per business sector. The selection criteria were based on the amount of positive traction a certain project had in main-stream media (meaning, not blockchain specific media).

For the collection of academic literature to find theories to be used as lens to look at the knowledge gaps, the academic databases Google Scholar and Scopus were used with the following keywords:

- Potential Disruptiveness: *Disruptive Innovation, Disruptive Technology, Incremental Innovation, Radical Innovation, Innovation Diffusion, S-curves, Technological Maturity, Ecosystem Maturity, Innovation Maturity*
- Strategical Alignment: *Strategical Alignment, Strategic Alignment Model, IT Investment, Business Strategy, Business Process Fit*
- Organizational Readiness: *Business readiness, Readiness to Change, Transformational Readiness, Change Management, Psychological Factors, Structural Factors*

For the collection of (grey) literature to find design factors that play a role in the design of a Tokenized Ecosystem, as described in 2.2.2, 'grey' literature was used by reading blogs of blockchain thought leaders, update posts of blockchain projects and other types of online articles. Most articles were found on Medium, an at the time of writing famous online blog platform. There following keywords were used to find relevant articles: *Token Engineering, Token Design, Ecosystem Design, Primitives, Crypto-economic Primitives, Cryptographic Primitives, Game Theory, Pareto Efficiency, Policy Design, Common-Pool Resourcing, Curation, Governance, Mechanism Design, Proofs, Zero Knowledge Proofs, Token Curated Registries, Directed Acyclic Graphs, Cryptography, Public-Private Key, Homomorphic Encryption, Digital Signatures and Identity.*

Also, since some of these keywords have been described in academic literature thoroughly, the main articles about those topics were read as well. The topics in question are: *Game Theory, Common-Pool Resourcing, Mechanism Design, and Cryptography.*

2.3.2 EXPERT INTERVIEW

To gain empirical evidence about the required components of a Tokenized Ecosystem assessment tool, expert interviews were conducted. In order to select relevant interviewees, a selection of experts within the blockchain space was conducted.

An expert within the blockchain space was defined as a combination of the following characteristics:

1. The person in question is a 'Thought Leader' within the blockchain landscape.
 - o He has written public articles with insights of the direction of blockchain technology
 - o Someone who trains, consults or help businesses implement blockchain technology
2. The person in question has a 'High Position' at a (blockchain) institution
 - o He is a blockchain startup co-founder / CxO / Lead
 - o He is a blockchain researcher / Consultant
3. The person in question is an IT Manager or Technology Lead
 - o He makes decisions on which technologies to implement
 - o He is highly familiar with business processes and strategy
4. The person in question is familiar with Tokenized Ecosystems
 - o He is familiar with the core-concepts
5. The person in question has experience with making IT business decisions
 - o He has experience with assessing new technologies and innovations for adoption

Multiple people were considered to be experts for the interview and were assessed on how many of these characteristics they possessed. An interviewee candidate ideally had as many characteristics as possible. The following 8 experts were selected and interviewed:

- Wesley van Heije, Technical Lead at Consensys
 - o Characteristics: 1, 2, 3, 4, 5
 - o Face to face
- Dimitri de Jonghe, Product Director at Ocean Protocol and BigchainDB
 - o Characteristics: 1, 2, 3, 4, 5
 - o Face to face
- Olivier Rikken, Director at Axveco
 - o Characteristics: 1, 2, 5
 - o Face to face
- Jan-Peter Doomernik, Business Developer at Enexis
 - o Characteristics: 1, 2, 3, 4, 5
 - o Face to face
- Rutger van Zuidam, CEO at DutchChain
 - o Characteristics: 1, 2, 4, 5
 - o Telephone
- Vinay Gupta, CEO at Mattereum and Co-Founder of the Ethereum Blockchain
 - o Characteristics: 1, 2, 3, 4, 5
 - o Skype
- David Furlonger, VP & Fellow at Gartner
 - o Characteristics: 1, 2, 4
 - o WebEx
- Trent McConaghy, CTO at Ocean Protocol and BigchainDB
 - o Characteristics: 1, 2, 3, 4, 5
 - o Google Hangouts

Almost all interviews took place face to face or through a video conference program like Skype or Google Hangouts (except 1 interview, where a face to face or video conference was practically impossible because the interviewee was driving). An advantage of this is that the researcher could adapt questions if necessary, clarify doubts, and ensure that the responses are properly understood. Also, any discomfort, stress, or problem that the respondent experiences can be detected visually (Sekaran, 2016). A main disadvantage of face to face interviews (other than that they are more difficult to organize than telephone interviews) is that the interviewees might feel uneasy about the anonymity of their responses. This was mitigated by kindly asking their permission to record the interview, stating that the transcript will not be included in the final thesis, and by asking permission to use their name in the thesis.

2.4 DATA ANALYSIS

To analyze the data that was gathered empirically through semi-structured expert interviews, a qualitative data analysis was conducted. Qualitative data is not immediately quantifiable unless they are coded and categorized in some way (Sekaran, 2016). The qualitative data analysis happened in sequential steps. First, in order to being able to work with the data, the interviews were transcribed. Then, the transcribed interviews were coded and grouped in categories.

2.4.1 TRANSCRIBING THE INTERVIEWS

The audio files of the expert interviews were used as an input for this process. By listening to the audio, every said word was written down as accurately as possible. Some sentences had grammar issues or were not completed, because spoken language is different from written language, this was also fixed during this step. The transcript of every interview was sent back to the interviewee for confirmation. At the same time, consent and permission was asked to use their response as data for the analysis.

2.4.2 CODING THE INTERVIEWS

The next step was to code the transcribed interviews. This was done by using the software: "ATLAS.ti".

2.5 CONCLUSION

In this chapter, the outline of the research methodologies are provided. The research will be based on the Design Science Research Method Process Model (DSRM) for Information Systems (IS) Research (Peppers, 2007), and will use the Design Science Research Cycles approach (Hevner, 2007). The research consists of 5 phases: (1) *Problem Exploration*, (2) *Problem Explication*, (3) *Requirements Definition*, (4) *Design* and (5) *Conclusion*. A research strategy and methodology are chosen for every phase, and the data collection method and data analysis method are described.

THEORETICAL BACKGROUND

GOAL

Explore the knowledge gaps through several academic perspectives and to describe components that are important to include in the Tokenized Ecosystems assessment tool.

PROCESS

This research departs from three knowledge gaps to provide an overview of what is currently known about the potential disruptiveness of Tokenized Ecosystems. It does this by using several academic perspectives. The three knowledge gaps were investigated through these perspectives. Through this process, components could be identified that were important in the design of a Tokenized Ecosystem assessment tool. The following 2 research questions were answered:

What is currently known about the potential value of applying Tokenized Ecosystems to existing business processes?

What components should the Tokenized ecosystem assessment tool encompass?

KEY RESULTS

- The decentralization of business (operations) is not a new phenomenon. It is an ongoing trend over the past centuries, of which Tokenized Ecosystems can be seen as the most recent form.
- Businesses have had a difficult time extracting value from blockchain technology, because they have been trying to apply this radical technology to incremental improvements in existing business processes.
- Tokenized Ecosystems bring value to startups that are built up in a decentralized way, but they can also add value to the incumbent business.
- Tokenized Ecosystems have the potential to disrupt multiple business sectors
- 4 components were found to be important for the design of a Tokenized Ecosystems assessment tool: innovation maturity, business process fit, organizational fit, and high-level design overview

**“The value capture of
Tokenized Ecosystems is
that a crowd grows and
builds up the
infrastructure on behalf
of a business”**

Dimitri de Jonghe, Founder of Ocean Protocol



3. THEORETICAL BACKGROUND

This chapter describes the problem explication phase and it will do this in two parts. It will first explicate the problem by making clear what is currently known about applying Tokenized Ecosystems to business processes. It will then further explicate the problem statement by identifying the components that are of importance for a Tokenized Ecosystem assessment tool.

Paragraph 3.1 provides the structure of the theoretical background. This paragraph will thereby describe how paragraphs 3.1 to 3.6 are written. This chapter will end in an overview of all found components that are required for the design of a Tokenized Ecosystem assessment tool, described in 3.7.

3.1 THEORETICAL BACKGROUND OVERVIEW

The amount of academic literature written about Tokenized Ecosystems is really small. Also, every scientific research about Tokenized Ecosystem uses a single perspective, which makes the knowledge base of Tokenized Ecosystems really fragmented. A literature review on Tokenized Ecosystem resulted in the appearance and identification of three knowledge gaps. This research starts from these knowledge gaps, and by using several perspectives, an overview is given of what is currently known about Tokenized Ecosystem. The aim of this overview is to find the components that are important for the design of an assessment tool.

First, the potential disruptiveness of tokenized ecosystems is unclear. Startups apply tokenized ecosystems in various ways and they may or may not be successful. Business models with underlying tokenized ecosystems are fundamentally different than business models without. This does not have to mean that the business models themselves are different, but rather how their underlying processes are different. Whether this actually results in a more profitable business model is unclear. Also, if startups with more profitable business models because they are underlined with tokenized ecosystems will actually disrupt incumbent businesses is unclear. This knowledge gap will be investigated through several perspectives. First, since Tokenized Ecosystems are about the decentralization of business operations, and because of the fact that this is not a new phenomenon, the trend of business and organization decentralization over the last centuries will be described in 3.2. Then, the potential disruptiveness of Tokenized Ecosystems will be explained in 4 stages in 3.3. Then, in how the potential disruptiveness of Tokenized Ecosystems is described through the perspective of the Diffusion of Innovation in 3.4. This perspective is used, because this perspective provides a sound method to identify the factors that determine whether an innovation will diffuse to the large mass, which makes it successful.

Second, an approach to assess whether the application of tokenized ecosystems within a business aligns with the goals of that business is lacking. In order to assess this alignment, a structural approach is required. This structural approach should be comprised of components that explain whether tokenized ecosystems fit with the current business goals and strategy. Also, there should be components that explain whether a business is actually able to implement tokenized ecosystems, even if its application aligns with the goals and processes of the business. This knowledge gap will be explored by using the Strategic Alignment Model in 3.5.1. This perspective is used because it provides factors that determine business process fit. Also, the perspective of organizational readiness will be used in 3.5.2, because this perspective can explain psychological factors of individuals within businesses that regard the application of Tokenized Ecosystem.

Third, a high-level overview of tokenized ecosystem design is lacking. Before a business can implement a tokenized ecosystem, it would be wise to design a Minimum Viable Product (MVP). An MVP is a fundamental concept within the Lean Start-up methodology and can be defined as a version of a new product, which allows a team to collect the maximum amount of validated learning about customers with the least effort. Thus, by creating an MVP, businesses allow themselves to test tokenized ecosystems with their partners and potential customers without putting in too much effort. However, before a business could design an MVP, a high-level overview of how such a design should look like is required. Tokenized ecosystems can change from use-case to use-case and the its design thus changes accordingly. The high-level design overview is discussed in 3.6 and will use a technological perspective in a layered approach.

An overview of how the knowledge gaps are researched through perspectives, and to what kind of components this process leads in illustrated in figure 12.

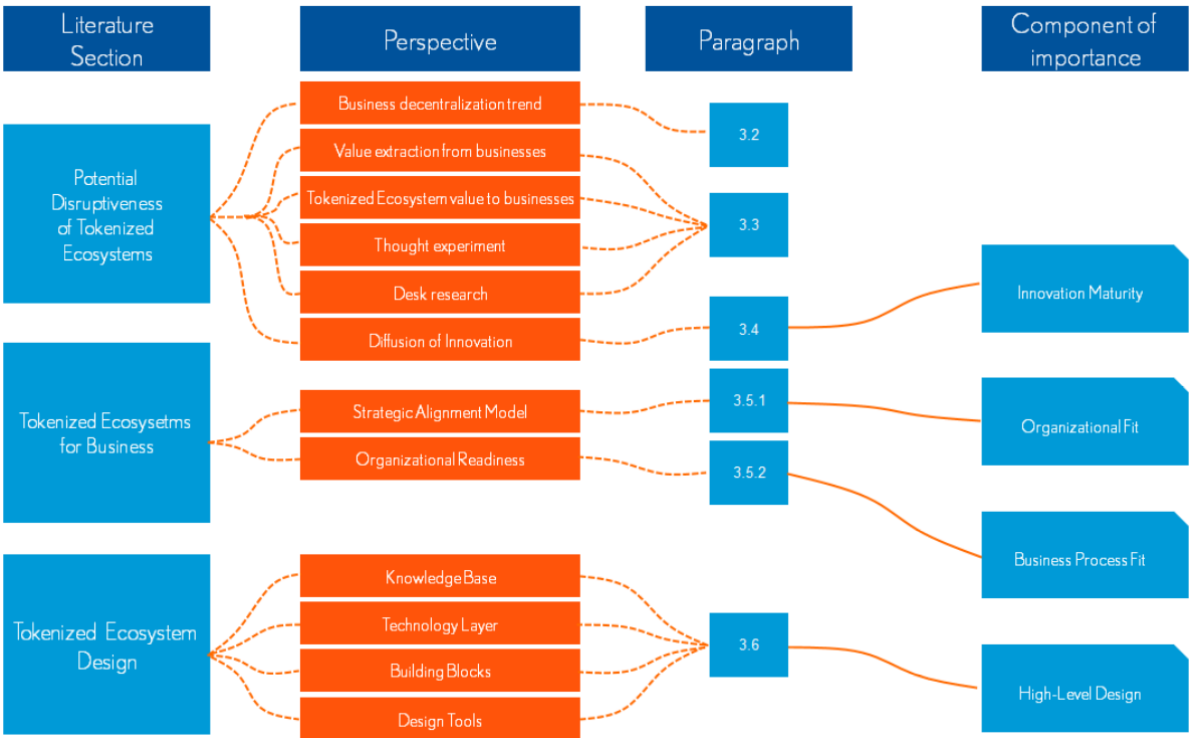


Figure 11: The identification of assessment tool components by departing from the knowledge gaps while using various academic perspectives

3.2 DECENTRALIZATION WITHIN BUSINESSES: A TREND

The decentralization of business (operations) is not a new phenomenon. It is an an ongoing trend over the past centuries, of which Tokenized Ecosystems can be seen as the most recent form. The trend of business decentralization is described through multiple academic theories. In this chapter, these theories will be explained in two sections. First, theories of the decentralization of Social Order explain a trend in the decentralization of how humans organize themselves on scale in a social way, from centrally planned tyrannical governments to organic free markets with limited governmental influences. Second, theories of the decentralization of businesses explain why and how businesses specifically have been increasingly diffused into the public.

3.2.1 DECENTRALIZATION OF SOCIAL ORDER

For a better understanding of this trend, we must first look at Social Order, which can be described as a way in which various components of a society (social structures, institutions, interactions, norms, beliefs, etc.) work together to maintain a certain status quo. At the same time, Social Order is in contrast with social chaos or disorder. People maintain a Social Order when it is stable and prevents chaos (Cooley, 2017).

The existence of Social Order is in principle illogical because groups of people and individuals have different motives. On one hand, people are social creatures, and need others for survival, as well as to be happy and healthy. That is why they tend to act in small groups. At the other hand people are individuals, led by personal goals and desires. Often, these distinct interests between individuals and groups are at odds. For example, individuals do not always follow the rules of the group or do not contribute enough to collaborative goals. Also, behaving cooperatively for individuals sometimes comes with a cost.

When theorizing about Social Order, sociologists and economists have asked themselves why Social Order exists in the first place, how life was before society and how the first governments emerged. Over time, the theory of maintaining Social Order has shifted from made order (centralized) to spontaneous order (decentralized)

Thomas Hobbes - made order by an absolute sovereign

In 1651, Thomas published his book "Leviathan". In this book he describes a 'state of nature', which is a hypothetical situation of the lives of people without any kind of society; no political or economic institution. His view of the state of nature is negative. He describes people as self-interested and focused on desires like reputation, possessions and avoiding death. Also, he saw people as using all means to attain these desires and saw others desiring the same things as enemies. Hobbes saw the state of nature as a 'war of all against all' (Hobbes, 2016).

According to Hobbes, the only way to create a Social Order that is more stable and pleasant to live in than his described state of nature, is for people to acknowledge a sovereign power. Hobbes stated that people will not give up freedom in return for security unless it is coerced by the (tyrannical) sovereign.

Hobbes saw Social Order as 'made order', in which order is preserved through rational planning that is controlled by a central authority and imposed on society.

John Locke - made order by a limited, impartial government

John Locke had a different view on the state of nature of people. He believed that at the core, most people are peaceful and kind. He believed they should be able to roam freely and should not be limited by someone other's will. At the same time, he believed some people are 'rotten apples' that undermine the freedom and rights of the good people. These rights and freedoms were determined by a natural law (the rule of God) and stated that no individual should harm someone else (or his possessions) (Locke, 1841).

Locke further believed that people cannot defend their own rights and that an impartial judge or government should resolve conflicts and defend people. However, Locke stated that this government should not be oppressive or absolute, but a limited power that simply maintains the existing good state of nature. Locke saw Social Order as 'made order' as well, but in a much more limited scope than Hobbes.

Adam Smith – spontaneous order by the invisible hand

In his books “the Wealth of Nations” and “the Theory of Moral Sentiments”, Adam Smith describes the ‘invisible hand’, which is the unintended social benefit of an individual’s self-interested actions. He believed that most people follow their own instincts, morals and self-interest and that Social Order is spontaneously made. Other people are ‘man of systems’ which are people in governments that believe society will run smoother if all people cooperate with their plan (Smith, An Inquiry into the Nature and Causes of the Wealth of Nations, 1817).

Smith believes Social Order will preserve if the plans of ‘man of systems’ coincide with the spontaneous order of the other individuals. Without a government or ‘man of systems’, Smith argues that Social Order will also preserve, as people operate in a decentralized, self-governed mechanism without grand scheme or purpose. He stated that economic actors are guided by their self-interest and conduct to an end that were never part of their intentions, as if they were moved by an invisible hand. He also

Smith hereby introduces the concept of spontaneous order, which opposed from made order, is non-directed and decentralized Social Order.

Friedrich Hayek – true spontaneous order through free markets

Friedrich was a strong believer in free markets, he states that an open and free market will always be more efficient than a centrally planned economy. He argued that Social Order can only exist when there is a free market and when people are free to communicate and make expectations about markets (Hayek, Individualism and economic order, 1980).

A free market exists when individuals make choices as to whether or not to buy a commodity, they affect that commodities price. If it becomes scarce its price increases and if it becomes plentiful its price decreases. In this sense the free market acts as a with a kind of hivemind or collective wisdom and there is a constant and complex debate on the value of goods. A free market is a form of collective agreement made amongst all of the people operating in that market. He argued that a central planner or government could never offer more value or have more wisdom than the collective wisdom of thousands or millions.

He thereby states that the free market should not be intervened with by governments. He was for example against any central planning that was involved with setting the prices of goods. Because information and knowledge are decentralized (Hayek states that they are dispersed among individuals in a society), he states that a decentralized economy of a free market is best suited for it (Hayek, 1945)

3.2.2 DECENTRALIZATION OF BUSINESSES

In order to describe the trend of the decentralization of businesses, an explanation of why businesses exist in the first place is required. With a Nobel Prize winning article in 1937, Robert Coase proposed an economic explanation of why firms (in this thesis, the terms ‘firm’ and ‘business’ are used interchangeably) are more efficient in organizing production than a market of individuals, as long as the transactional cost of *using the market* (for example the cost of bargaining) is higher (Coase, 1937).

Robert Coase: Why do firms exist?

According to Robert Coase, there is a stark distinction between markets and firms. Firms consist of employees that follow directions from their managers and markets consists of individuals that follow price signals within that markets. The notion of markets is different here than explained in 3.2.1, where markets are a system in which businesses and other institutional bodies and individuals exchange goods and

services (mostly in exchange for money). In 3.2.2, we use the definition of markets as used by Robert Coase, where markets are truly decentralized platforms of exchange, without any kind of hierarchy (a business can still exchange in this definition of markets but is seen as an individual actor).

In his paper "The Nature of the Firm" from 1937, Robert Coase answers the question of why Firms exist. He does this by providing an economic perspective to why individuals collaborate under institutions with set rules, rather than acting freely in a market under mutual agreements with other individuals. He does this by describing the traditional theory of 'production' (in economic theory production is defined as an activity that is carried out under the control and responsibility of an institutional unit that uses inputs of labor, capital, and goods and services to produce outputs of goods and/or services), which stated that production can be carried out most efficiently by the market. In a market, if an individual knows a way to produce a good or service in the cheapest way, they are already doing so. This makes hiring that individual always more expensive than to contract him out (Coase, 1937).

Robert Coase states however, that every contract between individuals in a market comes with a plethora of transaction cost. Transaction costs can for example simply be the cost of obtaining a good or service, which is most of the time higher than the actual price of the good or service (because of the additional margin for the seller on top of the cost). Other types of transaction costs within a market can be:

- Search costs. These are costs associated with finding available goods and services and assessing its price to quality ratio.
- Information costs. For certain goods or services, additional information is required to retrieve its value. For example, when an individual purchases new equipment or machinery, he still has to learn how to operate and maintain it. Another example is due diligence, in which additional costs are being made to investigate the potential profitability of a financial activity (for example purchasing goods and services).
- Bargaining costs. These are the costs that are required to come to an agreement between individuals in a market. This can be the time and money invested in the negotiation and writing up the actual contract.
- The cost of keeping trade secrets.
- Policing and enforcement costs. These are the costs associated with making sure that once a contract is agreed upon, all parties involved stick to the agreements. For example, the contracting of an external monitor or time and money invested in informal monitoring can drive up costs of any transaction in a market.

Robert Coase theorizes that firms will arise wherever the external transaction costs are higher than what a firm can produce internally, everything else will be contracted out to other firms and individuals in the market. He also states that not everything can be internalized by a firm as every firm has its own natural limit. A firm can initially grow because of advantageous reduced costs by internalizing transaction costs, but a firm cannot grow indefinitely because eventually additional overhead costs - the cost of hiring employees - will have diminished returns.

Yochai Benkler: Commons-based peer production and the wealth of networks

Other than the dichotomous view of organizing people in firms and markets, Yochai Benkler introduces a third mode of economic production. This third mode is distinct from the other two and has significant advantages over the other two. He calls this mode commons-based peer production. In this mode individuals collaborate on projects, but are not organized in firms, and do not follow price signals of a market. Commons-based peer production is not property-based (like firms are) or contract-based (like

markets are) but individuals are rather guided by motivational drives or social signals. In commons-based peer production, the assumption is made that computers and communication capabilities are widely spread globally and not concentrated in for example a few firms or countries (Benkler, 2002).

He explains the two main advantages of commons-based peer production over managerial hierarchies and markets. First, it is better at finding, identifying and assigning human capital, meaning...

3.3 THE POTENTIAL DISRUPTIVENESS OF TOKENIZED ECOSYSTEMS

This research departs from the fact that businesses have had a difficult time extracting value from blockchain technology, because they have been trying to apply this radical technology to incremental improvements in existing business processes. This research attempts to explain why Tokenized Ecosystems, which are based on blockchain technology, can add value business processes. The first phase of this research is aimed at answering the following research question: *What is currently known about the potential value of applying Tokenized Ecosystems to existing business processes?*

As explained in Chapter 2.2.2, this question will be answered in 4 stages: (1) determine how incumbent businesses have attempted to extract value from blockchain technology, (2) explain how Tokenized Ecosystems can add value to incumbent businesses, (3) conducting a thought experiment by theoretically applying a Tokenized Ecosystem to a known incumbent business, and (4) conducting a desk research to find potential businesses that can be disrupted by Tokenized Ecosystems.

First, Stage 1 will be described in 3.3.1. Then, Stage 2 will be described in 3.3.2. Then, Stage 3 will be described in 3.3.3. Finally, Stage 4 will be described in 3.3.4.

3.3.1 HOW BUSINESSES ATTEMPT TO EXTRACT VALUE FROM BLOCKCHAIN TECHNOLOGY

This stage will be described in 3 parts:

1. What are the value drivers of blockchain technology?
2. How can business blockchain initiatives be categorized?
3. What is the impact of these categories?

What are the value drivers of blockchain technology?

Blockchain technology offers the promise to being valuable to many different business sectors. Businesses try to extract value from 7 elements of blockchain technology that can be value drivers. This means that if such an element is incorporated correctly in a project, that element will provide a certain benefit to that project. The elements are: 1) a distributed ledger of records, 2) the immutability of records, 3) the traceability of records, 4) a consensus mechanism, 5) smart contracts, 6) the creation or representation of digital assets and 7) payment tokens. See Table 1. (Gartner, 2018a)

1. A distributed ledger of records enables business to make data transparent and prove its integrity and provenance. It can be a value driver for business if they intent to launch a project that seeks data transparency and/or integrity. For example: a business does not have to share certain information that they possess with other businesses within a certain blockchain, because it is automatically updated and shared with the other businesses of that blockchain.
2. The immutability of records enables businesses to be sure that the data they are looking at is exactly the same as how it was once stored. This can be a value driver for businesses that want to be able to have append-only data structures. For example: it is impossible for a person to claim that he did not say or do something if that statement or action was once stored on a blockchain. He has no way to ever remove that statement or action from the blockchain.

3. Traceability of records enables business to track the whole history of a data point. This can be a value driver for businesses that want to track the origins or history of that data point. For example: a business can track where and when a certain coin of a currency was spend, or track the location of a certain product.
4. Consensus mechanisms enable businesses to agree with peers without having to know them. This means they don't have to trust them to act "good", since the consensus mechanism will find the truth for them anyways.
5. Smart contracts enable businesses to automatically execute terms. Smart contracts are pieces of code that are stored on the blockchain and can execute certain terms of a contract described in that code. Smart contracts automatically do this and are basically digital extensions of the traditional notion of a contract. This can be a value driver for businesses that want to automate certain contracts and develop new ways to write contracts. For example: a business can allow a father to put aside some cash that will automatically become available through a smart contract to his son once he has graduated and is 25 years old. Another example: a car can automatically agree upon terms and make deals with police, law enforcement, insurance companies and the hospital at the moment a crash happens.
6. Digital asset creation and/or representation enables businesses to represent any type of asset (a loan, debt, mortgage, house or car) on the blockchain in such a way that it is not duplicable. This can be a value driver for businesses that want to create new business cases or products.
7. Payment tokens enables businesses to use tokens as a means of value transfer. Token transactions on the blockchain don't have the problem of double spend. This means that once someone has committed a token for a transaction, he cannot spend it somewhere else when that transaction is still taking place. Double spend is a potential flaw for any digital currency in which the same digital token is spent twice. Normally, double spend is prevented by a trusted third party such as a bank, tokens on the blockchain cannot be double spent.

Also, almost with any type of initiative, multiple drivers are used to extract value for that initiative. Lastly, these value drivers can overlap slightly. For example: if some data is traceable on the blockchain, it must also be immutable. Otherwise it will still be hard to prove its provenance.

How can business blockchain initiatives be categorized?

Business have attempted to extract value form business technology with 7 identified value drivers (see table 1). When looking at most business initiatives and assess which value driver they included, four main categories emerge: Record keeper, efficiency play, digital asset market and blockchain disruptor (see table 2).

Table 1: Blockchain value drivers (Gartner, 2018b)

| Value Driver | Capabilities |
|---------------------------------------|--|
| Digital asset creation/representation | Ability to create a unique representation of any asset that enables exchange of value, while preventing duplication. |
| Payment token | Ability to use a digital token for payment that transfers value, while preventing double spend. |
| Distributed ledger of records | An expanding list of cryptographically signed, irrevocable transactional records shared by all participants in a network. Each record contains a time stamp and reference linkages to the previous transactions. |
| Immutability of records | A characteristic that prevents something from being changed, once it is created. Data elements recorded in the distributed ledger cannot be changed. Only new records can be appended for any corrections. |
| Traceability of records | Ability to audit all historical changes to a record in a blockchain. |
| Consensus mechanism | A process by which all nodes in a distributed network agree on the latest status of a given ledger. Consensus mechanisms, therefore, enable the execution of transactions under certain conditions. |
| Smart contracts | A computer program or protocol that facilitates, verifies or executes the terms of a contract. Smart contracts are digital representations and extensions of the traditional notion of a contract. |

Table 2: Four main blockchain business initiatives: which value drivers are used? (Gartner, 2018b)

| Value Driver / Category | Record Keeper | Efficiency Play | Digital Asset Market | Blockchain Disruptor |
|---------------------------------------|---------------|-----------------|----------------------|----------------------|
| Digital creation/representation asset | | | Yes | |
| Payment token | | | Yes | Yes |
| Distributed ledger of records | | Yes | Yes | Yes |
| Immutability of records | Yes | Yes | Yes | Yes |
| Traceability of records | Yes | Yes | Yes | Yes |
| Consensus mechanism | | Yes | Yes | Yes |
| Smart contracts | | Sometimes | Sometimes | Sometimes |

The first business initiative is “Record Keeper”. It is a business initiative whose primary purpose is to ensure that records cannot be corrupted and that they can be audited on demand. Projects could be led by one organization that primarily benefits from it, or they could provide a common service for multiple organizations. Government entities tend to be suitable for a range of initiatives where the focus is on the key value drivers of immutability and traceability. These initiatives do not involve digital assets or a strong consensus-based decision mechanism. The intent of use of the distributed ledger is resiliency, rather than decentralization across parties.

An example of a “Record Keeper” business initiative is a business that enables certification proof within the food industry. Organic food have a stamp on their package that proves it is produced according to organic standards. Consumers are only able to trust or distrust the stamp. With blockchain, they can actually see who certified the producer and to what standards the producer was tested. These records are immutable and traceable for anyone scanning the product.

The second business initiative is “Efficiency Play”. It is a business initiative that attempt to improve efficiencies in existing business processes within a company or at an industry level. They tend to preserve the current business models and the actors within. Decentralization is attempted only at the technology architecture level, if at all. In these initiatives, there is no new market such as those created in the digital asset market initiative. The use of blockchain is limited to activities once a transaction or interaction is complete. That is, blockchain is not used to facilitate one. The key value drivers of blockchain for these initiatives are the distributed ledger and the immutability and traceability of records. Consensus can be strong or not, depending on how much decentralization is sought in the use case. Smart contract usage is optional. These initiatives tend to not have new digital assets or to use cryptocurrencies for payments.

They can be led by a dominant player in an ecosystem, such as a large multinational using blockchain in its supply chain. Market infrastructure companies, where they exist (such as stock exchanges in financial

services), play a pivotal role in initiating such projects in their markets. They can also be initiated by informal or formal alliances (such as consortiums) between enterprises in a market

An example of an “Efficiency Play” business initiative is a business that puts the whole coffee supply chain on the blockchain. Every step and every transaction in the supply chain of coffee is stored on the blockchain. This makes it easier for the supply chain participants to see what happened to the coffee beans and to make deals with others.

The third business initiative is “Digital Asset Market”. These are new markets that facilitate the creation (or representation) and trading of new digital assets. Blockchain's cryptocurrency mechanisms enable creation of new digital assets or representation of physical ones. Digital asset markets tend to use all the value drivers of blockchain, including its ability to create/represent digital assets, the distributed ledger, a strong consensus mechanism, the immutability and traceability of records, acceptance of cryptocurrency tokens, and smart contracts. Blockchain's capabilities in tracking the provenance of an asset, as a consensus mechanism to consummate a transaction, plus having the ability to improve clearing and settlement functions and records management, all contribute to developing these markets. Note that a digital asset market is a specific kind of blockchain disruptor, one that uses blockchain's ability to represent a digital asset and offers a market based on it. Other kinds of blockchain disruptors are specified in the fourth category and are of a more broad type.

An example of a “Digital Asset Market” is the tokenization of physical assets such as houses. A family owning a house can convert their ‘shares’ into tokens and publicly sell them to investors. This makes owning a house a more liquid asset and enables the owners to use those assets for other purposes. Families can buy back their shares if they ever want to physically sell the house once they are moving, providing a profit for the investors buying the tokenized house shares. Businesses building platforms that facilitate tokenization and a token marketplace reap benefits through for example commissions.

The fourth business initiative is “Blockchain Disruptor”. These initiatives rely primarily on a blockchain foundation to achieve decentralization of business and/or technology functions. Their critical business functionality is enabled by most of blockchain's capabilities, including the distributed ledger, a strong consensus mechanism, the immutability and traceability of records, and acceptance of cryptocurrency tokens. In most cases, they employ smart contracts to encapsulate certain business functionality. Their business models may or may not be new. Many of them tend to raise capital through initial coin offerings (ICOs). Examples are mostly startups, but they can include spin-offs from large enterprises.

An example of a blockchain disruptor is hard to give, since it requires future prediction. Startups that are building their business in disruptive ways does not prove its disruptiveness in 10 years and only time will tell. The example could can be ridiculed or celebrated in 10 years from now.

The impact of each initiative category

The four given categories can be overlapping, but at least show some degree of distinction between business initiatives. At the same time, every business initiative have different impact on the incumbent business.

The first two business initiatives can be considered as cost reducing approaches that rely on incremental innovation and improvements on current business processes. Most incumbent business experiment with these types of business initiatives and have a hard time extracting value from it, because it is not obvious

how and where it will offer better value than current enterprise technologies. Also, some businesses see blockchain technology as a one-size-fits-all solution. Furthermore, they are reluctant towards decentralizations and open sourcing, two key elements related to blockchain technology.

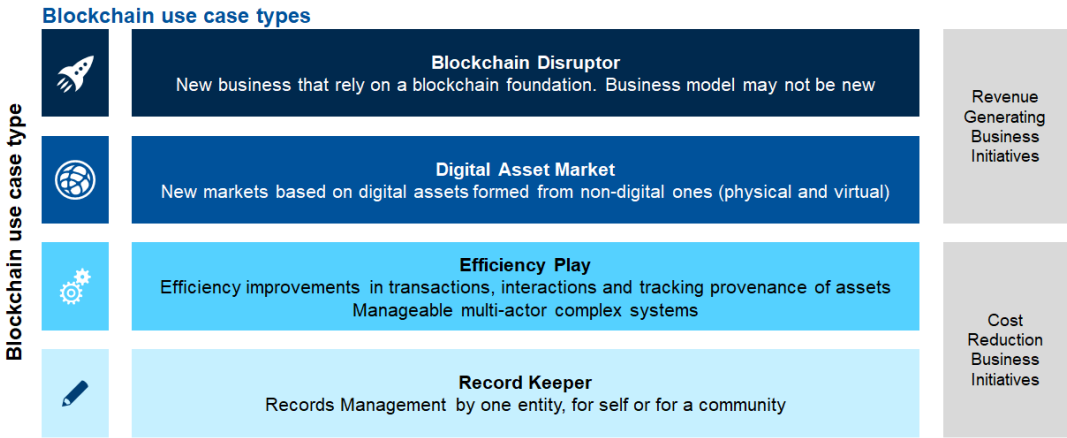


Figure 12: Blockchain use case types

The last two business initiatives are rarely seen within the incumbent business and rather in startups and scale-ups. This is because if the incumbent business want to fully leverage blockchain technology, they have to change core processes, models and systems. This is difficult for business to do, because changing them comes with a large risk. Startups and scale-ups on the other hand are build up with these newer core processes, models and systems baked into them.

Businesses have attempted to extract value from blockchain technology; unfortunately, no incumbent business has succeeded to launch a profitable business case on blockchain technology. Many business leaders risk overestimating the short-term benefits of blockchain as a technology for helping their business to differentiate and win (Gartner, 2018e). Since about 2012, various technology evangelists have given the impression that blockchain is not only new, but that it is one technology solution that can be applied to solve a multitude of business problems. Further, they expect solutions to occur fairly quickly, easily and with no side effects and significantly improved cost structures (Gartner, 2018e). This prospect has proven to be false, given the inability of businesses to launch successful blockchain business initiatives. An assessment of possible reasons of this failure is described below:

- Lack of understanding of the value drivers.** The vast majority of businesses are not designed to use all of the core components of the original block chain concepts, like: encryption, immutability, distribution, decentralization and tokenization. In particular, the focus on purely encryption, immutability and limited forms of distribution that are still called blockchain masks the ability to achieve these same goals using understood, available, tried and tested technologies such as cloud, relational databases, middleware and messaging infrastructures. Moreover, these private/permissioned versions do not use tokenization, and concentrate on being purely a system of record. While blockchain "may" still offer benefits in solving these enterprise problems, careful analysis needs to reflect the inclusion of value drivers via minimum viable product (MVP) development using existing technology. Defaulting to blockchain is not necessarily the best or only option (Gartner, 2018e).
- Perception of blockchain as a one-size-fits-all solution.** Blockchain has been regarded as a magic stick that could be pointed at any problem which it then solved. This has lead to many failed projects (Frederik, 2018).

- **Unfocused “hype” enthusiasm.** The projects that did succeed, did not always really work on blockchain technology. Businesses were simply stating they were using blockchain to get more investments since anyone was throwing money at it anyways (Frederik, 2018).
- **Reluctance towards decentralization.** The intention of the first blockchain was to disrupt and disintermediate centralized entities, operations, processes and business models using open source and democratized engagement. By limiting implementations to re-platforming existing centralized architectures, entities revert to type. Technical and business silos are reinforced, business models are preserved, architecture is made more complex, the potential for vendor lock-in encouraged and the potential creation of new value structures are inhibited. Ultimately, such enterprise/private projects create a false sense of business model security that assumes that the enterprise is prepared to counter any disruption that can come through blockchain-based innovators, while in reality that is not the case (Gartner, 2018e).

The four reasons why businesses have difficulties extracting value from blockchain are summarized in figure 7.

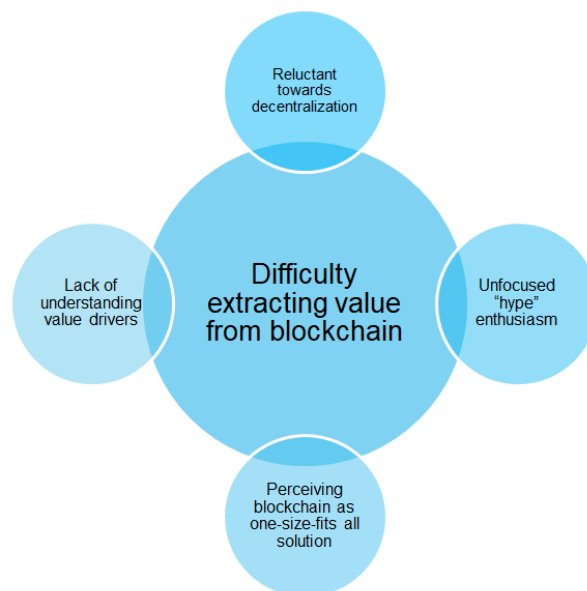


Figure 13: The difficulty of extracting value form blockchain technology

In summary: Blockchain technology may be transformational to a lot of business sectors (Gartner, 2018c), but not in the way that most might think. It is not a one-size-fits-all solution and it might not even play a big part in future paradigms. Furthermore, businesses do not yet understand the value drivers of blockchain technology and are reluctant towards decentralization. Lastly, businesses follow the hyped state of blockchain technology resulting in an unfocused enthusiasm and failed projects.

However, the decentralized and peer-to-peer nature of blockchain *enables* a revolutionary way to look at how business and global economy can be redesigned. In that way, blockchain technology is a trampoline or stepping stone into a new paradigm, and functions from then on merely as a substrate for other technologies and business initiatives. An overlooked business initiative within the “Blockchain Disruptor” category that functions as such a technology on top of blockchain technology, is Tokenized Ecosystems.

3.3.2 TOKENIZED ECOSYSTEMS

Tokenized Ecosystems are a way to organize a business in a decentralized way. This means that a community will create and sustain business processes, and they are incentivized through token reward functions. Individuals can earn tokens by being valuable to the business process, these tokens can have monetary value or can for example give rights of some sorts. The business process has now become a network which nobody in particular owns, but is owned by everyone holding a token related to that business process. With Tokenized Ecosystems, business can decentralize some (or all) of their business operations. A community behind the business operation will run and sustain it as a network. Members of this community are incentivized to do so through token reward functions. Tokenized Ecosystems consist of multiple tokens of several archetypes (currency, security, utility). In order to explain this well, blockchain technology must first be reframed from a trust machine to an incentive machine.

Blockchain as incentive machine

Because token holders have 'skin in the game', their incentives are aligned: tribes of token holders have the same goal. These incentives are not only aligned, but can also be programmed (because the incentive itself, the token, is a programmable piece of code). This opens business operations up to a much larger community.

Token holders have 'skin in the game'

Having 'skin in the game' refers to someone who has committed themselves to some goal. This can be done by staking or gaining incurred risk (for example by investing money) towards that goal. From then on, that person is involved in achieving that goal in the sense that he benefits from a stable investment and he has confidence in the team behind achieving the goal and that the goal returns an expected yield that is higher than the investment.

When multiple people hold a certain token, they all have 'skin in the game' behind the project of that token (the token is inherently tied to the project behind it, since it is built on that platform and does not exist outside of it). This means that they share a common goal and can be seen as a tribe, endorsing the same belief. Also, because they have skin in the game, their incentives are aligned.

Aligned incentives can be programmed

Because the incentives are aligned through tokens and tokens can be programmed, the incentives themselves can be programmed as well. If a project or community designs a way in which a network can be created and sustained by peers, they can use tokens to design the incentives because tokens can be programmed.

A network with programmable incentives for peers to build and sustain that network means it can enable the programmable economy: autonomous businesses. Once a design is set into place and once the objective of a network is known, you can design the incentives in such a way that peers will be rewarded with good behaviour, and punished by bad behaviour. The system can run by itself from then on.

The power of incentive structures: Bitcoin

An example of an incentive machine can be seen in the core innovation of the bitcoin blockchain. To achieve validate transactions in a stable, secure and decentralized way, a lot of participants were needed. Bitcoin solves this by incentivizing people to participate in the consensus mechanism of the bitcoin blockchain: Proof of Work. The more people that let their computers run overnight to validate transactions, the more secure the bitcoin blockchain. However, letting your computer run costs energy and time and incentives

such as esteem and loyalty are not strong enough, a monetary incentive was implemented. Participants in the network validating transactions are automatically 'paid' through the protocol based on the amount of effort. The incentive machine of the bitcoin blockchain is so strong, that people created their own "mining rigs": towers of GPUs that validate bitcoin transactions. It incentivized people to create specific chips called ASICs (Application-Specific Integrated Circuits) that are designed to just do bitcoin transaction verification. The amount of energy that people use to validate Bitcoin transactions globally is currently more than for example what the whole Czech Republic consumes. The blockchain incentive machine got people to do stuff.

Tokens: getting people to do stuff

A few startups have realized this power of getting people to do stuff by rewarding them with tokens. However, they also realised that the incentive of throwing a lot of energy towards a system might not be the best token reward function. If you can get people to do such a thing, why not let them do something valuable. Something valuable not only to the business, but to the network these people work in itself. They have built their business as a network of peers that build and sustain the project. These startups did this by looking at the objective function of a network. The object function of a network is the optimized way in which a network can run.

From objective function to token reward function.

For example, if someone wants to save files on the cloud, he can go to Dropbox to use their cloud storage services, for free. If Dropbox ever goes bankrupt and that person is unaware, he files are lost. This would never happen with system in which the cloud storage servers are not centrally owned, but operated by a multitude of people. This is exactly what Filecoin tries to do. They have been looking at the objective function of cloud storage and have designed incentives in such a way that people themselves can sustain the network. In a decentralized cloud storage service, no one owns the network of servers, but every participant owns their own server. The consumer won't notice anything different from the front end of a centralized cloud storage service like Dropbox, apart from the moment it ever goes bankrupt. He will still go to a website or app and drags his files into the cloud folder. On the back end things are different. The file will be split into several packages and every package gets duplicated. All of these packages are then spread on the network of people running their little servers. The main idea is that once a node ever drops out (the server can fail, run out of power, get hacked or the owner might even turn malicious himself), the file can still be relocated on the other servers. As long as there are a lot of nodes working, the network works. This is where the incentives come in, as there needs to be an incentive for people to keep their nodes running. The incentive is the filecoin which storage providers can earn by providing storage, and storage users can spend to get storage. If the demand for storage is high, the incentive goes up and the other way around.

Network effects in Tokenized Ecosystems

The main benefit of Tokenized Ecosystems is that they use network effects to their benefit. For centralized business, a larger network means a larger marginal cost of (maintaining the) infrastructure. For a decentralized business (with a Tokenized Ecosystem), a larger network means a lower marginal cost of (maintaining the) infrastructure, because the network *is* maintaining the infrastructure.

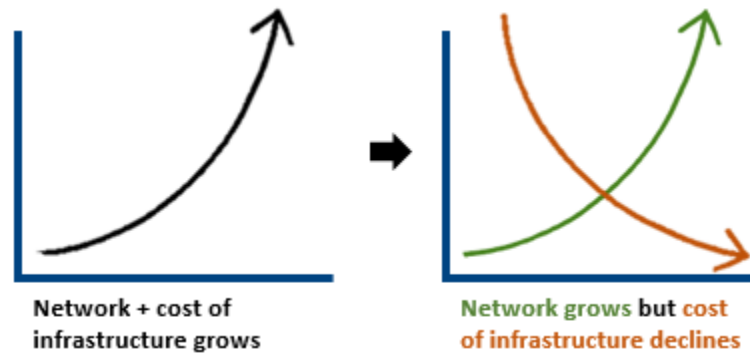


Figure 14: The workings of network effects in Tokenized Ecosystems

3.3.3 TOKENIZED ECOSYSTEMS FOR BUSINESS

Tokenized Ecosystems bring value to startups that are build up in a decentralized way, but they can also add value to the incumbent business. To explain this, thought experiment is conducted by applying Tokenized Ecosystems to an incumbent business case. In this thesis, the case is about Facebook.

Facebook is broken

Every January, Mark Zuckerberg comes up with a personal challenge for the upcoming year. Until now, he has learned mandarin, ran 365 miles and visited every US state. His first challenge in 2009 was to come up with a profitable business model for Facebook and wore a tie every day to remind him of this challenge. At the end of that year, he found the business model: data-driven audience-based advertising. This model has brought Facebook a lot of revenue and profits, but it is exactly this model that is the inspiration for the current challenge: fix it. According to Mark himself, Facebook is full of problems: “whether it’s protecting our community from abuse and hate, defending against interference by nation states, or making sure that time spent on Facebook is time well spent.”, and “we currently make too many errors enforcing our policies and preventing misuse of our tools” (Weinberger, 2018).

With over 2 billion users, the reach of Facebook is immense; it reaches nearly a quarter of the earth’s population. Although Facebook helps people connect all around the globe and helps to spread news and ideas, it also helps spread malicious content. Malicious content can be any hateful and violent content like bullying, hate-speech, terrorist ideals, but also forms of nudity, child pornography, etc.

To cope with this, Monika Bickert - the head of global policy management - has the approach to set policies that keep people safe and enable them to share freely. These policies are crafted by 60 full-time employees and are comprised of deep, highly specific set of operational instructions for content moderators that is reviewed constantly by Bickert’s team and in a larger intra-Facebook gathering every two weeks. For example “Someone, shoot Trump!” should be deleted, while “Let’s beat up fat kids” is allowed to stay (Madrigal, 2018).

Around 8000 human content moderators have to go through all of the content and use these policies and guidelines to assess whether the content should be allowed to stay, flagged to other users as disturbing, or removed completely. This is a difficult task, as the judgement calls based on the content and the guidelines can be very ambiguous. For example, one rule that came to light in a Guardian investigation noted that while nudity on Facebook is prohibited in general, it was okay to show adult nudity in the context of historical Holocaust photographs. Also, some violent content is tolerated, unless it “gives an unreasonable ground to

accept that there is no longer simply an expression of emotion but a transition to a plot or design" (Madrigal, 2018).

This statement mimics content regulation laws created by democratic governments. Pretty much any type of content is protected by free speech laws unless it incites immediate violence. However, Facebook is not structured like a democratic government to actually handle the responsibility to evaluate so much content posted by humans around the globe. Facebook and democratic governments are different in three mains: the presence of debate, the open nature of discussion and the incentive structure.

First of all, there is no debate. Content moderators just follow the guidelines of what they should flag, not why they should flag it. Since they follow these guidelines, the judgement is based on a binary decision: allow the post, or don't allow it. In a democratic government, regulators will go over the arguments of multiple sides before making a decision. This takes more time, but it is time required to make a good decision.

Secondly, the discussion is not open. Although the open published broad guidelines, the more specific guidelines are only shared internally. This is to prevent users to game the system, they could post malicious content in such a way that it is just compliant with the guidelines. This is in sharp contrast with a democratic government, in which laws and guidelines are discussed in an open and transparent way. Also, after a law is published, it is subject to several iterations of readings and improvements. In some scenarios, the general public is also brought into these discussions.

Lastly, the incentives and goals of Facebook are inherently different from democratic governments. In a democratic society, the guiding principles include freedom of speech, freedom of political debate and protecting the public from malicious content. Facebook however, wants to attract and retain users, that don't want to click malicious links. Facebook won't go so far as to undermine their data-driven business model.

Next to the difficulty of the task, the size of the task is problematic as well. With the current volume of content to be assessed, those 8000 human content moderators have only 10 seconds to judge each piece of content. Also, even with this short time to think, it is impossible to review the huge mass of content coming in every second.

A decentralized solution

An idea that startup Steemit is working with, is to build up a social media platform from the bottom up, in a decentralized way. On their platform, publishers of content can get upvoted by other users (much like how reddit works). However, instead of just earning point, they get an actual monetary reward in the form of 'Steem', the native token of the Steemit blockchain. Another novel way in which Steemit works is that people can earn Steem by curating and moderating content. Curating means once users discover content of others that is of high quality, they can vote and comment on it. This way they can grab an early-mover advantage and receive a higher reward than people that 'discover' the content later. Moderating means exactly what is described in the Facebook case. Users can vote on malicious content and once others agree, he will get a first mover advantage reward (the other users that agree get lower rewards. This system works in an automated way and users that behave badly (upvoting malicious content or downvoting quality content) can be punished or cast out the network (Haupt, 2018).

Here it becomes obvious that a bigger network means a better working network on a lower marginal cost of infrastructure. More users means more moderators, more curators, a higher chance of quality content

and a lower chance of malicious content. This has more value than how the centralized Facebook works. More users means more work for moderators and curators, a lower chance of quality content and a higher chance of malicious content; higher marginal costs of infrastructure are required to cover this deficit.

However, it is very unlikely that Steemit will actually challenge Facebook, because of network effects and critical mass. Not many users will change from Facebook to Steemit, if their friends are not on Steemit yet. For a social media platform to work well, you need a critical mass for people to be convinced to migrate there as well. For example, Steemit has about 1 million users compared to 2200 million users on Facebook.

Tokenize the enterprise: Facebook

What could also happen, is that Facebook decentralizes itself and use tokens to incentivize users to behave well on the platform. When taking a closer look, many more business operations than just content moderating appear to be tokenizable. An overview of some major business operations that Facebook could tokenize to incentivize a community to sustain that operation can be seen in table 2.

Table 3: Potential for the incumbent business: Tokenized Ecosystem

| Stakeholder | What value they provide | What they get in return |
|---|-------------------------------------|-------------------------------------|
| Data/service provider, data custodian, data owner | Data/service (supply of the market) | Tokens for providing service |
| Data/service referrers, curators. Could include third parties | Curation | Tokens for curating |
| Data/service verifier. Includes Oracles | Verification | Tokens for verification |
| Data/service consumer | Tokens | Data/service (demand of the market) |
| Keepers | Running nodes in the network | Tokens for running the network |
| Data/service moderators | Moderation | Tokens for moderating |
| Developers | Adding features / improve systems | Tokens for contributing |
| Facebook shareholders | Distributed Governance | Increased Token Value |

3.3.4 POTENTIAL BUSINESSES SECTORS THAT CAN BE DISRUPTED BY TOKENIZED ECOSYSTEMS

WEB 2.0 → WEB 3.0 COMPARISON LANDSCAPE. WELCOME INTERNET OF BLOCKCHAINS

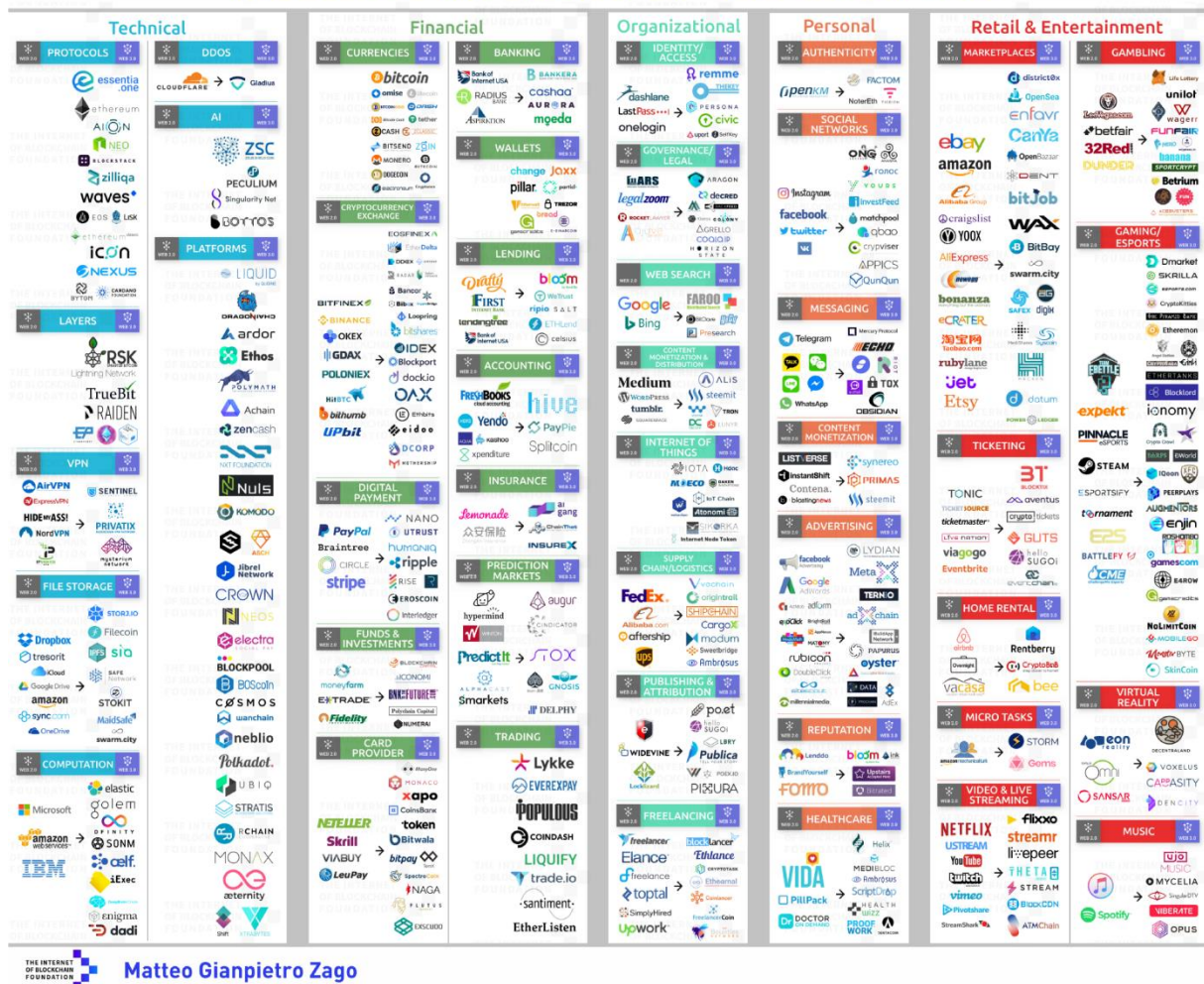


Figure 15: An overview of business sectors potentially disruptable by Tokenized Ecosystems

3.4 ASSESSING THE POTENTIAL DISRUPTIVENESS OF TOKENIZED ECOSYSTEMS

As explained in chapter 3.3, Tokenized Ecosystems show capabilities to disrupt many business sectors because of their beneficial network effects and anti-fragility. However, it is still unclear how the potential disruptiveness can be assessed by businesses. This means it is unclear for businesses whether tokenized ecosystem may or may not disrupt their business model, and in what way tokenized ecosystems can add potential value. In this section, the potential disruptiveness of Tokenized Ecosystems will be analysed. This is being done by defining disruptive technologies and innovations in 3.4.1. Then, the potential disruptiveness of tokenized ecosystem will be discussed. This is done with using the theory of diffusion of innovations in 3.4.2. The found component is presented in 3.4.3.

3.4.1 DEFINING DISRUPTIVE TECHNOLOGIES AND INNOVATIONS.

Not all innovations are the same. Some innovations are incremental innovations. Meaning, small upgrades or improvements to existing products, services, processes or methods. These upgrades or improvements, applied separately or in combination, are aimed at e.g., increasing efficiency; productivity; price or for

example competitive differentiation. Incremental innovation is a common tactic for companies because it is relatively low risk.

The opposite of incremental innovation is radical innovation. A radical innovation is a new product, service, process or method. These innovations are introduced on the market with an aim to replace existing ones. Radical innovation requires significant amounts of time and money invested and producing radical innovation therefore a high-risk business tactic. Radical innovation is almost similar to disruptive innovation, but a radical innovation is an innovation that actually creates a new market and value network and eventually disrupts an existing market and value network, displacing established market leaders and alliances (Bower, 1995).

Whether, how and at what rate disruptive innovations spread through the public is discussed in the book "Diffusion of Innovations", written in 1962 by Everett Rogers. With the theory of Diffusion of Innovation, he describes that disruptive innovations are adopted over time by participants of a social system through a process called diffusion. Within diffusion, an innovation is adopted by five categories of adopters: innovators, early adapters, early majority, late majority and laggards. The diffusion of an innovation, the rate at which an innovation is adapted, is depended on the category of adapter. According to Roger's study, most innovations follow this S-curved graph, see figure 16. First, the technology is slowly adapted by small groups of innovators that tinker with the innovation. Then, early adapters might find the innovation interesting and start adapting it at a higher rate than the innovators did. If successful, the innovation might be adapted by an early majority (the innovation now reaches the highest rate of adaption). Note that if a disruptive innovation has reached this state, multiple companies have adopted the innovation and are working on their own competitive edge, resulting in niche versions of the innovations. The companies do this by incremental innovation on top of the 'base' innovation. Then, a late majority follows to adapt the innovation at a slower rate which results in a market-wide (however big the market is) adoption. The innovation has now created a new market with many niche versions of the innovation. Last, laggards adopt the innovation at a very slow rate (Rogers, 2003).

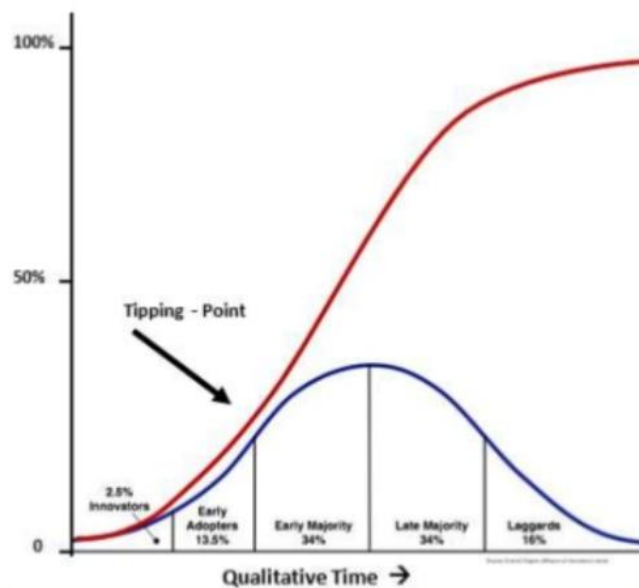


Figure 16: An s-curve (Rogers, 2003)

This gives room for a new disruptive innovation, as there is a market to disrupt. A new disruptive innovation typically starts at the end of another. This results in a recognizable pattern of S-curves of innovation diffusion that follow each other up. Every new S-curve is a new innovation disrupting the earlier one. The steeper an S-curve, the higher the rate of adoption and incremental innovation.

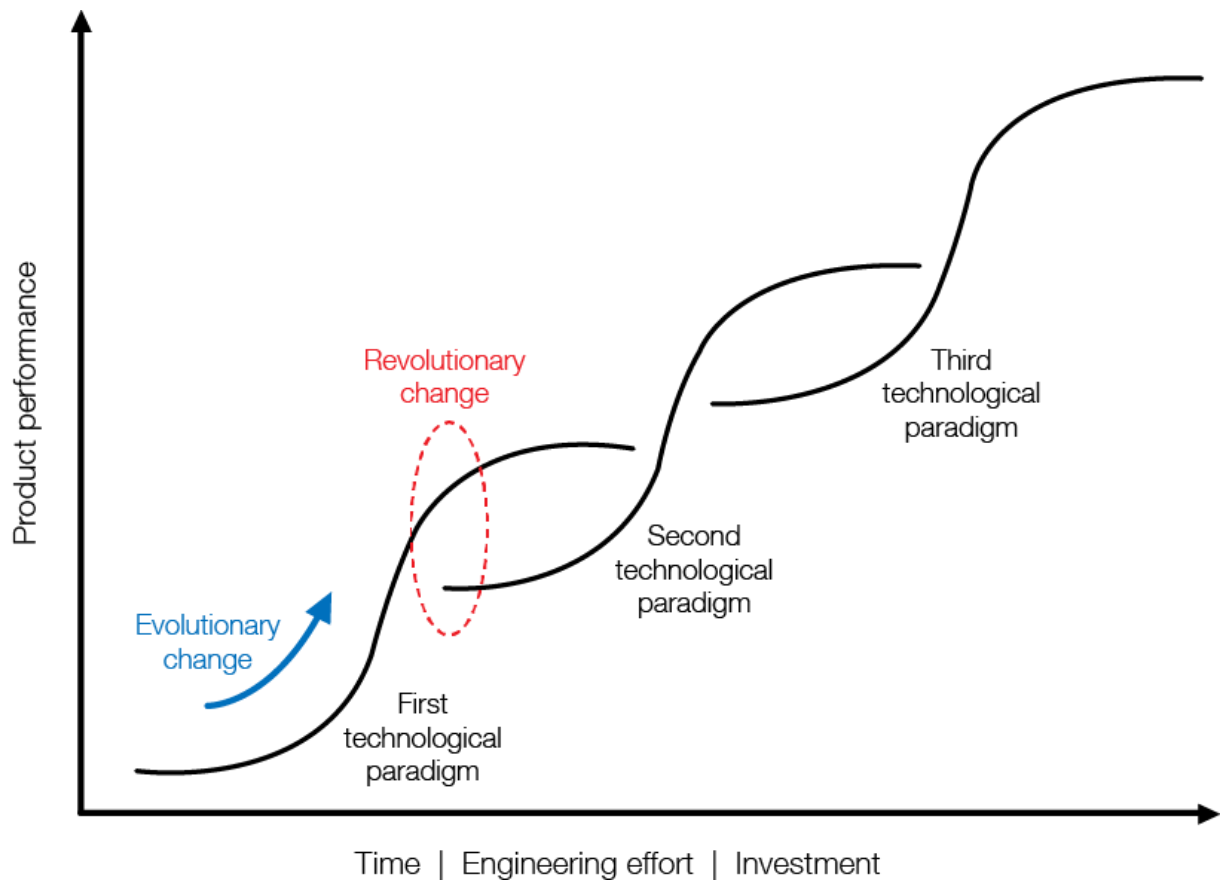


Figure 17: S-curves in sequence (Rogers, 2003)

Whether an S-curve actually follows an earlier S-curve depends on the potential disruptiveness of an innovation. According to the Rogers, next to the adapters, this depends on four additional key elements: (1) Innovation, (2) communication channels, (3) time and (4) social system.

1. Innovation: Is an idea, practice or object that is perceived as new by an individual or group [or organisation]. (Rogers, 2003)
2. Communication: The process by which participants create and share information to one another in order to reach a mutual understanding (Rogers, 2003)
3. Time: Time involved in the innovation-decision process, the time taken to adopt an innovation by the adopter and the adoption rate across the social system (Rogers, 2003)
4. Social system: Are a set of interrelated social units (e.g. individuals, informal groups, organisations) that are engaged in problem solving to achieve a common goal. (Rogers, 2003) - it determines the boundary for a diffusion process; it can be affected by norms, and the degree to which individuals can influence one another

There are also five main characteristics of innovations that determine how an innovation will be responded to by an adapter group:

1. Relative Advantage - The degree to which an innovation is seen as better than the idea, program, or product it replaces. (Rogers, 2003)
2. Compatibility - How consistent the innovation is with the values, experiences, and needs of the potential adopters. (Rogers, 2003)
3. Complexity - How difficult the innovation is to understand and/or use.
4. Trial ability - The extent to which the innovation can be tested or experimented with before a commitment to adopt is made. (Rogers, 2003)
5. Observability - The extent to which the innovation provides tangible results. (Rogers, 2003)

3.4.2 THE POTENTIAL DISRUPTIVENESS OF TOKENIZED ECOSYSTEMS ACCORDING TO THE DIFFUSION OF INNOVATION

Next, the characteristics of Tokenized Ecosystems as an innovation will be analyzed in order to determine its potential disruptiveness. As discussed in 1.3.4, Tokenized Ecosystems has an impact on a variety of markets. Following the definition of Bower and Christensen, this means that Tokenized Ecosystems will be a disruptive innovation if these existing markets will be replaced by a new one. This can happen in theory but will be depended on the five described elements that will determine the diffusion of Tokenized Ecosystems.

Innovation characteristics of Tokenized Ecosystems

For adapters to adapt the innovation at an earlier stage and at a higher rate, Tokenized Ecosystems must show a proven relative advantage compared to existing products and systems. Currently, the advantage is only shown in theory and in proof of concept, as described in Chapter 1. Second, Tokenized Ecosystems must be compatible with the values, experiences and needs of potential adapters. Currently, some people within the blockchain space are convinced that Tokenized Ecosystems have this compatibility. Third, Tokenized Ecosystems must have a level of complexity that makes it easy to understand and use. Currently, Tokenized Ecosystems are extremely difficult to understand, even for the innovators building them; let alone that there is an easy way for other adapters to use Tokenized Ecosystems. Third, Tokenized Ecosystems must be testable. Without being able to test or experiment with different setups, adoption will hamper. Currently, Tokenized Ecosystems are ideal to test and experiment on, as computers can simulate whole ecosystems. Last, Tokenized Ecosystems must create tangible results in order to produce proofs so that adaption will improve. Currently, results from the simulations are very tangible because they can be benchmarked with the existing systems Tokenized Ecosystems aim to disrupt. Only some projects are actually live that produce some tangible results, but these projects have yet to be tested on scale.

Adaptors of Tokenized Ecosystems

Currently, Tokenized Ecosystems are mainly adopted by the innovator group. Tokenized Ecosystems are produced by risk-taking startups that are quickly evolving and changing the technology in itself. They are not risk-averse in the sense that they cope with uncertainties. They have an important role in the sense that they are the once that decide what information about the technology goes out into the public and how they introduce the innovation. Some early adaptors have also adapted Tokenized Ecosystems. They are opinion leaders that are known to a wider public. They report on the innovations and provide advice and information to others. They are aware of the problems of the technology and comfortable changing to and thereby adopting new technologies. Once more early adapters are adapting Tokenized Ecosystems, they can help trigger a critical mass required for the group of the early majority. This can be done by conveying a message that approves the technology. The early majority is far from reached, there is no proof or evidence of a

working concept. For Tokenized Ecosystems to be potentially disruptive, the early majority must be reached.

Communication Channels of Tokenized Ecosystems

Tokenized Ecosystem projects are defined by their openness. Most projects publish their code on Github (a web-based platform to host and publish code), where any user can view, review the code and post contributions to it. Also, many projects discuss their progress on Slack and/or Discourd (two popular business communication and collaboration tools at the time of writing) in an open way with anyone that has access to their channel (most channels are open to the public). Any news or update is published on Telegram (a popular mass-group secure messaging app at the time of writing) or is tweeted out and thought leaders of the project post lengthy pieces of writing on Medium (a popular blog hosting web-page). Usage of so many communication channels boasts the potential adaptation by a large margin and the open discussion helps the public to understand Tokenized Ecosystems and increases the trust in the project due to its transparency.

Time involved in the innovation process of Tokenized Ecosystems

As most projects are but a year old, it is hard to determine what the current adaption rate of Tokenized Ecosystems is and when it can be expected to ramp up.

The social system of Tokenized Ecosystems

The open nature of Tokenized Ecosystem projects has resulted in a very diverse ecosystem. The development of Tokenized Ecosystems happens in the middle of a so-called Triple Helix. Within a Triple Helix, businesses, universities and government work together in a highly efficient way to foster economic and social development (Etkowitz, 1995). This can be seen in multiple Tokenized Ecosystem projects. From businesses they get support in the form of financial investment, market expertise and event sponsorship. From governments they get support in the form of advisory services, policy formulations, innovation support and grants. From universities they get support in the form of technical assistance, human capital supply and academic proof for ideas.

3.4.3 COMPONENT 1: INNOVATION MATURITY

The potential disruptiveness of Tokenized Ecosystems can be determined through analyzing five key elements of Innovation Dispersion as described by Roger. Tokenized Ecosystems currently show potential disruptiveness but has to overcome critical hurdles before it can reach mass market. Communication channels are abundant and clear and there is a strong social system to develop Tokenized Ecosystem, but the technology is very complex and not well understood. Also, no test on large scale has been conducted so it is hard for early adapters to convey potential effectiveness and functionality without tangible results. This is required for the early maturity to adapt Tokenized Ecosystems over an existing system.

For businesses it is important to understand whether Tokenized Ecosystems are disruptive to their market because it will affect their strategy. If the potential disruptiveness of Tokenized Ecosystems is low, they can ignore it focus on some other upcoming technology. If the potential disruptiveness is high, they can choose to acquire startups and/or build a Tokenized Ecosystem of their own. It is important to have a tool that can assess the potential disruptiveness, because the innovation maturity of Tokenized Ecosystems is constantly changing. Therefore, innovation maturity is the first component of the assessment tool. The component is defined below:

COMPONENT 1: INNOVATION MATURITY

The component of the Tokenized Ecosystem assessment framework that determines the innovation maturity. Innovation maturity is defined as the rate of adoption of the innovation, communicated through channels, among members of a social system.

3.5 TOKENIZED ECOSYSTEMS: VALUE FOR BUSINESSES

Now, whether the application of tokenized ecosystems is actually adding value to an existing business is investigated. If the tokenized ecosystems are disruptive to the market or product/service the business is involved in, there is a chance for that business to develop its own tokenized ecosystem. The business will thereby transform itself into the new paradigm and has a lower chance of failure compared to when it has to battle tokenized ecosystem with a system that is relatively more legacy.

First, a literature review on whether and how tokenized ecosystems have a fit with the current business goals and strategy in 3.4.1. This will give insights for businesses on how to assess whether the application of Tokenized Ecosystems aligns strategically with their business. Since a business can have strategical alignment with the application of Tokenized Ecosystems but could be not ready for that change, it is important to assess its organizational readiness. This is the reason for the second literature review in 3.4.2: whether a business is actually able to implement tokenized ecosystems is explained. even if its application aligns with the goals and processes of the business.

3.5.1 STRATEGICAL ALIGNMENT

The difficulty of realizing value from information technology (IT) investments is firstly due the lack of alignment between the business and IT strategy of the business. Secondly, it is due to a lack of a dynamic administrative process that ensures continuous alignment between the business and IT domains (Henderson, 1993). The Strategic Alignment Model (SAM), developed by Venkataman, is said to help businesses align their business strategy with a proposed IT innovation. It is also said to give insights in how this strategy can be conceptualized and how it could leverage value from the IT innovation on a continuous basis. This model can be helpful for businesses that want to analyse strategical alignment with Tokenized Ecosystems.

The SAM consists of four domains that are the quadrants of 2 axes. The first axis regards the strategic fit, which can be external and internal. The other axis regards the functional integration, which can be within the business domain or within the IT domain. These two axes then produce four domains on the quadrants (Henderson, 1993):

- Business strategy (external strategy, business domain). This domain regards the business scope (what business are you in?), the distinctive competencies (What do you do well to distinguish yourself from competitors?) and business governance (what external business relations do you depend on?).

- IT strategy (external strategy, IT domain). This domain regards the technology scope (what IT support or creates the business opportunity?), the IT competencies (what characteristics of the IT creates business advantage?) and the IT governance (what external relations does the IT depend on?).
- Business infrastructure and processes (internal strategy, business domain). This domain regards the business structure (what is the organizational structure?), the business processes (What are key business processes?) and business skills (what HR resources are required to accomplish the competencies?)
- IT infrastructure and processes (internal strategy, IT domain). This domain regards the IT infrastructure (What are the required hardware, software, databases, networks, etc.?), the IT processes (What does the development, maintenance, operations, etc. look like?) and the IT skills (what skills are required to maintain architecture and execution of processes?).

For businesses it is important to understand whether Tokenized Ecosystems align with their current business strategy and processes. If Tokenized Ecosystems are potentially disrupting the market the business is playing in, it should align its strategy accordingly. Whether there is a fit with Tokenized Ecosystems as an IT on one hand, and the business strategy and processes on the other hand should be assessed. This will prevent bad investments if there is no fit and will provide a conceptualized strategy of how to invest in Tokenized Ecosystems if there is a fit. Therefore, business process fit is a component of the assessment tool. The component is defined below:

COMPONENT 2: BUSINESS PROCESS FIT

The component of the Tokenized Ecosystem assessment framework that determines the business process fit. Business process fit is defined as the situation when Tokenized Ecosystem can be applicable to a businesses and can be aligned with the business strategy.

3.5.2 ORGANIZATIONAL READINESS

Even if the business has a strategical alignment with Tokenized Ecosystems, it must assess whether the business is actually ready to change. The assessment of an organization's readiness for change is a key element in the implementation phase of any IT (NCCMT, 2017). Readiness, or readiness for change can be defined as "the extent to which organizational members are both psychologically and behaviorally prepared to implement change." (NCCMT, 2017). A framework to assess organizational readiness consists of four areas (Holt, 2007): Individual psychological factors, individual structural factors, organizational psychological factors and organizational structural factors. The importance of why every area should be assessed is described (Khan, 2014):

- Individual psychological factors: It is important to assess the beliefs, attitudes, and/or perceptions of individual staff members regarding the intervention.
- Individual structural factors: It is important to assess the knowledge, skills, and/or abilities of individual staff members to deliver the intervention.

- Organizational psychological factors: It is important to assess how effectively staff in the organization work together to achieve a common goal.
- Organizational structural factors: It is important to assess the availability of human (e.g., staff, champions, leaders) and/or material (e.g., information technology, equipment, finances) resources to support the intervention.

For businesses it is important to understand that if Tokenized Ecosystems align with their current business strategy and processes, they should be ready for transitioning towards it. Whether the business is ready for that change it has an organizational fit with Tokenized Ecosystems. An insight in whether a business has an organizational fit with Tokenized Ecosystems will prevent bad investments if the business is not ready yet and will provide factors that the business needs to have before being ready for that change. Also, an organizational fit can give a green light for Tokenized Ecosystem projects and strategies for the business in question. Therefore, organizational fit is a component of the assessment tool. The component is defined below:

COMPONENT 3: ORGANIZATIONAL FIT

The component of the Tokenized Ecosystem assessment framework that determines the organizational fit. Organizational fit is defined as the ability of businesses to apply Tokenized Ecosystem to their business processes and strategy.

3.6 TOKENIZED ECOSYSTEMS: HIGH-LEVEL DESIGN

If a business has a business process fit and organizational fit, it still lacks a high-level overview of tokenized ecosystem design. Before a business can implement a tokenized ecosystem, it would be wise to design a Minimum Viable Product (MVP). An MVP is a fundamental concept within the Lean Start-up methodology and can be defined as a version of a new product, which allows a team to collect the maximum amount of validated learning about customers with the least effort. Thus, by creating an MVP, businesses allow themselves to test tokenized ecosystems with their partners and potential customers without putting in too much effort. However, before a business could design an MVP, a high-level overview of how such a design should look like is required. Tokenized ecosystems can change from use-case to use-case and the its design thus changes accordingly.

Before a business can design a Tokenized Ecosystem thorough understanding of several theories. These are described in the knowledge base in 3.5.1. Then, a business can look at an IT structure that can support Tokenized Ecosystems. These technologies are described in the technology layer 3.5.2. Then there are several building blocks that can be used for specific use-cases. They are provided in 3.5.3 Last, several design tools are described that can be used to create the building blocks. They are shown in 3.5.4.

3.6.1 TOKENIZED ECOSYSTEM KNOWLEDGE BASE

Particular knowledge is required to design Tokenized Ecosystems. This is knowledge that employees of a firm should be knowledgeable of before starting to think about Tokenized Ecosystems. This list provides insight for businesses into what their employees need to learn or what kind of people they need to hire.

Note that these is particular knowledge that might not be obvious. The obvious knowledge that is required to design Tokenized Ecosystems is left out (for example: being able to write code).

Pareto Efficiency

When designing a Tokenized Ecosystem, an attempt is made to design interactions of users that lead to an aggregate outcome that is "socially good". This is a hard task if "socially good" is not defined. When is a protocol 'good', and how is one protocol better than another. What does better mean here?

A criterion could be that the outcome of the social interaction should be *efficient*. This means that resources should be used in an efficient manner. An ideal outcome is now based on two elements: (1) the outcome should maximize total payoff over the other sets of outcomes and (2) the outcome is preferred by an individual over the other sets of outcomes.

This means that a pareto improvement can happen where a change to a different allocation makes at least one individual better off without making others worse off. This can be allocation of goods, funds, services and for example rights; basically, anything that a group of individuals can value. Something is pareto efficient if no additional pareto improvement can happen and the set of allocations is optimal.

Calculating the pareto efficiency of a good or service within a Tokenized Ecosystems is critical because it is a function of maximum utility. A system that does not have pareto efficiency does not run at maximum utility and is undesirable. This makes Pareto efficiency an important and widely accepted standard, but it is also a weak standard. It's a weak standard because there may be many efficient situations and the Pareto test doesn't tell us how to choose between them. That is the main problem with Pareto efficiency, there are individuals that rather act out of self-interest than group interest. This can lead to the tragedy of the commons.

Common-pool resources

A common-pool resource (CPR) is a type of good that consists of a resource system. A group of individuals uses this resource, but it bound to certain limits because unlike public goods, they face problems of overuse. An example of a CPR is a pond that provides fish for a certain group of individuals. Every individual has a certain amount of fish he can catch per time unit. If he catches more fish, the benefits of all other individuals will diminish because the pond cannot produce the same amount of fish anymore. This is the so-called tragedy of the commons.

In her Nobel-prize winning paper, Eline Ostrom describes that the commons can be protected by a small community of consumers of that commons by 8 design principles. If the community followed these design principles, it could succeed in self-regulated management of the resource, without ever overconsuming it. These design principles worked in 'small' communities but could not scale, because they hinged on cheap transaction costs (communities can simply talk to each other) and costly punishment (reputation on the line within a small community).

The transparent and decentralized nature of the blockchain makes it easier for small and large communities to reach consensus and implement innovative forms of self-governance. The possibility to record every interaction on an incorruptible public ledger and the ability to encode a particular set rules linking these interactions to a specific transaction (e.g., the assignment of cryptographic tokens) makes it possible to design new sophisticated incentive systems, which might significantly differ from traditional market-based mechanisms.

Understanding the 8 design principles of Eline Ostrom help design a Tokenized Ecosystem that has pareto efficiency *and* cannot lead to a tragedy of the commons. The design principles are as follows:

1. Define clear group boundaries.
2. Match rules governing use of common goods to local needs and conditions.
3. Ensure that those affected by the rules can participate in modifying the rules.
4. Make sure the rule-making rights of community members are respected by outside authorities.
5. Develop a system, carried out by community members, for monitoring members' behavior.
6. Use graduated sanctions for rule violators.
7. Provide accessible, low-cost means for dispute resolution.
8. Build responsibility for governing the common resource in nested tiers from the lowest level up to the entire interconnected system.

Game theory

When designing Tokenized Ecosystems, the goal is to structure social interactions in a way that leads to Social Order and pareto efficient outcomes. It is important that participants of a Tokenized Ecosystems align their individual desires with that of the group so that the network functions well. A framework is required that can design a system for humans that will act in this way.

Game Theory has developed a large quantity of tools that mathematically and theoretically predicts how people will act, given certain conditions. Game theory is an umbrella term for the science of logical decision making in humans, animals and computers. As game theory can predict what decisions individuals will make based on a specific designed system, it can predict the decisions and actions of token-holders in response to the embedded incentives in the system. As this is to the core of Tokenized Ecosystems, a thorough understanding of Game theory is paramount.

Game theory will provide insights in the intricacies of self-interest vs group interest.

Mechanism Design

An even more relevant knowledge domain to Tokenized Ecosystems is mechanism design. Mechanism design can be thought of as the inverse of game theory. In game theory, we take the game as a given and analyze its outcomes according to players' utilities. In mechanism design we start by defining desirable outcomes and work backwards to create a game that incentivizes players towards those outcomes. Consequently, the theory of mechanism design takes a systematic look at the design of institutions and how these affect the outcomes of interactions. The main focus of mechanism design is on the design of institutions that satisfy certain objectives, assuming that the individuals interacting through the institution will act strategically and may hold private information that is relevant to the decision at hand (Jackson, 2000).

Game theory and mechanism design go hand in hand designing a Tokenized Ecosystem. Game theory is the analyzer, mechanism design the synthesizer.

3.6.2 TOKENIZED ECOSYSTEM TECHNOLOGY LAYER

Business building a Tokenized Ecosystem have to realize that blockchain is only a small part of the solution. For example, blockchains are bad databases and large data files make transactions slow. What works better, is posting pointers on the blockchain that refer to data on an off-chain database. Next to blockchain technology, the following technologies might still be required (depending on the use-case):

- Databases
- (Cloud) Computing

- Networks
- Internet
- Machine learning / predictive analysis
- Robotics
- APIs
- Etc.

3.6.3 TOKENIZED ECOSYSTEM BUILDING BLOCKS

With the right theories and technologies, an overview of building blocks is given. These building blocks can be used in combination to create a Tokenized Ecosystem. A building block is intended to do a single thing and to solve a specific problem. Every use-case uses a different combination of building blocks. Also, a building block can be present in a prominent way within one use-case, and in a minor way within the other.

Identity

First of all, identity is important for Tokenized Ecosystem because the system needs to make sure that identities do not get mixed up. These identities are actually digital identities, because they can represent individuals, but also a device, a thing or for example an organization. The definition of digital identity used here is a set of attributes related to an entity. Digital identities make authentication of entities possible without intervention of human beings.

Identity within Tokenized Ecosystems can be seen in the forms of a Decentralized Identifier (DID), which is a form of self-sovereign identity. This means that the owner of a DID (can be a human or for example an object) has control over the DID, without a central registration. When needed, the owner can decide that his DID will be authenticated. Another form of identity is public-key cryptography. Within a system that uses pairs of keys, public keys can be shared widely, while private keys are only known to the owner. The public key can verify that only the owner of both keys could have sent a message, while only a paired private key can decrypt the message that was encrypted by the public key.

Proofs

Within Tokenized Ecosystems, a community builds and sustains a network and is incentivized through token reward functions. Individuals in such a community must be able to perform tasks over a global network, while being sure that their anonymity is preserved *and* while being sure that the tasks of other individuals actually happened. In other words, as an individual you must be able to proof stuff within Tokenized Ecosystems, without revealing who you are. Also, this proof must be happening in a decentralized way: so, without an intermediary checking it.

Within Tokenized Ecosystems, there are many elements where proofs exist because of intrinsic cryptographic schemes, but the two most important ones are proof of machine work. Let's say that Alice wants some data computed, but only Bob can do that for her. Alice does not know Bob and does not want to share her actual data. Furthermore, they need to be able to prove that this transaction happened to the other peers in the Tokenized Ecosystem, without sharing actual data or other details of the transaction.

With the first kind of proof of machine work, Alice can send Bob encrypted data that he can perform computations on. This proof is critical, because Alice needs to know that her data stayed encrypted and that Bob performed the computation, while Bob needs to know that the computation worked. This proof can be provided by homomorphic encryption. Homomorphic encryption is described in 3.5.4.

The second type of proof of machine work that is required, is to signal that the computation by Bob actually happened. But, in order to preserve anonymity and prevent intermediation, the proof must only state that the computation happened between the two digital identities, not what the computation was or between who this transaction happened. This can be solved by zero knowledge proofs, which is described in 3.5.4.

Consensus

Because Tokenized Ecosystems are based on blockchain technology, there must be a consensus mechanism. This consensus mechanism makes sure that allows users in the network to validate the transactions and update the registry in the entire network without intermediaries (Walburg, 2016).

Curation

Because in a Tokenized Ecosystem, the community maintains a network, there can be no central party that maintains and upholds what is good and what is bad. That is why Tokenized Ecosystems are built by Curation markets, where individuals within a market-like space, can cast their votes on for example the value of assets, or on whether certain behavior of actors is regarded good or bad. This is similar to how markets are organized in the real world as opposed to businesses, whereby individuals follow price signals and cast their votes on products and services which determines its value. Curation within Tokenized Ecosystems can be done in two main ways, binary or continuous.

Binary curation happens through Token Curated Registries (TCRs). TCRs are They are fast becoming one of the hottest “Token Building Blocks” for decentralized blockchain applications (Lockyer, 2018). TCRs are basically listings that are generated by token holders. These lists can consist of actors within a Tokenized Ecosystems or for example simply some hashes (these hashes can theoretically represent anything). A TCR containing a list of actors within a Tokenized Ecosystem can be maintained by some token holders. After the creation of the list, it gets published over the network. The creator of this list, the token holder, must stake some of his tokens towards this list. By writing a smart contract, he puts some tokens within that list that he can only get back when other token holders within a Tokenized Ecosystem approve of that list. When this happens, the initial token holder receives his stake back, together with a bonus as a reward for sharing novel information and knowledge. The more valuable or novel the list, the bigger his reward. Other token holders are also incentivized to cast votes on the correctness of this list, because they can gather a bonus too, although it being smaller than the initial token holder - they do not have the first mover advantage. If the list is faulty or malicious, the initial token holder loses his stake.

If this list contains the digital identities of all token holders within a Tokenized Ecosystems, the community can now decide in a decentralized way which token holders act out good behavior and which ones act out bad behavior. They can vote to opt-out any actor with bad behavior.

Many things can be done with TCRs, as you can build a layered-TCR for example. Within layered-TCRs, token holders discrete-valued membership, where token holders can increase their rank (layer), and with it, their rights and responsibilities (Trent, 2018). These lists can be staked, but also be determined by ‘amount of time spent by doing ...’, or for example whenever a token holder has added some value.

Token Standards

Tokenized Ecosystems consists of multiple tokens, working together in a micro-economy. There are many variations and theories about the different types of token. During writing, the lists and definitions of tokens changed per week. That is why only the most relevant are described in this section. An overview of the

current knowledge of Tokens is provided in figure X (Samani, 2018) and they thoroughly described in the article by Pereira (Pereira, 2018).

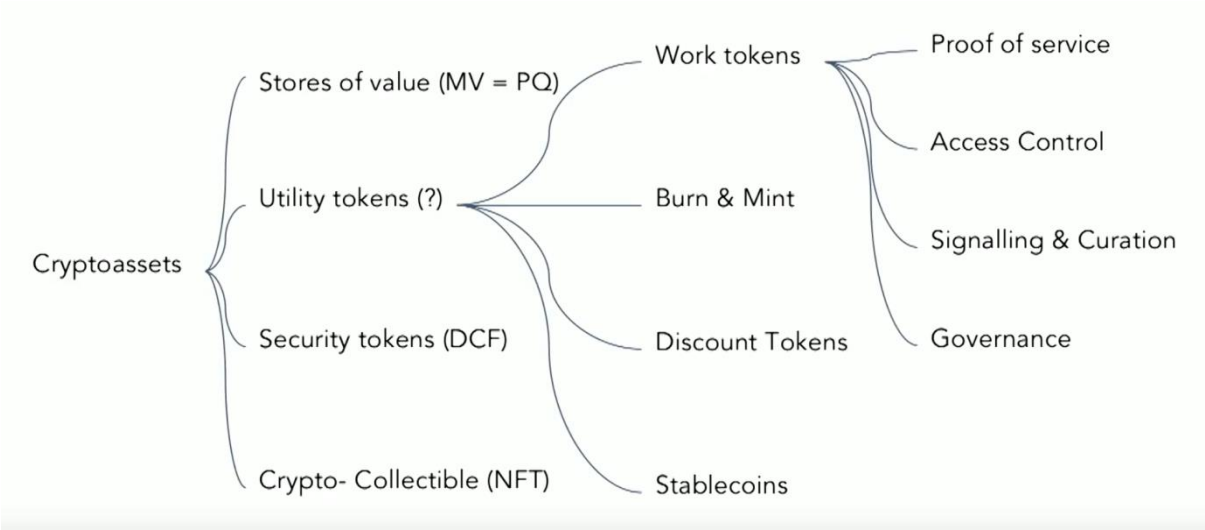


Figure 18: An overview of Token Standards (Samani, 2018)

Stores of value are similar to how Cryptocurrencies are described in chapter 1.1.2. They are general-purpose tokens with independent, free-floating monetary bases. They should be valued using the equation of exchange (which is $MV = PQ$, the token supply times its volatility is the same as its price times its real expenditure), in the prism of quantity theory of money (Pereira, 2018).

Security Tokens are similar to how Tokenized Securities are described in chapter 1.1.2. They represent physical or digital assets and are valued based on the Discounted Cash Flow (DCF), which is a method to assess its value based on future value (Cunningham-Green, 1965).

Crypto-Collectible can also be called Non-Fungible Tokens (NFT) and represent a single entity. This can for example be a piece of art, or the digital representation of a unique baseball card. An NFT token cannot simply be swapped with another NFT (which is the definition of an NFT) because they are not the same. You can swap a dollar for any other dollar, but you cannot swap a baseball card, for any other baseball card. Therefore, the value of an NFT depends on the value of that single and unique NFT, which is based on for example its scarcity, perceived prettiness and perceived value.

Utility Tokens are similar to how I described them in chapter 1.1.2. An additional definition is that utility tokens are Tokens which are uniquely required to incentivize or disincentivize behavior in order to provide a service accrue value relative to that services utility (Duncan, 2018).

Stablecoins are tokens that have a relatively very stable value with low volatility. Stablecoins have long been hailed as the holy grail of cryptocurrencies (Pereira, 2018). There are two approaches to achieving stability: issuing real-world-asset-pegged tokens, where for example a token always follows the price of a real-world currency like the dollar; and algorithmically expanding or contracting the supply of a token according to its usage, which can be referred to as “seignorage shares”.

3.6.4 TOKENIZED ECOSYSTEM DESIGN TOOLS

In order to create the building blocks described in 3.5.3, the designers of a Tokenized Ecosystems need tools to design them. Again, there are many design tools that can be used and knowledge and consensus about them changes every week. At the time of writing, these were the most relevant, and timeless ones:

Hash functions

A hash function creates a string of text out of any arbitrary data by using a cryptographic function called Hash-based-Message-Authentication-Code, or HMAC (Krawczyk, 1997). The produced string can only resemble a single piece of data and only links to it. This means that only if you have the original data and its hash function, you know for sure they link to each other. This also means that if you only have a hash function, you can never know what the data represents.

If a piece of text is hashed, for example "Hello World" it will create a hash function that can look like this: 35d91262b3c3ec8841b54169588c97f7. If only a single character is added, by for example adding an exclamation mark: "Hello World!"; the hash could look something like this: ff6626c69507a6f511cc398998905670. This means that any hash is basically completely different from any other hash, even if the original datasets are extremely similar.

Homomorphic encryption

With homomorphic, computation can be done on encrypted data in such a way that when the data gets decrypted, computed data is retrieved. In other words, computation on encrypted data would deliver the same results when decrypted as if the computation on data would happen if it would have never been encrypted.

Fully homomorphic encryption has numerous applications. For example, it enables private queries to a search engine - the user submits an encrypted query and the search engine computes a succinct encrypted answer without ever looking at the query in the clear. It also enables searching on encrypted data - a user stores encrypted files on a remote file server and can later have the server retrieve only files that (when decrypted) satisfy some boolean constraint, even though the server cannot decrypt the files on its own. More broadly, fully homomorphic encryption improves the efficiency of secure multiparty computation (Gentry, 2009).

3.6.5 THE DESIGN COMPONENT

Concluding, there are many different design options that a business must take into regard. These design options are put in different sections. The knowledge base describes the theories the business must be knowledgeable of before it can start to design a Tokenized Ecosystem. It refers to the theoretical capabilities of a company. The technologies that a business must be knowledgeable of are described in the technology layer. Then there are several building blocks that can be used for specific use-cases. Last, several design tools are described that can be used to create the building blocks. A clear overview of all these design options is critical for a business to understand what is required for the design of a Tokenized Ecosystem

COMPONENT 4: HIGH-LEVEL DESIGN

The component of the Tokenized Ecosystem assessment framework that provides a high-level design overview of all options that are required for the design of a Tokenized Ecosystem

3.7 ALL COMPONENTS OF THE TOKENIZED ECOSYSTEM ASSEMENT TOOL

The theoretical background provided four components that are important to incorporate in the Tokenized Ecosystem assessment tool. These four components are the basis for the empirical data gathering in Chapter 4 Requirements Definition. The four components are summarized in figure 20.

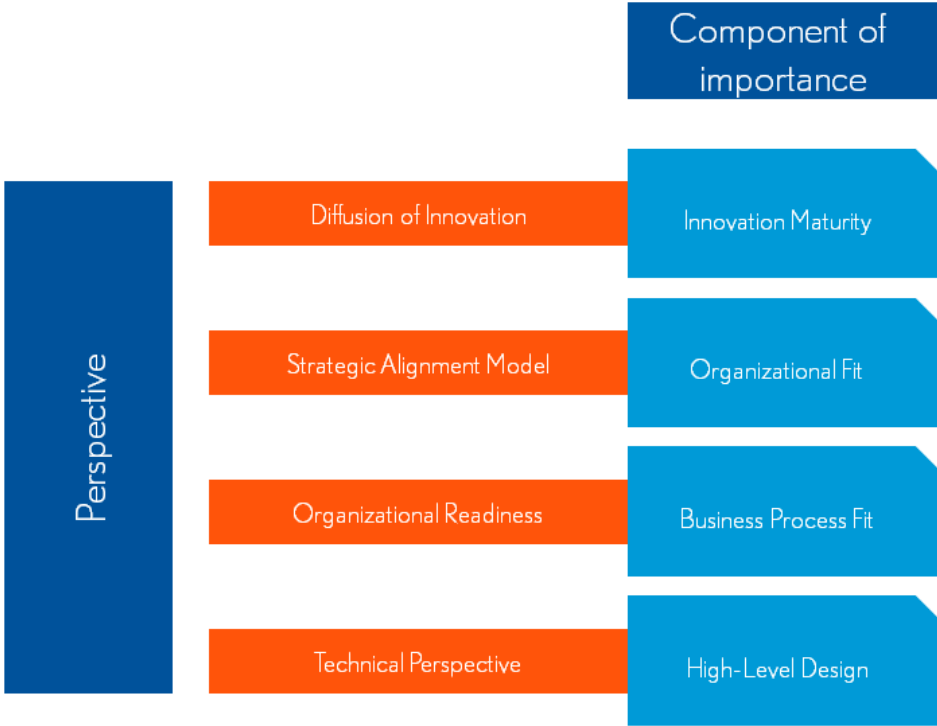


Figure 19: An overview of important components

DEFINITION OF REQUIREMENTS

GOAL

Concretizing the Tokenized Ecosystem assessment tool components that were identified in the literature review. This chapter produces requirements for the tool that are based on theoretical and empirical evidence.

PROCESS

Empirical research will be conducted by interviewing industry experts within the field of blockchain technology. The relevant experts were found through an interviewee selection process. The experts were asked about their opinion regarding the potential disruptiveness of Tokenized Ecosystems and its business processes. The audio recording of their answers were transcribed, coded and qualitatively analyzed. The following research question is answered:

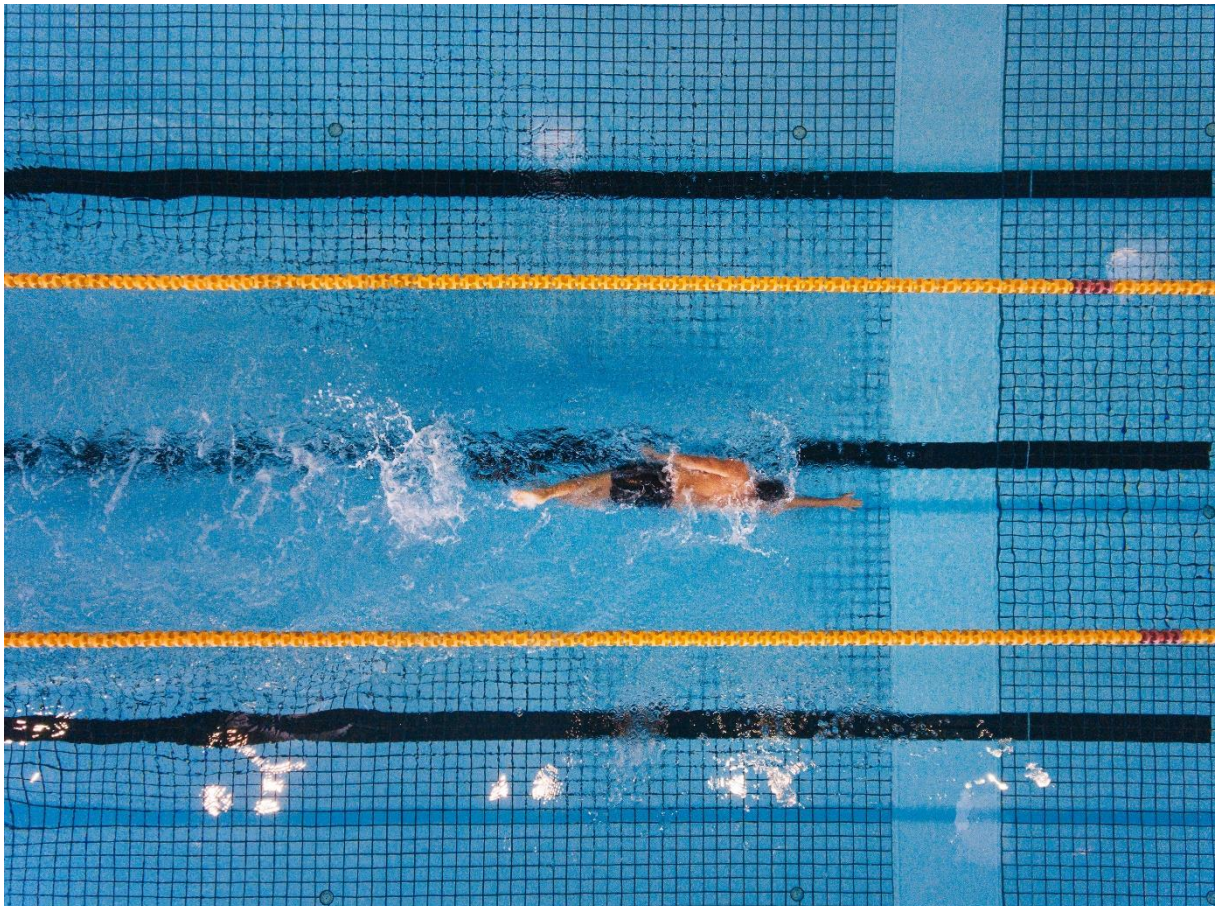
What are the requirements for a tokenized ecosystem assessment tool that improves decision-making for businesses?

KEY RESULTS

- The Tokenized Ecosystem assessment tool must be able to determine the technological maturity, which is based on the *complexity, compatibility, scalability, transaction volume* and *energy usage* of the technology, and the ecosystem maturity, based on the *enterprise readiness, interoperability capabilities, cross-functional knowledge competencies* and *diffused sense of importance* within the ecosystem, involved in markets potentially being disrupted by Tokenized Ecosystems.
- The Tokenized Ecosystem assessment tool must be able to determine the business process fit regarding the application of Tokenized Ecosystems, which is based on the *internal- and external strategy* and the *internal- and external infrastructure*.
- The Tokenized Ecosystem assessment tool must be able to determine the organizational fit regarding the application of Tokenized Ecosystems, which is based on the *individual psychological factors, individual structural factors, organizational psychological factors* and *organizational structural factors*.
- The Tokenized Ecosystem assessment tool must be able to provide a high-level design overview of Tokenized Ecosystems in order to develop a Minimum Viable Product. This consists of a *knowledge base, a technology layer, building blocks and design tools*.

**“Tokenized Ecosystems
are about transformation
and businesses either face
potential disruption, but
can also play part in it”**

Rutger van Zuidam, CEO of DutchChain



4. REQUIREMENTS DEFINITION

An overview of how the concretization of the components from chapter 3 will be concretized can be seen in figure x. The previous research phase produced 5 components during the literature review in the theoretical background. These are the five components that need to be present in the assessment tool but require concretization. In order to concretize these components, empirical data is gathered by conducting explorative expert interviews. Based on the components, the questions for these interviews are outlined.

An overview of this research phase is described in 4.1. The concretization of the four components are described in 4.2 until 4.5. An overview of the requirements for the assessment tool is provided in 4.6. Finally, the chapter will conclude in 4.7, during which the research question will be answered.

4.1 REQUIREMENTS OVERVIEW

An overview of how the concretization of the components from chapter 3 will be concretized can be seen in figure 21. The previous research phase produced 4 components during the literature review in the theoretical background. These are the five components that need to be present in the assessment tool but require concretization. In order to concretize these components, empirical data is gathered by conducting explorative expert interviews. Based on the components, the questions for these interviews are outlined.

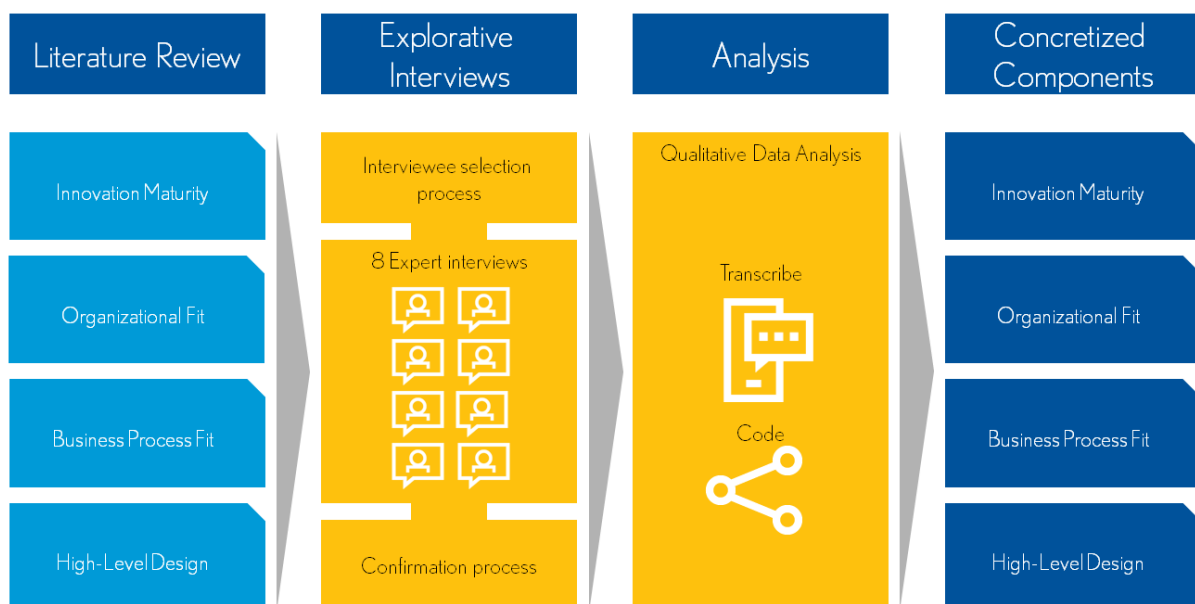


Figure 21: An overview of the concretization process

4.2 CONCRETIZING THE INNOVATION MATURITY COMPONENT

Whether or not Tokenized Ecosystems will disrupt the market and/or products and services of a business, depends on the innovation maturity of Tokenized Ecosystems. Innovation maturity is defined as the rate of adoption of the innovation, communicated through channels, among members of a social system. This component was found by looking at the disruptiveness of Tokenized Ecosystems through the theory of diffusion of innovation. Expert interviews were conducted to concretize when Tokenized Ecosystems reach

innovation maturity. First, the findings from the literature review are summarized in 4.2.1. This summary is then followed by insights from empirical evidence in 4.2.2. Finally, the component will be concretized by a comparison between the theoretical and empirical method, in 4.2.3.

4.2.1 LITERATURE REVIEW INSIGHTS

By using a basis in diffusion of innovation theory, the innovation maturity of Tokenized Ecosystems can be determined by (1) the innovation, (2) the communication channels, (3) time, (4) the social system and (5) the adapters.

1. Innovation. Tokenized Ecosystems are accepted as a new technology based on its *relative advantage, compatibility, complexity, trial ability and observability* (Rogers, 2003)
2. Communication channels. Tokenized Ecosystems are accepted as a new technology based on the process by which participants create and share information to one another in order to reach a mutual understanding (Rogers, 2003)
3. Time. Tokenized Ecosystems are accepted as a new technology based on the time taken to adopt an innovation by the adopter and the adoption rate across the social system (Rogers, 2003)
4. Social system. Tokenized Ecosystems are accepted as a new technology based on the set of interrelated social units (e.g. individuals, informal groups, organizations) that are engaged in problem solving to achieve a common goal. (Rogers, 2003)
5. The adapters. Tokenized Ecosystems are accepted as a new technology based on which category of adapters is currently accepting the technology.

4.2.2 Explorative expert interview insights

When asked about the potential disruptiveness of Tokenized Ecosystems there appeared to be consensus within the group of expert interviewees. They stated that in theory, no market or business was protected from Tokenized Ecosystems. The added benefit of Tokenized Ecosystems was clear for the experts.

I don't think any business is protected. You can look at pretty much every industry: from education to media and banking. Wherever you go, there are opportunities for startups to create models which change the motion of value, cost, speed or risk, etcetera. Some of the aspects of blockchain arguably make that more attractive: things like identity, trust and certainly in the way of the creation, replication and transmission of assets. And obviously you are doing this in a decentralized context.

However, all interviewees agreed that Tokenized Ecosystems currently cannot lead to actual disruption. Because blockchain technology is a critical part of Tokenized Ecosystems, they are currently not well developed to provide the promised value. For example, it is impossible to transact in large quantities and the energy cost is too high for Tokenized Ecosystems to flourish as a technology. Most of the experts have stated that this is a critical limitation of the technology, but that scalability solution will appear over time.

A challenge to build Tokenized Ecosystem is with regards to the technology itself. Although it's being hyped a lot, the technology is still very much in its infant state. However, scalability is not an issue, because we do have scalability solutions, we just don't have consensus yet on what is the best solution. Also, it completely depends on the use-case you are building. Yes, the technical hurdles are there, but there are none of my worries since they are the easiest one to overcome. Especially with ecosystems this big.

Next to the technological maturity of Tokenized Ecosystems, some experts pointed out that the maturity of the ecosystem is critical for the acceptance of the technology. The startup scene currently building

Tokenized Ecosystem cannot survive without the help of companies. The incumbent firm has a lot of power to block the innovation and a lot of resources to help the innovation.

The challenge is the acknowledgement that this change needs to happen and empower people and businesses that acknowledge this with the right resources and economic incentives to grow in a faster way than that they can now grow in the financial and hierarchical structures of these incumbent worlds. The incumbent firms have an enormous amount of knowledge, a strong network, existing processes, high accuracy and are very efficient. They have managed to lower the risk of a lot of things. Whereas the startups have novel solutions, are really creative and are high risk – high reward. The trick is to create an ecosystem where both work together to accomplish greater things. They both need to realize that they are equally important to co-create the future. Without this type of ecosystem, Tokenized Ecosystems have a low chance of being disruptive.

Because of the complex nature of Tokenized Ecosystems, most experts have pointed out that a lot of different sectors and fields of expertise have to work together to create Tokenized Ecosystems.

We now enter a world where cross-functional knowledge is more important than ever. We need IT'ers that understand governance, risk and compliance. We need lawyers who understand IT. We really need to understand the effect of disintermediation and decentralization, especially with regards to creating sustainable business models.

Last, an insight was given about the potential disruptiveness of Tokenized Ecosystem. Some experts stated that disruption was the wrong word, as it implies that the incumbent firm will not be a part of a newly formed market or product/service.

It's not about disruption at all, but this is about transformation. Businesses will be disrupted however, only because they do not acknowledge that this transformation is going on. It's not about disruption, because there is a role for them to play as well in this new paradigm, as long as they acknowledge it is there.

4.2.3 CONCRETIZING INNOVATION MATURITY

By analyzing the responses from the expert interviews quantitatively, the component of innovation maturity can be concretized. The innovation maturity component is found to be two-dimensional. First, technological maturity plays a role in determining the potential disruptiveness of Tokenized Ecosystems. Second, ecosystem maturity is another determinant in assessing the potential disruptiveness of Tokenized Ecosystems. A comparison of the two research methods to explain the potential disruptiveness, being theoretical and empirical, is provided in table 1. Note that according to the experts, technological maturity accounts to only a portion of the potential disruptiveness of Tokenized Ecosystem. The influence the maturity dimension has on potential disruptiveness is given on a 3-level scale from small, to medium, to large.

Table 4: Concretized Innovation Maturity Component

| Innovation Maturity Dimension (degree of influence on potential disruptiveness) | Theoretical based elements | Empirical based elements |
|---|---|---|
| Technological Maturity (medium influence) | <i>complexity</i> | Complexity |
| | <i>compatibility</i> | Compatibility |
| | | Scalability |
| | | Transaction volume |
| | | Energy usage |
| Ecosystem Maturity (large influence) | <i>Adapters</i> | Enterprise readiness |
| | <i>trial ability, observability, communication channels</i> | Interoperability capabilities |
| | <i>Communication channels, social systems</i> | Cross-functional knowledge competencies |
| | <i>relative advantage, communication channels, social systems</i> | Diffused sense of importance |

The innovation maturity component of the assessment tool has the following requirement:

The Tokenized Ecosystem assessment tool must be able to determine the technological maturity, which is based on the complexity, compatibility, scalability, transaction volume and energy usage of the technology, and the ecosystem maturity, based on the enterprise readiness, interoperability capabilities, cross-functional knowledge competencies and diffused sense of importance within the ecosystem, involved in markets potentially being disrupted by Tokenized Ecosystems.

4.3 CONCRETIZING THE BUSINESS PROCESS FIT COMPONENT

The literature review provided several factors that determine whether there is a fit between Tokenized Ecosystems and the business processes of a particular business. Expert interviews were conducted to concretize this component. First, the findings from the literature review are summarized in 4.3.1. This summary is then followed by insights from empirical evidence in 4.3.2. Finally, the component will be concretized by a comparison between the theoretical and empirical method, in 4.3.3.

4.3.1 LITERATURE REVIEW INSIGHTS

Literature on business processes and the fit with Tokenized Ecosystems is limited because Tokenized Ecosystems are such a new phenomenon. The business process fit can be determined whether there is a strategic fit (which can be internal and external) and whether there can be integration with Tokenized Ecosystems regarding the IT domain or the business domain.

4.3.2 EXPLORATIVE EXPERT INTERVIEW INSIGHTS

Some experts have pointed out that Tokenized Ecosystems will disrupt the workspace of a business. Tokenized Ecosystems will add value in the sense that it could make the allocation of human capital cheap and efficient.

Basically, any type of company that uses transactions can tokenize them, but the token must have an added value of some sort. This will disrupt the working space; how we deal with contracts of users and employees. The real disruption for a business would be that the most employees come from one country, but with Tokenized Ecosystems you could set up a global payment system without having to go through payment systems or international banks.

Most experts pointed out that once there are middleman or intermediaries within a business process, they potentially hinder the value chain of that business process by adding friction to it. This friction can then only be solved by these intermediaries and ask commission for it. Meaning, if the only way to transfer value from A to B, is through C, then a business can earn money by simply positioning themselves at C. When there are processes where intermediaries play a role, there is a potential fit with Tokenized Ecosystems.

One of the biggest costs is having an intermediary that either is doing you a service that is beneficial or is doing you a service because that's how it has always been done and they have created a certain role in the market.

Some experts provided the insight that in order for a business to have a business process fit with Tokenized Ecosystems, it needs to be clear that certain assets and/or processes are tokenizable.

You have to look at their assets first and if they can tokenize them. If they can manage to open up their asset base towards a tokenized crowd, Tokenized Ecosystems are possible. The value capture of operating that process would go down as this crowd grows and builds up the infrastructure on behalf of the business, but the value of the business would go up as maintenance to any network has become more efficient and the network has grown in value. So, the question is, can they convert assets to local communities that maintain it?

Lastly, some experts mentioned that businesses were more suitable for Tokenized Ecosystems if there is collaboration with other businesses. The transformation towards Tokenized Ecosystems does not happen from business to business, but from multiple businesses at the same time, working together to create Tokenized Ecosystems.

You cannot just launch a project for Tokenized Ecosystems, you need to create a separate type of entity, where you will not decide on the business model and where you just want to find a way on how to make this movement successful with regards to the vision and mission of that project. You immediately need to acknowledge that this is not about your business model, you have to start to think in the way of ecosystems. The basic understanding is that you can create this radical change not from within but from outside.

4.3.3 CONCRETIZING BUSINESS PROCESS FIT

By analyzing the responses from the expert interviews quantitatively, the component of business process fit can be concretized. The business process fit can be determined by assessing whether there is a strategic fit (which can be internal and external) and whether there can be integration with Tokenized Ecosystems regarding the IT domain or the business domain.

The component produced by the literature review proposed that these four domains were critical in order to assess the business process fit and is concretized by adding elements found in the expert interviews. They are listed in table 2.

Table 5: Concretized business process fit component

| | |
|---------------------------|--|
| Strategy (business) | Strategy towards transformation |
| | Collaboration competencies |
| Strategy (IT) | Own value capture as intermediary |
| | Openness of assets |
| Infrastructure (business) | Cost of intermediaries |
| | Possibility of decentralization of processes |
| Infrastructure (IT) | Possibility of asset tokenization |

The Tokenized Ecosystem assessment tool must be able to determine the business process fit regarding the application of Tokenized Ecosystems, which is based on the internal- and external strategy and the internal- and external infrastructure.

4.4 CONCRETIZING THE ORGANIZATIONAL FIT COMPONENT

For businesses it is important to understand that if Tokenized Ecosystems align with their current business strategy and processes, they should be ready for transitioning towards it. Whether the business is ready for that change depends on whether it has an organizational fit with Tokenized Ecosystems. Insights in whether a business has an organizational fit with Tokenized Ecosystems will prevent bad investments if the business is not ready yet and will provide factors that the business needs to have before being ready for that change. Also, an organizational fit can give a green light for Tokenized Ecosystem projects and strategies for the business in question. Therefore, organizational fit is a component of the assessment tool and was produced by literature review. The component was concretized by expert interviews. First, the findings from the literature review are summarized in 4.4.1. This summary is then followed by insights from empirical evidence in 4.4.2. Finally, the component will be concretized by a comparison between the theoretical and empirical method, in 4.4.3.

4.4.1 LITERATURE REVIEW INSIGHTS

A framework to assess organizational readiness consists of four areas (Holt et al, 2009): Individual psychological factors, individual structural factors, organizational psychological factors and organizational structural factors. The importance of why every area should be assessed is described (Khan et al, 2014):

- Individual psychological factors: It is important to assess the beliefs, attitudes, and/or perceptions of individual staff members regarding the intervention.
- Individual structural factors: It is important to assess the knowledge, skills, and/or abilities of individual staff members to deliver the intervention.
- Organizational psychological factors: It is important to assess how effectively staff in the organization work together to achieve a common goal.
- Organizational structural factors: It is important to assess the availability of human (e.g., staff, champions, leaders) and/or material (e.g., information technology, equipment, finances) resources to support the intervention.

4.4.2 EXPLORATIVE EXPERT INTERVIEW INSIGHTS

One expert made the notion that a readiness model created value for a business that wants to assess whether it is capable for a transformation towards Tokenized Ecosystems.

You need to create a readiness model for the organization. It is a bit like business capability modelling for enterprise architecture. You have to be able to assess what that looks like, create a model, and play in the various metrics including funding, knowledge and sense. You then come out with a score that determines your capabilities to make those changes.

All experts have pointed out that the business in question that is taking Tokenized Ecosystems in consideration should have capacity to innovate.

I have to look at the innovation capacity the organization has and the readiness to change. If they have no desire to innovate, they have very poor or limited change management or transformational capabilities.

Most of the experts have pointed out that an individual that pushes the innovation is required in an organization. This individual should lead the others within the company and convince them of the benefits of Tokenized Ecosystems.

You need to have people that are really thinking outside of the box. I see a lot of the technology being pushed by internal process improvement, maybe ecosystem improvements but not willing to really radically think different like we ever did before. This is about self-cannibalization in the end. As soon as we start cannibalizing on existing business, then whole different forces start to play and that is just plain old internal politics because no one wants to give up a department of 100 FTE because that means they have less power. In the end it comes down to individuals and egos.

Strong visionary leadership is required, but in a humble and supportive way. Strong leadership does not mean they have the ultimate decision here. Strong means you can be persistent, because when there is change there is also a lot of resistance.

However, whether there is an individual within the company leading the innovation does not matter if there is no support from the board. Without the board the innovation becomes a trivial project within or even out of the strategy scope of the business. The board must be convinced of Tokenized Ecosystems being the next step for the business transformation.

if you have no support in the board whatsoever, it's never going to fly. You need a believer in the board, otherwise you just get some funding and a nice press report. The problem is the innovation centers of all the incumbents because somebody in the board says that innovation is important. So, they allocate a budget in 'the innovation thing' and give a press release and that's it because they don't take it seriously. That's the problem if you don't have the backing from the top.

Furthermore, experts had contrasting views regarding whether a business had an IT infrastructure that could support a transformation towards Tokenized Ecosystems. Some said that it did not matter how far behind they were on the path towards digitization, because it mattered more if they had issues trusting third parties. For these businesses, Tokenized Ecosystems would add even more value because it actually solves current problems.

Businesses that are behind right now can come on top at the end because they don't have the disadvantage of the law of diminishing returns. This is what we actually see, especially in certain areas or countries where the third parties can be less trusted. In well developed countries, it's harder to implement these kinds of things than less developed countries. I do foresee that in areas like South America, Africa and Asia, things can move much faster than in Europe and the US. Even in Europe we can make a distinction between north and the rest of Europe basically. Although it's quite interesting looking at the trust perspective and the efficiency in the Netherlands it doesn't make sense to go decentralize business models. Because in the Netherlands everything is, despite what we think, arranged very well, very cheap etcetera. Taking out a trusted third party, there is not really a need in that because the trusted third party are very trustworthy. We have quite an innovate country, so we are working on it quite a bit already so that's quite interesting to see as well. In the end they (countries or businesses that are behind) could leapfrog basically from the digital stone-age to the next phase.

Other experts disputed this by saying that leapfrogging into that a new paradigm, without thorough understanding of digitization and/or decentralization is likely impossible.

If you are already working on digitization and you are familiar with open source, one would assume that the adoption of for example blockchain - at least from a mind-set perspective - is easier to understand. But if you are still working with mainframe and paper it's likely to be a bridge too far to jump into some of the concepts that blockchain might have. I guess we deal with organizations that have reached a point where in a sense taking that leap is not palatable because the alternative is the fact that their current systems and processes are basically dead anyways.

Most experts said it was important for the business to understand that in order to transform, or at least in order to understand what factors are required for transformation, they must have a willingness to let go of some processes. This means there needs to be a willingness to self-cannibalize, to let go of some profit-generating business process in order to open up resources for new business processes. It also means that people need to be willing to give up their current job in the prospect of having a position in a new paradigm.

There also needs to be a willingness to cannibalize, but in the right perspective: acknowledge that any ecosystem needs an autumn and a winter. This means that during autumn, some parts of the business die off in order to make room for new parts that can grow during spring. These parts can be developed during a winter season of a business or ecosystem.

4.4.3 CONCRETIZING ORGANIZATIONAL FIT

By analyzing the responses from the expert interviews quantitatively, the component of organizational fit can be concretized. The organizational fit can be determined by assessing the individual psychological and structural factors, and by assessing the organizational psychological and structural factors.

The component produced by the literature review proposed that these four domains were critical in order to assess the business process fit and is concretized by adding elements found in the expert interviews. They are listed in table 3.

Table 6: Concretized organizational fit component

| | |
|--------------------------------------|--|
| Individual psychological factors | Willingness to self-cannibalize |
| | Openness towards decentralization |
| | Flexibility |
| Individual structural factors | Innovation capacity |
| | Current blockchain knowledge |
| | Current understanding of decentralization |
| Organizational psychological factors | Willingness to self-cannibalize |
| | Openness towards decentralization |
| | Support from the board |
| Organizational structural factors | Presence of a persistent transformational leader |
| | Current IT architecture |
| | Inter-organizational collaboration |

The Tokenized Ecosystem assessment tool must be able to determine the organizational fit regarding the application of Tokenized Ecosystems, which is based on the individual psychological factors, individual structural factors, organizational psychological factors and organizational structural factors.

4.5 CONCRETIZING THE DESIGN COMPONENT

This section regards the concretization of the design component of the assessment tool. The design component was identified in the literature review and regards a high-level design overview of any specific Tokenized Ecosystem that will help to create a testable Minimum Viable Product. The high-level design overview puts forth all the factors that might be required in a Tokenized Ecosystem design. In the literature review it was found that Tokenized Ecosystems change from use-case to use-case and the its design and required factors thus changes accordingly. However, by conducting expert interviews it was found that Tokenized Ecosystems are so complex, that almost with every use-case, all factors of described in the high-level design overview are required to develop a well-functioning Tokenized Ecosystem.

First, the findings from the literature review are summarized in 4.5.1. This summary is then followed by insights from empirical evidence in 4.5.2. Finally, the component will be concretized by a comparison between the theoretical and empirical method, in 4.5.3.

4.5.1 LITERATURE REVIEW INSIGHTS

The high-level design overview consists of four layers: a knowledge base, a technology layer, building blocks and design tools.

Before a business can design a Tokenized Ecosystem, thorough understanding of several theories is required. These are described in the knowledge base. These can be seen as required competencies within a business before you can start to design a Tokenized Ecosystem. Then, a business can look at an IT infrastructure that can support Tokenized Ecosystems. The required technologies within the IT infrastructure are described in the technology layer. There are several building blocks that can be used for specific use-cases. With these building blocks, any Tokenized Ecosystem can be built. In order to create these building blocks, design tools are required.

4.5.2 EXPLORATIVE EXPERT INTERVIEW INSIGHTS

All the experts were convinced that the factors that were found in the literature review were critical for any Tokenized Ecosystem. The experts recalled every factor and explained that the tool should not opt-out any of the factors within the high-level design overview.

You want to look for token designs that accomplish these things. If you can predict the outcomes we know what the incentives should be. Game theory is one of the theories used here. Other things that are required are for example things that incentivize early-mover advantage, token curated registries, curation markets, non-fungible tokens, all types of work tokens, governance tokens, stable coins.

The stable coins measure a collateral base and they mint accordingly. These are really interesting for companies, because if you have an infrastructure and everything has an NFT, and you have a token that measures that value and responses accordingly to that collateral base then you have under writing, which can be virtual and physical. You need mechanism design to employ it.

Game theorists are scarce and theoretical, mechanism design is the synthesis of these things, but you have to put them in practice. You have to test these primitives.

Blockchain in itself is hardly ever the solution. If you really want to disrupt the way we are doing business right now, you make a combination between basically three main technology groups. One is that we have a good working and reliable IoT environment, in combination with blockchain and Big Data analytics or Artificial Intelligence. The combination of those can be very powerful. In the end that will result in the most beautiful use cases.

Next to consensus mechanisms we need a trustworthy digital identity. As soon as we are going to do IoT integration, identity goes much further than personal identity but also object identity etcetera. So that is something we need to build up as well. A trustworthy digital identity, interoperability between coins and some sort of stablecoin in order to perform payments so we can do last month's payments. Those are very important.

Any form of cryptography is useful. Being public-private key cryptography, homomorphic cryptography, etc. Homomorphic is that we can share encrypted data with each other, perform calculations on the encrypted part and decrypt it to get the result, without sharing all the various parts. Zero knowledge proofs, where we can prove something without showing what we have proven. Whether the proof happened or not is zero-knowledge proof. Zero-knowledge range proof has a spectrum instead of a binary outcome.

We also need compression techniques, sharding techniques, in order to make sure that the amount of data that goes over isn't going to be too extensive.

Next to blockchain technology, through which the tokens flow, the measurement of value capture and trying to slash and incentivize. Around that are all the resources, the off-chain resources that proof that they did something on-chain. They take the computing off-chain and proof that a compute actually happened on the right data, with the right instructions, and that proof goes on-chain. So, you have proof of compute, rather than on-chain compute.

For Tokenized Ecosystems, businesses need to ask the question of whether they can design the rules, like the legal and regulatory stuff? These are all important questions when you think of required competencies. Are there ministries and media channels, as you need very good communication skills. Stakeholder management, being able to work in public-private partnerships. You need business development, you need entrepreneurs, innovation managers, designers, token engineers, etc. For a tokenized Ecosystem to flourish, you need a very big ecosystem with many partners involved.

4.5.3 CONCRETIZING HIGH-LEVEL DESIGN

The experts named the same Tokenized Ecosystem high-level design overview factors, as the ones that were found in the literature review. This component was not further concretized because the experts endorsed it. However, the notion that the high-level design overview changes from use-case to use-case was disputed. Namely, the factors within every layer of the high-level design overview are required for every use-case and should not be ignored.

The Tokenized Ecosystem assessment tool must be able to provide a high-level design overview of Tokenized Ecosystems in order to develop a Minimum Viable Product. This consists of a knowledge base, a technology layer, building blocks and design tools.

4.6 OVERVIEW OF REQUIREMENTS OF THE ASSESSMENT TOOL

The deliverable of this thesis is a tool that provides insights for businesses regarding the application of Tokenized Ecosystems. For the design of this tool, the following components are required:

1. The Tokenized Ecosystem assessment tool must be able to determine the technological maturity, which is based on the *complexity, compatibility, scalability, transaction volume* and *energy usage* of the technology, and the ecosystem maturity, based on the *enterprise readiness, interoperability capabilities, cross-functional knowledge competencies* and *diffused sense of importance* within the ecosystem, involved in markets potentially being disrupted by Tokenized Ecosystems.
2. The Tokenized Ecosystem assessment tool must be able to determine the business process fit regarding the application of Tokenized Ecosystems, which is based on the *internal- and external strategy* and the *internal- and external infrastructure*.
3. The Tokenized Ecosystem assessment tool must be able to determine the organizational fit regarding the application of Tokenized Ecosystems, which is based on the *individual psychological factors, individual structural factors, organizational psychological factors* and *organizational structural factors*.

4. The Tokenized Ecosystem assessment tool must be able to provide a high-level design overview of Tokenized Ecosystems in order to develop a Minimum Viable Product. This consists of a *knowledge base, a technology layer, building blocks and design tools*.

Furthermore, because the tool intends to improve decision-making of business regarding the application of Tokenized Ecosystems, the tool must accomplish the following things:

- The Tokenized Ecosystem assessment tool is used as an initial assessment for business that explore the applicability of Tokenized Ecosystems for their business processes
- The Tokenized Ecosystem assessment tool should be effective in the sense that the insights provided actually help the business with their decision-making and that these insights were easily obtained.
- The Tokenized Ecosystem assessment tool should provide a business with a fundamental strategy they can adhere to.

4.7 CONCLUSION

This chapter described how the Tokenized Ecosystems assessment tool components, that were found in the literature review, were concretized with empirical evidence. The concretization process was done by conducting expert interviews. This chapter answers the third research question: *What are the requirements for a tokenized ecosystem assessment tool that improves decision-making for businesses?* First, the Tokenized Ecosystem assessment tool must be able to determine the innovation maturity of Tokenized Ecosystems because that determines whether Tokenized Ecosystems will actually disrupt the business processes of the incumbent business. The Tokenized Ecosystem assessment tool must be able to determine whether there is a fit between their business processes and Tokenized Ecosystems because it gives them insights in whether they can play a role in this potential new paradigm. The Tokenized Ecosystem assessment tool must be able to determine whether there is an organizational fit between the business and Tokenized Ecosystems because it gives them insights in whether there is organizational readiness to transform to that potential new paradigm. Last, the Tokenized Ecosystem assessment tool should provide the business with a high-level design overview that helps with the design of a Minimum Viable Product.

The produced concretized components from this chapter will serve as design requirements in the next chapter, where the Tokenized Assessment tool will be designed.

DESIGN

GOAL

To design the Tokenized Ecosystem assessment tool that will help businesses to regard Tokenized Ecosystems as an application to their business processes

PROCESS

This section describes the design methodology that was used to design the Tokenized Ecosystems assessment tool. A bottom-up design approach was used. The design process was an iterative and incremental design process. Every design iteration used a diverge and converge method.

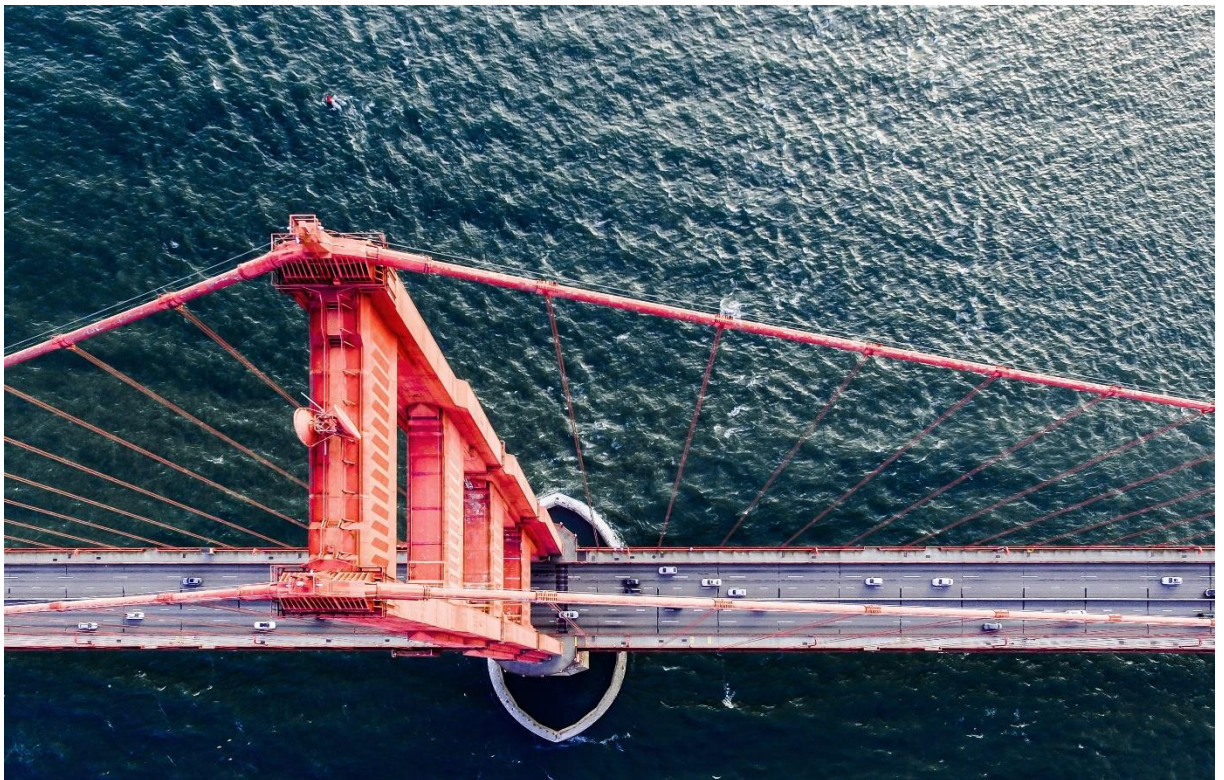
KEY RESULTS

- The Tokenized Ecosystem assessment tool consists of three steps that will guide a user through an assessment process
- The first step determines the current state of innovation maturity, which regards the current technological maturity and ecosystem maturity of Tokenized Ecosystems.

- The second step determines whether there is a fit between the business in question and the application of Tokenized Ecosystems and depends on the input form the user regarding the business process fit and organizational fit.
- In the last step a high-level design overview of a Tokenized Ecosystem is provided to the user.
- The tool is used by representatives of businesses that consider applying Tokenized Ecosystems to their business processes.
- The tool provides insights into which strategy the business of the user's choice should pursue regarding the application of Tokenized Ecosystems.
- This potentially prevent the business investing (too much) money and time into the development of Tokenized Ecosystems when it actually shouldn't, and prevents the business ignoring Tokenized Ecosystems when it actually shouldn't.
- The tool can be used multiple times because the inputs can change over time.
- This means the tool is timeless in the sense that it can provide insights to the user independent of the current state of Tokenized Ecosystems.

“Tokens are uniquely required to incentivize or disincentivize behavior”

Luke Duncan, Blockchain researcher



5. DESIGN

In this chapter the process of designing the tokenized ecosystem assessment tool is described. During this phase, the identified requirements from chapter 4 will be used for the design of the assessment tool. This will be done by answering research question: What are the requirements for a tokenized ecosystem assessment tool that improves decision-making for businesses? This relates to the final step of the DSRM process model described in 2.1.1. It states: Finally, the problem and its importance, the artefact, its utility and novelty, the rigor of its design and its effectiveness should be communicated to researchers and other relevant audiences such as practicing professionals, when appropriate (Peffer, 2007)

First, the methodology for the design is explained in 5.1. Then, the process of the design is described in 5.2. The product of the process design, the Tokenized Ecosystems assessment tool is delivered in 5.3. At the end this chapter is concluded, and the fourth research questions is answered in 5.4.

5.1 DESIGN METHODOLOGY

This section describes the design methodology that was used to design the Tokenized Ecosystems assessment tool. A bottom-up design approach was used, described in 5.1.1. The design process was an iterative and incremental design process, described in 5.1.2. Every design iteration used a diverge and converge method, described in 5.1.3.

5.1.1 A BOTTOM-UP DESIGN APPROACH

The design of the Tokenized Ecosystem design tool uses a bottom-up design approach, as opposed to a top-down design approach. A bottom-up design approach is defined as an incremental approach applicable for the development of qualitatively new systems where their application range and complexity of functions cannot be defined on the base of their future user requirements (Gadomski, 1998). This approach works best for design a Tokenized Ecosystem assessment tool because the approach has an explorative character and it is relying on the verification of the utility and applicability of new software methods and technologies for never yet implemented particular functions (Gadomski, 1998).

5.1.2 AN INCREMENTAL DESIGN PROCESS

The incremental design process, in which a design is periodically upgraded with new features, is going through several iterations. Therefore, after new functionality has been introduced, the resulting system has to be implemented such that additional functionality (Pop, 2004).

This incremental design process, where the design follows several iterations, is visualized in figure 22. The incremental design process follows a loop between requirements on one hand, and design on the other. The loop is started at the requirements side. The requirements of the Tokenized Ecosystems assessment tool were collected through a theoretical basis and empirical evidence from expert interviews. With these requirements, a first version of the design of the tool was developed. This version had a moment of reflection before it went through another iteration of requirements (because more experts were interviewed with slightly adjusted questions). This developed a subsequent input for a second version of the design, which was then reflected upon and so forth, and so forth.



Figure 22: The incremental design loop, taken from IBM's design loop (IBM, 2018)

5.1.3 THE DIVERGE AND CONVERGE DESIGN METHOD

During the actual design of the Tokenized Ecosystem assessment tool, which happens in the design part of the design loop, there were brainstorm sessions to formulate ideas and concepts. Every design iteration uses a brainstorm session. These brainstorm sessions were based on a creative thinking method: divergence and convergence, see figure 23. The formulation of ideas and concepts happened through a consecutive process of divergence and convergence. Divergence and convergence are both important elements of organizational design processes (Visscher, 2009).

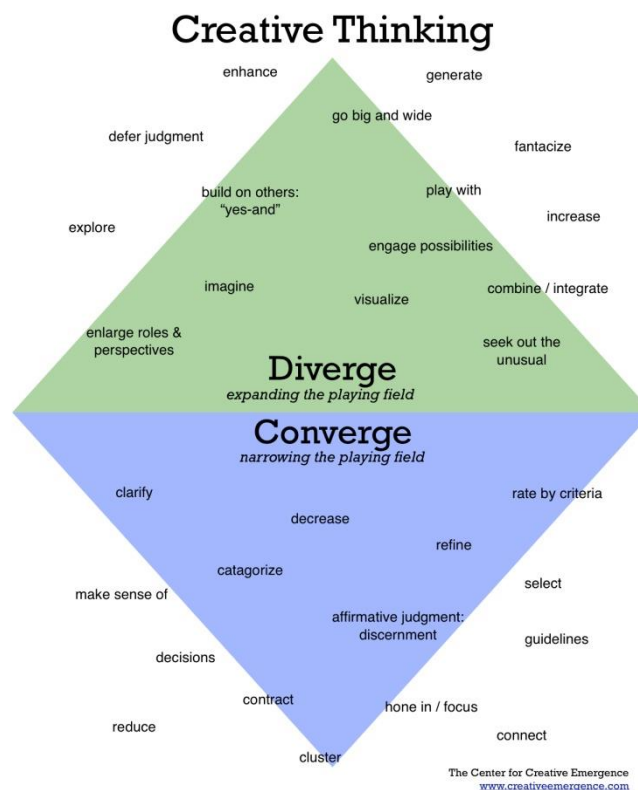


Figure 23: Creative thinking method: diverge and converge

Divergence is stimulating new thinking by diversifying and exploring. This method of thinking departs from the problem statement and will produce many ideas. The point is that no idea is bad and rather is a foundation for other ideas. For example, an idea that seems stupid should not directly be discarded but

regarded as a new field of ideas. Sometimes you need this stupid idea in order of being able to think of other new ones.

After a divergence session, an analytical phase happens where the best ideas are combined and selected. This process is called convergence and is about refining and choosing the best possibilities. r

5.1.3.1 Divergence principles

The purpose of all divergence principles is to stimulate the production of new ideas. Not all principles are always used, and they are not always as effective in every situation. The following 5 principles were used in the divergence process (Wycoff, 2007):

Suppose: Putting yourself in imaginary situations switches on new ways of thinking. During the divergence process, the researcher imagined to be a future user of the assessment tool. While attempting to think like for example a business developer from a business that considers applying Tokenized Ecosystems to their business processes, the researcher looked at the tool and developed possible design options.

Wander: Wandering through new territory with an open mind vacuums up new connections and linkages. The researcher deliberately looked at assessment tools in completely different fields, e.g. assessments on urban planning, medical situations, etc. Simply looking at how these assessment tools were created produced more design possibilities.

Associate: Deliberately create new linkages between objects, ideas, events, people, or processes. As you link things together that normally are not connected, you begin to see new relationships and new possibilities. Some design options that are not normally linked to each other, were interlinked. This sometimes created a design option that was not apparent before.

Morph: Change various aspects of the situation, make the familiar strange and the strange familiar. This was only done a few times by the researcher, as it did not always develop new ideas.

Inquire: Questions create openings. Instead of looking for new ideas, sometimes a simple question was asked. It is easier for the mind to find a solution to a well-structured simple question, than to attempt to think of new ideas. An example of such a question was: How can something be rated?

5.1.3.2 Convergence principles

The job of convergence principles is to make sense of what is often an overwhelming number of possibilities and to narrow down the choices in order to make an intelligent decision. The following 5 principles were used in the convergence process (Wycoff, 2007):

Sort: In order to make sense of what is often hundreds of possibilities, they need to be grouped into meaningful categories. Categories might be related to time, feasibility, market demand, availability of resources, type of possibility or any other category that would bring order out of the chaos.

Order: Possibilities within a viable category can be ranked against pre-established criteria to create an order of preference.

Adapt: Once likely possibilities have been identified, they can be expanded and adapted to create even better ideas.

Refine: Likely possibilities need to be bullet proofed to find the weak spots and possible failure points.

Select: This principle narrows down the possibilities to just a few, which can be used later on for iteration processes.

5.2 DESIGN PROCESS

This section describes the process of how the Tokenized Ecosystem assessment tool was designed. First, in 5.2.1 the concretized requirements for the assessment tool are reflected upon and translated into key questions. Then, in 5.2.2 the first design iteration is described, during which a divergence and convergence method was used to develop a lot of ideas and selecting the best options. In 5.2.3, the best options are combined into the first version of the assessment tool. Lastly, how the iterative design approach resulted in better variations of the assessment tool is described in 5.2.4.

5.2.1 THE CONCRETIZED REQUIREMENTS

This section reflects upon the requirements for the Tokenized Ecosystem assessment tool by translating them into key questions, as well as describing their key functionality.

The Tokenized Ecosystem assessment tool must be able to determine the technological maturity, which is based on the *complexity, compatibility, scalability, transaction volume and energy usage* of the technology, and the ecosystem maturity, based on the *enterprise readiness, interoperability capabilities, cross-functional knowledge competencies and diffused sense of importance* within the ecosystem, involved in markets potentially being disrupted by Tokenized Ecosystems.

Key Question: What is the current technological and ecosystem maturity of Tokenized Ecosystems?

Key Functionality: Explicate the current situation of innovation maturity of Tokenized Ecosystems.

The Tokenized Ecosystem assessment tool must be able to determine the business process fit regarding the application of Tokenized Ecosystems, which is based on the *internal- and external strategy* and the *internal- and external infrastructure*.

Key Question: Which factors need to be considered regarding the application of Tokenized Ecosystems to business processes?

Key Functionality: To determine whether there is a fit between Tokenized Ecosystems and business processes.

The Tokenized Ecosystem assessment tool must be able to determine the organizational fit regarding the application of Tokenized Ecosystems, which is based on the *individual psychological factors, individual structural factors, organizational psychological factors and organizational structural factors*.

Key Question: Which factors need to be considered regarding the organizational readiness of the business that considers applying Tokenized Ecosystems to their business processes?

Key Functionality: Determine whether the ability of the business regarding the application of Tokenized Ecosystems.

The Tokenized Ecosystem assessment tool must be able to provide a high-level design overview of Tokenized Ecosystems in order to develop a Minimum Viable Product. This consists of a *knowledge base, a technology layer, building blocks and design tools*.

Key Question: What does a high-level design overview of Tokenized Ecosystems look like?

Key Functionality: Provide insights in what factors are required for a Tokenized Ecosystem design to develop a Minimum Viable Product which can be tested.

The Tokenized Ecosystem assessment tool must be effective: (1) it is used as an initial assessment for business that explore the applicability of Tokenized Ecosystems for their business processes, (2) it should be effective in the sense that the insights provided actually help the business with their decision-making and

that these insights were easily obtained and (3) it should provide a business with a fundamental strategy they can adhere to.

Key Question: How can the Tokenized Ecosystem assessment tool be effective?

Key Functionality: Making sure the assessment tool is effective and actually is of added value to the current decision-making process of a business.

5.2.2 DIVERGENCE AND CONVERGENCE OF ASSESSMENT INSTRUMENT OPTIONS

As explained in 5.1.2, there were multiple iterations between definition of requirements and design, respectively. In addition, as explained in 5.1.3, there were separate iterations within the design process; these concerned the divergence and convergence processes. After the first iteration, design options that could be analyzed for the first version of the Tokenized Ecosystems assessment tool were selected. The design options are described below.

Innovation maturity

- An estimation of technological maturity based on existing assessments like the NASA Technology Readiness Levels and the United States Airforce Technology Readiness Level Calculator.
- Providing a technology maturity score on a new assessment
- Providing an ecosystem maturity score on a new assessment
- Providing an overview of the current hurdles for the innovation to become mature
- Mapping the technological and ecosystem maturity on a plot with 4 quadrants.

Business process fit

- Providing a business process fit score
- Providing an overview of the business processes that do or do not have a fit with Tokenized Ecosystems.

Organizational fit

- Providing insights in how the organization must change
- Providing an organizational fit score
- Providing the factors that determine organizational fit with Tokenized Ecosystems

High-level design overview

- Providing potential design solutions for a Tokenized Ecosystem
- Providing the building blocks required for a specific Tokenized Ecosystem design
- Providing an overview of a high-level Tokenized Ecosystem design

Effectiveness of the tool

- An assessment per requirements
- Combining assessments
- Mapping outcomes visually

5.2.3 SELECTION TOWARDS FIRST ASSESSMENT TOOL VERSION

By combining identified design options described in 5.2.2, several initial versions of the Tokenized Ecosystems assessment tool were developed. Some of these prototypes do not cover all requirements because some of them were not found or concretized yet. With feedback from the academic and external supervisors, and by including all found concretized requirements, the following version of the Tokenized Ecosystems assessment tool was developed. This tool consists of 4 steps, see figure 24.

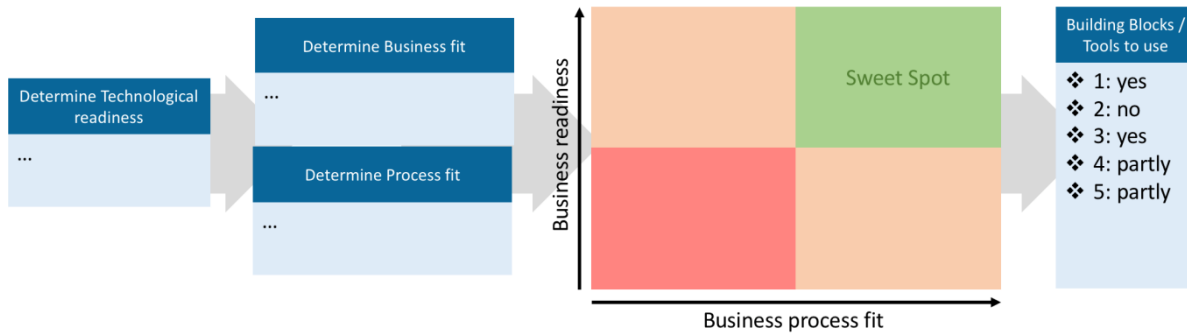


Figure 24: version mark I of the assessment tool

First, the technological readiness is determined by answering a couple of questions that were related to the technological maturity factors. This step relates to the 'innovation maturity' requirement and provides insights in the current maturity of Tokenized Ecosystems. Then, the business fit, and the process fit is determined. This step relates to both 'business process fit' and 'organizational fit' requirements and determines the business process fit and the organizational fit between a business and, the application of Tokenized Ecosystems. In the next step, this result is plotted on a quadrant. If the result lands in the green quadrant, the user of the assessment tool can continue to the last part. The last part provides the building blocks that are necessary for the design of a specific Tokenized Ecosystem use-case provided by the user of the tool.

This version was iterated with additional rounds of finding assessment tool components and requirements.

5.2.4 ITERATIVE DESIGN APPROACH

With additional knowledge collected through literature review, expert interviews, and feedback from the supervisors, the following version of the Tokenized Ecosystems assessment tool was developed. This next version envelops the following insights found in that round of iteration.

First, the technological readiness was changed to technological maturity. This was done because technological maturity takes more relevant factors into consideration. For example, this version of the assessment tool regards interoperability with other technologies as a relevant factor to determine innovation maturity.

Second, the quadrant that plots the outcome of the business process fit and organizational fit was updated. This version of the Tokenized Ecosystems tool provides a more insightful quadrant by naming every section:

- **Laggard:** The business can extract value from Tokenized Ecosystems and should play a role in the ecosystem. Once Tokenized Ecosystem reaches innovation maturity, and your business still lacks organizational fit, there is a high chance of becoming disrupted.
- **Thought Leader:** The business understands the value of Tokenized Ecosystems and is ready to change. It is however still unclear how exactly value can be extracted from Tokenized Ecosystems.

It is important for the business to understand it because there might not be a business process fit at all, making investments worthless.

- **Ecosystem Leader:** The business can extract value of Tokenized Ecosystems and understands how this might be possible. The business has invested in the potential transformation towards becoming a Tokenized Ecosystem and leads the overall ecosystem of business that consider Tokenized Ecosystems. Once Tokenized Ecosystems reach innovation maturity, the business is in an excellent position.
- **No Tokenized Ecosystem:** There is no business process fit or organizational fit. Tokenized Ecosystems are not interesting for the business in question.

Third, the last step of the assessment tool where elements of a Tokenized Ecosystem were identified and suggested was changed. It does not regard the use-case that is provided by businesses anymore, as the experts noted that the factors within every layer of the high-level design overview are required for every use-case and should not be ignored. That is why in this version of the assessment tool the step was changed from a tool that required an input from the tool user, to a static high-level design overview. This last step is mainly focused at providing insights in every building block that is required and shows the competencies the business must possess in order to develop a well-functioning Tokenized Ecosystem. This resulted in the next version of the assessment tool, see figure 25.

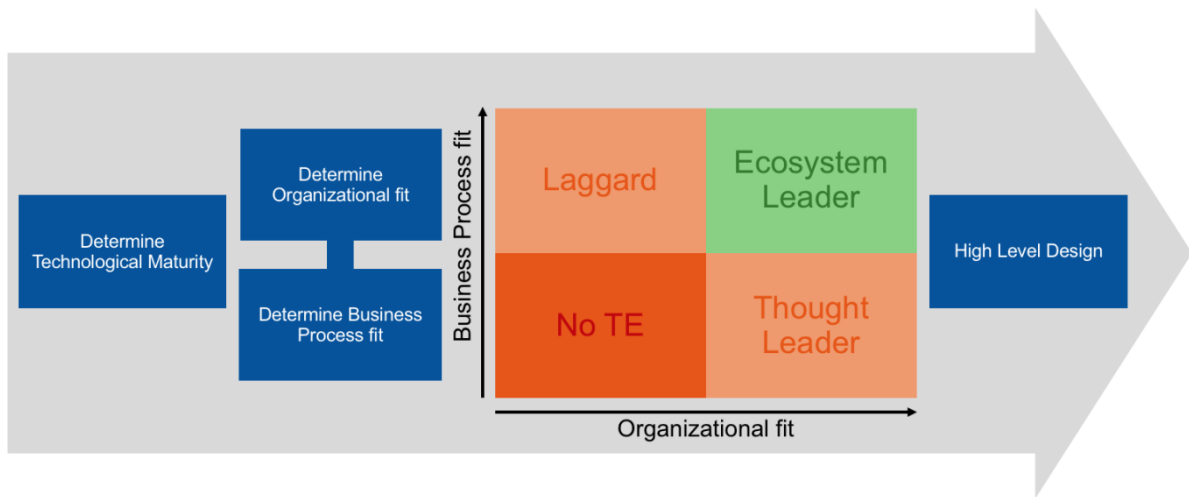


Figure 25: Version mark II of the assessment tool

5.3 THE TOKENIZED ECOSYSTEMS ASSESSMENT TOOL

Based on the feedback of the supervisors and expert interviews, the final version was developed. This final version contains all insights from the last iterations. These final iteration steps are described in 5.3.1. Then, the assessment tool is shown in 5.3.2 along with an explanation of how to use the assessment tool step-by-step.

5.3.1 THE FINAL ITERATION OF THE DESIGN

First, the innovation maturity assessment has been split up into two segments: the assessment of technological maturity and the assessment of ecosystem maturity. The outcome is plotted on a quadrant. Every quadrant is named to give insights to the business what it means to be in a specific quadrant and how it can adjust its strategy. The quadrants are:

- **Market Pull:** Tokenized Ecosystems have reached technological maturity but lacks an ecosystem to help it to reach the masses. Businesses have to pursue a market pull strategy. This means that they have to create a demand within the ecosystem to develop Tokenized Ecosystems (Filo, 2015).
- **Technology push:** Tokenized Ecosystems have not yet reached technological maturity but have an ecosystem doing research & design on it. For it to reach innovation maturity, businesses must pursue a technology push strategy. This means that they have to focus on R&D instead of mainly the ecosystem (Filo, 2015).
- **Innovation maturity:** Tokenized Ecosystems have reached technological maturity *and* ecosystem maturity. This means Tokenized Ecosystem is ready to deliver value to businesses if there is business process and organizational fit with those businesses.
- **No Tokenized Ecosystem:** Tokenized Ecosystems have neither technological maturity, nor ecosystem maturity. The business should have little to no interest in the application of Tokenized Ecosystems to their business processes.

Second, the visual guide to the Tokenized Ecosystems assessment tool has been updated to show three clear steps that directs the user to overviews of the results.

5.3.2 THE TOKENIZED ECOSYSTEM ASSESSMENT TOOL

The Tokenized Ecosystem assessment tool consists of three steps that will guide a user through an assessment process that determines whether a specific business should apply Tokenized Ecosystem to its business processes, see figure 26. To gain the most insights from this assessment tool, all three steps should be taken in sequence. Otherwise, if the business has been using the tool before, it could redo a single step in order to update previous results. The three steps of the Tokenized Ecosystems assessment tool will determine the *innovation maturity* of Tokenized Ecosystems, whether there is a *fit with the business*, and demonstrate a *high-level design overview* of Tokenized Ecosystems. Every step from the assessment tool renders additional insight to the user regarding whether a business should pursue applying Tokenized Ecosystems to its business processes.

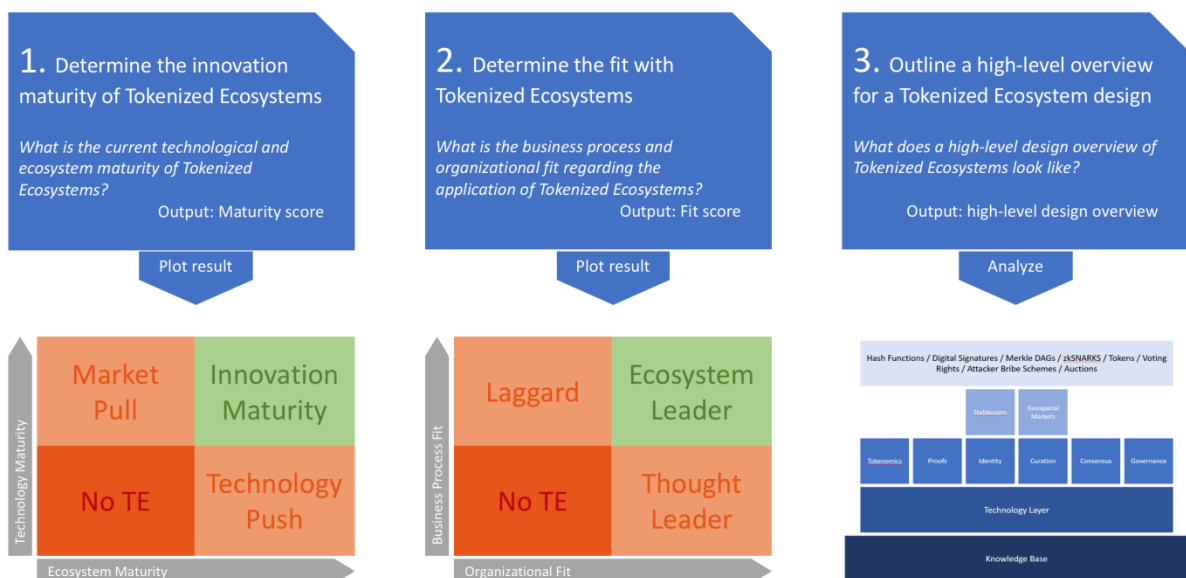


Figure 26: Final version of the assessment tool

Step 1: Determine the innovation maturity of Tokenized Ecosystems

The first step requires input from the user regarding the current state of innovation maturity of Tokenized Ecosystems. This input is required in order to calculate the scores for ecosystem maturity and technological maturity. The user puts in a score that reflects his opinion regarding the maturity factor that is asked on a 5-point scale. The 5-point scale (the Likert scale) is the most fundamental and frequently used psychometric tool in social sciences that captures the level of agreement with a certain statement (Likert, 1932). The score for the first is then mapped on a quadrant to show the user what the situation is regarding innovation maturity. The result of this is shown to the user, accompanied by a small text that informs him of what the result implies, as described in 5.3.1. If the result lands in the quadrant called "Innovation Maturity", the user is informed he should continue with the assessment tool. If the result does not land in this so-called sweet spot, the user is informed that he could still continue with the following steps of the tool, but that it will not result in a confirmation that the business in question should pursue Tokenized Ecosystems and that it is merely an exercise that provides additional insight.

Step 2: Determine the fit with Tokenized Ecosystems

The second step also requires input from the user, but this time it is regarding whether he considers there to be a fit between the business and Tokenized Ecosystems. For the rest, the same as the description from step 1 applies.

Step 3: Outline a high-level overview for a Tokenized Ecosystem design

This step demonstrates a high-level design overview of the design of Tokenized Ecosystems. If a business has a business process fit and organizational fit, and Tokenized Ecosystems have reached innovation maturity, it still lacks a high-level overview of tokenized ecosystem design. Before a business can implement a tokenized ecosystem, it would be wise to design a Minimum Viable Product (MVP). An MVP is a fundamental concept within the Lean Start-up methodology and can be defined as a version of a new product, which allows a team to collect the maximum amount of validated learning about customers with the least effort. Thus, by creating an MVP, businesses allow themselves to test tokenized ecosystems with their partners and potential customers without putting in too much effort. However, before a business could design an MVP, a high-level overview of how such a design should look like is required. Tokenized ecosystems can change from use-case to use-case and its design thus changes accordingly.

The Tokenized Ecosystem assessment tool will provide a high-level design overview, so that the user will gain insights in all the competencies that are required to develop an MVP for a Tokenized Ecosystem.

5.4 CONCLUSION

This chapter described the design process of a Tokenized Ecosystem assessment tool. This tool was designed by using concretized components that were identified as requirements for a tool that could add value to a business regarding the application of Tokenized Ecosystems. The tool was designed using incremental and iterative design methods, using a diverge and converge approach. This chapter also provides an answer to the fourth research question: *How does a Tokenized Ecosystem assessment tool look like?*

The answer is as follows: Tokenized Ecosystem assessment tool consists of three steps that will guide a user through an assessment process that determines whether a specific business should apply Tokenized Ecosystem to its business processes. The first step determines the current state of innovation maturity of Tokenized Ecosystems and depends on the input from the user regarding the current technological maturity and ecosystem maturity of Tokenized Ecosystems. The second step determines whether there is a fit between the business in question and the application of Tokenized Ecosystems and depends on the input from the user regarding the business process fit and organizational fit. In the last step a high-level design overview of a Tokenized Ecosystem is provided to the user.

The tool is used by representatives of businesses that consider applying Tokenized Ecosystems to their business processes. The tool provides insights into which strategy the business of the user's choice should pursue regarding the application of Tokenized Ecosystems. This potentially prevent the business investing (too much) money and time into the development of Tokenized Ecosystems when it actually shouldn't, and prevents the business ignoring Tokenized Ecosystems when it actually shouldn't. The tool can be used multiple times because the inputs can change over time. This means the tool is timeless in the sense that it can provide insights to the user independent of the current state of Tokenized Ecosystems.

DEMONSTRATION

GOAL

To demonstrate the workings and its feasibility of the Tokenized Ecosystem assessment tool.

PROCESS

The Tokenized Ecosystems assessment tool was demonstrated by conducting a case study, during a desk research, the value of Tokenized Ecosystems was assessed regarding the case. The case involved a business that was interested in applying Tokenized Ecosystems to their business processes. During this demonstration phase, the context of usage of the tool was defined: Who should use the tool and within which business (sector) should it be used?

KEY RESULTS

- The case study demonstrated how the use of the Tokenized Ecosystems assessment tool can lead to useful insights regarding the decision-making involved with applying Tokenized Ecosystems to their business processes.

- The case study demonstrated the capability of the Tokenized Ecosystem assessment tool to provide the insight to not (yet) invest in Tokenized Ecosystems because of its immaturity, even though it seemed to be *the* future technology for the business in question.
- The case study demonstrated the capability of the Tokenized Ecosystem assessment tool to show what the most important factors are a business should be aware of to reach organizational readiness
- The case study demonstrated that the Tokenized Ecosystems assessment tool was considerably efficient in its workings. It does not demand a large amount of (human) resources or time to complete.

“In much the same way that national governments all have their own cultural and historical nuance, token networks will develop similar subtleties, based on the values of the community”

Jamie Burke, CEO of Outlier Ventures



6. DEMONSTRATION

In this chapter the tokenized ecosystem assessment tool is demonstrated as it describes the fifth phase of this research: Artefact Demonstration. During this phase, the workings of the tool and its feasibility - which is based on the effectiveness and the efficiency of the tool - is demonstrated. This will be done by answering the fifth research question: How can the feasibility of the Tokenized Ecosystem assessment tool be demonstrated? This relates to the fourth step of the DSRM process model described in 2.1.1. It states: In this step the use of the artifact is demonstrated to solve one or more instances of the problem by experimentation, simulation, case study, proof, or other appropriate activity (Peffer, 2007).

First, the approach that was followed to demonstrate the assessment tool through case studies is described in 6.1. Then, the business that is used for the case study, being Dropbox, is described in 6.2. At the end of this chapter is concluded, and the fifth research question is answered in 6.3.

6.1 CASE STUDY APPROACH

In order to demonstrate the effectiveness, the efficiency and the workings of the tool, a case study is being conducted. The case study is being done by desk research, during which the value of Tokenized Ecosystems is assessed regarding the case. The case will be a business that might be interested in applying Tokenized Ecosystems to their business processes. This business, being Dropbox, is introduced in 6.1.1. The case study will start by assessing the innovation maturity of Tokenized Ecosystems based on the current state of play. This will be done by doing the first step of the Tokenized Ecosystem assessment tool. Then, the fit between the business and Tokenized Ecosystems is determined by following the second step of the Tokenized Ecosystem assessment tool.

6.1.1 CASE STUDY SELECTION

In order to select an appropriate case study, a couple of criteria were put forth. These criteria will make sure the case study fits the businesses the tool is designed for. The following criteria were used during the selection process for the case study:

- The case study should include a business that is well known
- The business should be an incumbent firm
- The case study should involve a business that resides in a market that can potentially be disrupted by startups using Tokenized Ecosystems
- The business should be involved in a market where startups using Tokenized Ecosystems are already building their own businesses and thereby challenging the incumbent firm
- The business should be a digital business, meaning that their core product or service is (almost) completely digital

Based on these criteria, a case was selected. The case is a file hosting and sharing service, operated by the business called Dropbox, Inc. Dropbox fulfills all the criteria: It is a well known business, which is currently an incumbent firm; it resides in a market where they are challenged by multiple Tokenized Ecosystem startups (i.e., Filecoin, Storj, Sia and Swarm); and it is a digital business.

6.2 CASE STUDY: DROPBOX

Dropbox is a file hosting service that offers cloud storage, file synchronization, personal cloud, and client software. According to their own website, they are a modern workspace that brings files together in one central place. They make files easy to find and safely synced across all the devices of the client. Dropbox is built for creative collaboration (Dropbox, 2018). Dropbox is one of the biggest cloud storage vendors (next to Apple's iCloud) with regards to public customers. Microsoft's 'OneDrive' and Google's 'Google Drive' are more business to business oriented: OneDrive serves 85% of Fortune 500 companies, probably because its synchronization abilities with Office365, which most companies use (Gildred, 2018).

Dropbox is particularly interesting for this case, because many people have talked about using blockchain for cloud storage (bitfwd, 2018). However, blockchain should not be used as data storage (since it has very low bandwidth and storing information would be too expensive). Tokenized Ecosystems - which runs on blockchain - are an interesting case for Dropbox, since it enables decentralized storage. Currently, Dropbox offers cloud storage, but in a centralized fashion. Meaning, Dropbox owns multiple server farms on which clients can store data for free, or in exchange for a monthly fee, depending on the client's subscription model. This centralized storage works fine (cloud storage companies have been highly successful), but there are also reasons for concern. Because of the centralized model, there is a single point of failure. Dropbox can go bankrupt or its servers can be hacked. This is why decentralized storage might be a better solution.

Multiple startups have built a decentralized cloud storage solution based on blockchain technology. This does not mean that the files are stored on a blockchain itself, but that blockchain technology merely serves as a transaction of value. Blockchain thereby enables peer-to-peer decentralized cloud storage. Peers provide cloud storage by connecting their computer/server to a network. This creates a network of cloud storage without a single point of failure. Peers are incentivized to sustain this network because they earn tokens that hold value. This value is monetary or comes in the form of extra rights on the platform/network (i.e., voting rights or premium services). Whenever someone on the network makes use of any service, there is a value transfer (tokens for using the service). The value transfers are what is stored on the blockchain. This makes blockchain a valuable technology for this use-case, because no single user or consortium of users owns this network. Rather, every peer in the network builds and sustains the network.

Startups using Tokenized Ecosystems to create decentralized cloud storage services are growing in size and potentially disrupt the market Dropbox is residing in. It might be interesting for Dropbox to create an ecosystem themselves. In order to assess whether they should investigate this option, and how many resources they should use in order to do so, Dropbox needs to know a couple of things. First, Dropbox needs to know what the innovation maturity of Tokenized Ecosystems are. Then, they need to know whether their business has a fit with applying Tokenized Ecosystems. Last, they need to know what a high-level design overview of Tokenized Ecosystems will look like. Dropbox can use the Tokenized Ecosystem assessment tool to improve its decision-making regarding the application of Tokenized Ecosystems. The following paragraphs describe these steps.

6.2.1 DETERMINING THE INNOVATION MATURITY OF TOKENIZED ECOSYSTEMS

In this first step, the innovation maturity of Tokenized Ecosystems is determined. This step required the user to collect information regarding the current state of innovation maturity of Tokenized Ecosystems. This is required as input in order to assess the ecosystem maturity and technological maturity of Tokenized Ecosystems. First the current technological maturity of Tokenized Ecosystems with regards to

decentralized cloud storage services is assessed. The complexity of Tokenized Ecosystems is high, as it is not easily understood. Only active members of a community designing Tokenized Ecosystems understands what is going on and has a hard time codifying this knowledge externally. The compatibility of Tokenized Ecosystems with the values, experiences and needs of potential adapters is low. Some experts believe in this compatibility and there are some use-cases, but this still needs to be proven. The scalability of Tokenized Ecosystems is low, as it is impossible to scale up with the current technology. However, there are scalability solutions in the pipeline of Ethereum, the blockchain on which most Tokenized Ecosystems run. The transaction volume of Tokenized Ecosystems is currently low. The current state can supply enough volume for Tokenized Ecosystems to work, but with high transaction costs. This might also be solved soon with the upcoming updates to Ethereum. The energy usage of Tokenized Ecosystems is very high, due to the Proof of Work consensus mechanism wherein users are incentivized to use a lot of energy. Then the current ecosystem maturity of Tokenized Ecosystems with regards to decentralized cloud storage services is assessed. The enterprise readiness of Tokenized Ecosystem is low, there are multiple incumbent firms working together, but collaboration is novel and not at the level to release a fully functional Tokenized Ecosystem. The interoperability capabilities are low, as Tokenized Ecosystems do not work well with other systems as of yet. The cross-functional knowledge competencies are low, as Tokenized Ecosystems are mainly developed by engineers. However, teams of Tokenized Ecosystem developers work more and more together with other disciplines like lawyers and ethical designers. The diffused sense of importance within the ecosystem is high for Tokenized Ecosystems, as more startups are emerging that realise business structures should incorporate Tokenized Ecosystems.

Based on these answers, the current score for the technological and ecosystem maturity of Tokenized Ecosystems is 32 out of 100 and 40 out of 100, respectively. These low scores reflect the current immature innovation maturity of Tokenized Ecosystems. This informs the user of the tool that the user is informed that he could still continue with the following steps of the tool, but that the tool will not confirm that the business in question should pursue Tokenized Ecosystems and that following the next steps of the tool is merely an exercise that provides additional insight. So, purely for additional insights, the following step of the Tokenized Ecosystem assessment tool will be done.

6.2.2 DETERMINING THE FIT WITH TOKENIZED ECOSYSTEMS

Whether Dropbox has a fit with Tokenized Ecosystems is assessed based on the business process fit and the organizational fit. The business process fit is defined as the degree to which Tokenized Ecosystems can be applicable to a Dropbox and can be aligned with its business strategy. Organizational fit is defined as the ability of businesses to apply Tokenized Ecosystem to their business processes and strategy. As already explained in the case introduction, there is good possibility of a fit with the business process. This case study also resulted in a high score on business process fit: 77 out of 100. However, the organizational fit scores 48 out of 100 according to the tool. This is mainly caused by the fact that the business is not ready to self-cannibalize and open up governance of their business processes to the public. In conclusion, Dropbox is a **Laggard**: The business can extract value from Tokenized Ecosystems and should play a role in the ecosystem. Once Tokenized Ecosystem reaches innovation maturity, and the business still lacks organizational fit, there is a high chance of becoming disrupted.

6.2.3 OUTLINING A HIGH-LEVEL OVERVIEW FOR A TOKENIZED ECOSYSTEM DESIGN

The tool shows the high-level design overview for Tokenized Ecosystems. This is insightful for Dropbox, because they lack organizational fit with Tokenized Ecosystems. The high-level design overview directs the user of the tool towards the competencies that are required for Dropbox to be able to design an MVP regarding the application of Tokenized Ecosystems.

6.2.4 CONCLUSION OF THE DROPBOX CASE STUDY

The assessment for the application of a Tokenized Ecosystem to the business processes of Dropbox resulted in a red light. This is mostly due to the first step of the assessment: innovation maturity. Tokenized Ecosystems have simply said not reached technological and ecosystem maturity yet. However, the tool did give insights in the fact that Tokenized Ecosystems have a good fit with the business processes of Dropbox. Meaning, Dropbox should be aware of decentralized cloud storage startups that apply Tokenized Ecosystems to their business processes; they might disrupt the business model of Dropbox. Also, if Tokenized Ecosystems have innovation maturity and Dropbox wants to apply them to their business processes, they will have a hard time doing so, according to their low score on organizational readiness.

6.3 CONCLUSION

The Dropbox case study demonstrated how the use of the Tokenized Ecosystems assessment tool can lead to useful insights regarding the decision-making involved with applying Tokenized Ecosystems to their business processes. The case study demonstrated that although Tokenized Ecosystems seem the future for Dropbox, it should not (yet) invest in the technology. Also, the case study demonstrated the factors that Dropbox needs to be aware of, because if the situation regarding those factors change, they need to re-assess. Also, the case study demonstrated that Dropbox is not ready as an organization to incorporate Tokenized Ecosystems as a technology yet, and what the most important factors are they should be aware of. Because the case study showed that the Tokenized Ecosystems assessment tool improved decision-making for Dropbox, it demonstrated the effectiveness. Also, because it took the researcher about 3 hours (and obviously only 1 person) to research the current state of Tokenized Ecosystems and Dropbox itself, use the input to fill in the assessment tool for every step; the case study demonstrated that the Tokenized Ecosystem assessment tool was considerably efficient.

CONCLUSIONS

GOAL

Present the conclusions of this research. Explain the managerial and academic relevance. Reflect on the research process itself, and the outcomes. Recommend future research options and describe the link with the MoT program.

PROCESS

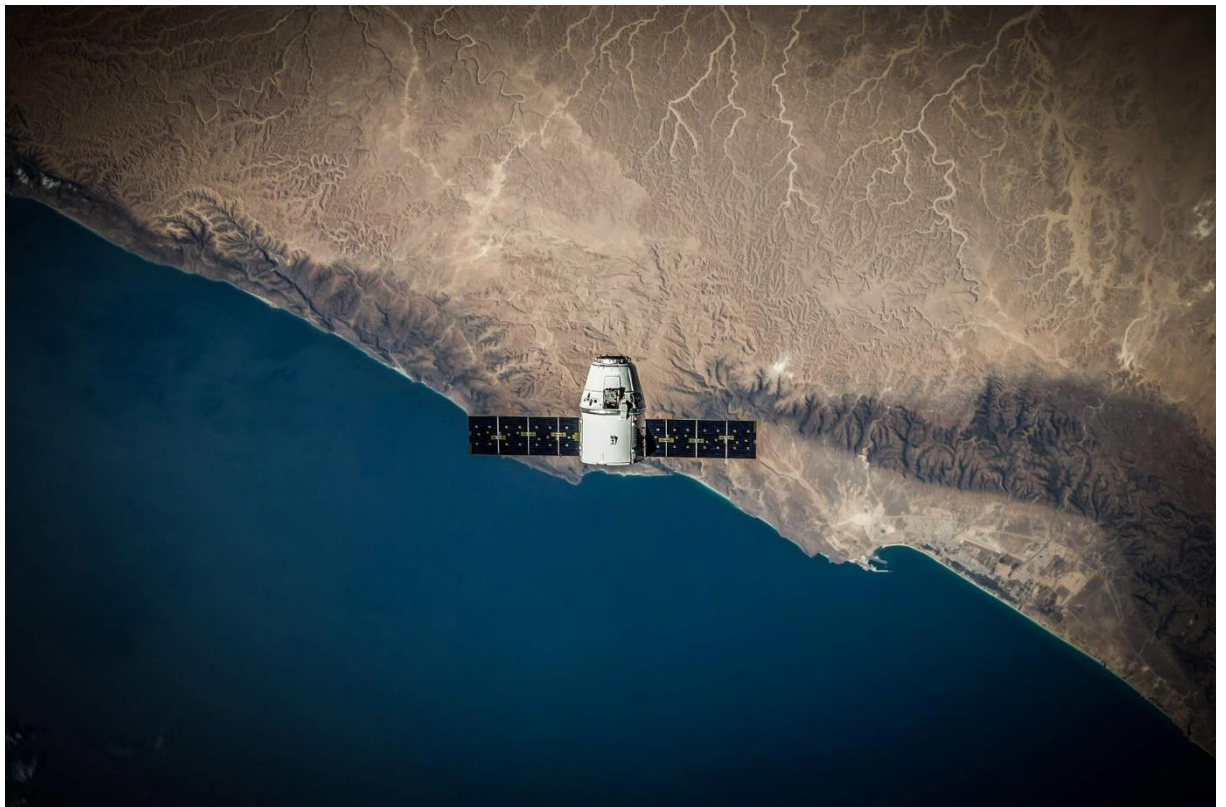
The results of every chapter and the answers to all the research questions are combined to discuss the main conclusions of the research. Then, the academic relevance is discussed, which is followed by a discussion about the managerial relevance. Then, a reflection on the research is conducted. Then, future research options were explored and provided. Finally, the link between this research and the MoT program is discussed.

KEY RESULTS

- The main research question is answered by summarizing the findings of every research phase, and by providing an overview of the assessment tool.
- This research is academically relevant since it explores an unexplored field of research: Tokenized Ecosystems. Also, it provides a novel systematic approach to assess the potential disruptiveness, the business process fit, and the organizational fit with Tokenized Ecosystems.
- This research is managerial relevant because it provides critical insights in how to react to an emerging potentially disruptive technology called Tokenized Ecosystems.
- This research is valid, reliable and verifiable, while the researcher was interdependent.
- The research has a link with the MoT program.

“Strong visionary leadership is required, but in a humble and supportive way”

Olivier Rikken, Director of Axveco



7. CONCLUSIONS

In this final chapter of this thesis, the conclusions of this research are presented, the managerial and academic relevance is explained, a reflection on the research process itself, and the outcomes is presented, and recommendations for future research are suggested. This relates to the final step of the DSRM process model described in 2.1.1. It states: Finally, the problem and its importance, the artefact, its utility and novelty, the rigor of its design and its effectiveness should be communicated to researchers and other relevant audiences such as practicing professionals, when appropriate (Peppers, 2007).

First, the main research question is answered in 7.1: How can an assessment tool improve decision-making by businesses on the application of Tokenized Ecosystems? Then, the managerial and academic relevance will be explained in 7.2. This will be followed by a reflection on the research itself, and its outcomes in 7.3. Then, recommendations for future research will be presented in 7.4. Finally, the chapter ends with explaining the link between this research and the perspectives provided by the master's program of Management of Technology (MoT) at the Technical University of Delft.

7.1 ANSWERING THE RESEARCH QUESTION

In order to answer the main research question, four sub questions were proposed in Chapter 1.5. These sub questions were answered throughout this thesis report and can be found in the ending conclusion paragraphs of previous chapters.

This research starts with describing how businesses currently have been attempting to extract value from blockchain business initiatives. These business initiatives can be grouped into several categories one of which is specifically interesting, because it is an unexplored blockchain business initiative: the initiative that can be framed as Tokenized Ecosystems.

Tokenized Ecosystems is a technology that companies can use to **decentralize** their business operations. The **community** can create and sustain the network that runs the operation because they are **incentivized** through **token reward functions**.

This research does not focus on the startups that currently are the main initiators and developers of this new technology, but rather on the incumbent businesses that can potentially be disrupted. Additionally, although Tokenized Ecosystems are potentially disruptive, they provide a significant chance for businesses to partake in the technology that can thereby claim a spot in a future of more decentralized businesses.

However, it is unclear how disruptive Tokenized Ecosystems can be for the incumbent business, and insights in how they should react to the startups using Tokenized Ecosystems are lacking. Thus, the objective of this thesis is to improve decision-making by business on the application of Tokenized Ecosystems, by designing an assessment tool that helps them to understand the disruptiveness of Tokenized Ecosystems, whether there is a business process and organizational fit and provides a high-level design overview of a Tokenized Ecosystem. In order to reach this objective, the following main research question was answered:

*How can an **assessment tool** improve decision-making by **businesses** on the application of **Tokenized Ecosystems**?*

In order to improve decision-making by business on the application of Tokenized Ecosystems, the Tokenized Ecosystems assessment tool regards 4 components. These components are required to assess the application of Tokenized Ecosystems in a systematic way and prevents businesses to make bad blockchain investments.

The first component determines the technological maturity, which is based on the *complexity, compatibility, scalability, transaction volume* and *energy usage* of the technology, and the ecosystem maturity, based on the *enterprise readiness, interoperability capabilities, cross-functional knowledge competencies* and *diffused sense of importance* within the ecosystem, involved in markets potentially being disrupted by Tokenized Ecosystems.

The second component determines the business process fit regarding the application of Tokenized Ecosystems, which is based on the *internal- and external strategy* and the *internal- and external infrastructure*

The third component determines the organizational fit regarding the application of Tokenized Ecosystems, which is based on the *individual psychological factors, individual structural factors, organizational psychological factors* and *organizational structural factors*.

The fourth component provides a high-level design overview of Tokenized Ecosystems in order to develop a Minimum Viable Product. This consists of a *knowledge base, a technology layer, building blocks and design tools*.

These four components were used in the design of a Tokenized Ecosystems assessment tool. The Tokenized Ecosystem assessment tool consists of three steps that will guide a user through an assessment process that determines whether a specific business should apply Tokenized Ecosystem to its business processes.

1. The first step determines the current state of innovation maturity of Tokenized Ecosystems and depends on the input from the user regarding the current technological maturity and ecosystem maturity of Tokenized Ecosystems.
2. The second step determines whether there is a fit between the business in question and the application of Tokenized Ecosystems and depends on the input form the user regarding the business process fit and organizational fit.
3. In the last step a high-level design overview of a Tokenized Ecosystem is provided to the user.

The tool is used by representatives of businesses that consider applying Tokenized Ecosystems to their business processes. The tool provides insights into which strategy the business of the user's choice should pursue regarding the application of Tokenized Ecosystems. This potentially prevent the business investing (too much) money and time into the development of Tokenized Ecosystems when it actually shouldn't, and prevents the business ignoring Tokenized Ecosystems when it actually shouldn't. The tool can be used multiple times because the inputs can change over time. This means the tool is timeless in the sense that it can provide insights to the user independent of the current state of Tokenized Ecosystems.

7.2 ACADEMIC AND MANAGERIAL RELEVANCE

This thesis draws **scientific conclusions**: Current innovation theories like the Strategic Alignment Model, the theory of innovation diffusion, and technological maturity are only applicable in a limited way when

assessing the possibility of applying Tokenized Ecosystem to business processes. Concurrently, ecosystem maturity – which is based on the *enterprise readiness, interoperability capabilities, cross-functional knowledge competencies* and *diffused sense of importance* within the ecosystem – plays a critically important role when assessing the possibility of applying Tokenized Ecosystems to business processes. Also, this thesis describes Tokenized Ecosystems as a melting pot of a plethora of various disciplines, theories, technologies, and design tools. This thesis produces a systematic overview which classifies and categorizes these in a high-level design overview for Tokenized Ecosystems. This thesis also draws **managerial conclusions**: The organizational readiness of a business plays a very important role in assessing the possibilities of applying Tokenized Ecosystems to business processes. Also, businesses should follow a systematic process when identifying possibility of applying Tokenized Ecosystems to their business processes. Furthermore, businesses should proceed with caution when deciding on investing in Tokenized Ecosystems and blockchain technology projects especially. There is no guarantee in a return of investment in the short run. However, businesses should be aware of the chance of being disrupted by startups that have successfully applied Tokenized Ecosystems to their business processes. Thus, businesses *must* constantly investigate the disruptive potential of Tokenized Ecosystems and act accordingly.

The academic relevance of this research is foremost explained by that fact the topic of research, Tokenized Ecosystems, is novel. When the term Tokenized Ecosystem is used as a keyword within Google Scholar, but 5 articles are mentioned, of which only one of them bears a close resemblance to how Tokenized Ecosystems are described in this thesis. When the term is used as a keyword within Scopus, no articles are mentioned. Other attempts to find academic papers on the topic (by using similar keywords like *business decentralization, business process tokenization, multi-token economies*, etc) have also been unsuccessful. Apparently, this topic is scientifically under-researched and is academically novel.

Furthermore, this research provides a systematic analysis of when Tokenized Ecosystems can add value to business processes. First of all, it provides a way to analyse the maturity of the innovation of Tokenized Ecosystems using the perspective of the Diffusion of Innovations. Second, it provides a way to analyse the organizational fit and business process fit between Tokenized Ecosystems and a business. This is a known field of research for IT innovations, but not for blockchain technologies and innovations, let alone for Tokenized Ecosystems.

The managerial relevance of this research is explained by the fact that it provides insights to managers of businesses. First, it provides insights in what Tokenized Ecosystems are and that multiple blockchain related startups organize themselves in that way. Second, it provides insights to managers in whether a business has an organizational or business process fit with Tokenized Ecosystems. Third it provides a high-level overview of Tokenized Ecosystem design options that identify necessary capabilities of a business to be able to design them. Lastly, it will help managers with strategic decisions regarding the application of Tokenized Ecosystems to a business process, because of identified strategic factors, for example that the development of Tokenized Ecosystems should not be internal. All in all, this will prevent bad investments if the business is not ready yet and will provide factors that the business needs to have before being ready for that change. Also, this research identifies factors that help managers to assess when the development of Tokenized Ecosystem is a good idea for the business in question.

7.3 REFLECTION

Reflection on this research was conducted in three ways. First, a reflection on the research process is described in 6.3.1. Then, a reflection on the research outcomes is provided in 6.3.2.

7.3.1 REFLECTION ON THE RESEARCH PROCESS

To reflect on the quality of the research process, four criteria are considered (Verschuren, 2005). The criteria are: the validity, the reliability, the researcher-interdependence, and verifiability of the research.

Validity. The validity of a research can be internal or external. Internal validity refers to the factors within the research methods that potentially threaten the truthfulness of the research findings. By analysing the factors that could threaten internal validity, two were found to be relevant to this research. Other factors were not applicable to this research method design. The first factor is selection bias. Because the researcher selected the interview participants for the expert interviews himself, the selection process was vulnerable to selection bias. This means that the selection of interviewees might have affected the truthfulness of the research findings in a negative way, for example because all of the participants might have been overly opportunistic about the potential of Tokenized Ecosystems. The second factor is experimenter bias. Because the interviews were conducted by a semi-structured approach, and because the researcher conducted the interviews himself, the interview process was vulnerable to experimenter bias. This means that the interviewer might have influenced the participants by steering the questions in such a way that the participants provided desirable answers. However, because the interviewees were representatives of blockchain technology institutes, their knowledge and expertise about Tokenized Ecosystems demonstrates internal validity of this research. Also, the approach to collect data from multiple sources as described in 2.3, demonstrates internal validity.

External validity refers to whether the findings of this research are generalizable to other situations. Because this research refers to businesses in the broadest sense, and the fact that a research finding was that Tokenized Ecosystems are relevant to any type of business, demonstrates the external validity of this research.

Reliability. The reliability of a research depends on if the research produces the same findings when other researchers use the same methods and processes. By describing every phase and step in each research process, and by explaining the reasoning behind it makes this research easy to replicate. Also, because the design of the tool is based on systematically analysed data from multiple sources, it is reasonable to say that other researchers would develop a similar tool; assuming they would follow the same steps.

Researcher-interdependence. This research was conducted by one researcher. The researcher was not linked in any way to any of the expert's organizations, apart from one; a researcher from Gartner (the institute where the researcher conducted the research) with no particular financial interest in the outcome of the study.

Verifiability. The research is verifiable when others can check whether the findings are indeed correct. To demonstrate the verifiability of the research, all data was documented in this research report except from the interview transcripts. The transcripts were left out because of anonymity concerns of the expert interviewees.

7.3.2 REFLECTION ON THE RESEARCH OUTCOMES

This research has a couple of limitations that are described below

Tokenized Ecosystems are not well understood. Because blockchain technology is such a relative new technology, businesses are still figuring out whether and how they can extract value from it. Let alone Tokenized Ecosystems, which is a new phenomenon within the blockchain space. Any understanding about

Tokenized Ecosystems is relying on the current knowledge, which can potentially change drastically over the years. This means that the findings of this research become unjust.

The future of Tokenized Ecosystems is uncertain. Because Tokenized Ecosystems is such a new phenomenon, it is uncertain if it will withstand the test of time. This means that the findings of this research might become completely irrelevant.

The Tokenized Ecosystem assessment tool was not tested properly. In order to further validate the effectiveness of the assessment tool, an evaluation research phase would have been ideal. By demonstrating the tool to relevant test participants, the usability of the tool could have been tested. Also, this demonstration could have pointed out some missing factors, or present factors that were actually irrelevant.

Only 8 experts have been interviewed. During the requirement definition phase of this research, only 8 participants were interviewed. More participants might have resulted in a better concretization of requirements for the design of a Tokenized Ecosystem assessment tool.

This thesis assumes that more and better insight into Tokenized Ecosystem will lead to a better strategy. In this thesis, a description is made in how business can construct a business strategy based on the insights gathered from using the Tokenized Ecosystem assessment tool. This assumption is based on common sense and is not backed by academic research.

7.4 RECOMMENDATIONS

This section suggests recommendations to future research. Because of the novelty of Tokenized Ecosystems, a plethora of research subjects surfaced to the researcher. Some of the most relevant are described below. First a study into Incentive Design is suggested in 6.4.1. Then, a study into the decentralization of social order trend is described in 6.4.2.

7.4.1 RESEARCH INTO INCENTIVE DESIGN

This thesis researches the fact that communities can develop and sustain a network because they are incentivized through reward functions. However, this thesis does not discuss how those incentives are design. It raises the question of what factors determine a good design, and how much such a design differs from use-case to use-case. Current research has regarded all design options of Tokenized Ecosystems as equally important, but this is probably not the case. It would be interesting to see how these design options differ in importance.

7.4.2 RESEARCH INTO THE DECENTRALIZATION OF SOCIAL ORDER TREND

During the research period, the researcher reviewed academic literature on the decentralization of Social Order and discovered a trend. Because this part did not answer any of the research questions, it was left out of this thesis. However, because research into the trend might still be interesting the beginning is presented here, in the hopes that another researcher will analyze this trend.

7.5 LINK WITH THE MOT PROGRAMME PERSPECTIVES

The link between the Management of Technology (MoT) Master's program and this thesis is explained. The MoT program is aimed to educate students as technology managers, analysts of technological markets (either as scientists or consultants), and entrepreneurs in highly technology-based, internationally-oriented and competitive environments for a variety of industrial sectors. The courses of the MoT program are grouped into 3 main disciplines: Technology, Innovation and Engineering Economics; Technology,

Innovation and Commercialization; and Technology, Innovation and Organization. For every discipline, the link with this thesis is described:

- Technology, Innovation and Engineering Economics. Courses in this discipline are about emerging and breakthrough technologies, technology dynamics, and economic foundations. This thesis focuses on an emerging technology, how it plays a role in businesses. Also, it uses perspectives learning in the economic foundations course.
- Technology, Innovation and Commercialization. Courses in this discipline are about technology, strategy and entrepreneurship. This thesis focusses on how businesses can develop strategies regarding the application of Tokenized Ecosystems and how startups develop Tokenized Economics with an entrepreneurial spirit.
- Technology, Innovation and Organization. Courses in this discipline are about leadership and technology management; business process management; and inter- and intra-organizational decision-making. This thesis focuses on leadership within businesses that are taking Tokenized Ecosystems in regard, how they relate to business processes and how decision-making is playing a role in this.

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